

## SECTION 16010

### ELECTRICAL GENERAL PROVISIONS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. The General Conditions, Supplementary General Conditions, and Special Conditions of this Contract form a part of this Division of Specification.
- B. This section forms a part of all sections under Division 16 Electrical.
- C. Requirements herein augment or clarify articles specified under aforementioned General and Special Conditions.
- D. City of Suffolk Public Facilities Manual (PFM) Volume II.

##### 1.2 GENERAL REQUIREMENTS

- A. The Contractor shall perform all electrical work necessary for the installation of the pump station equipment and services complete, tested, and ready for use. All work shall be completed by mechanics skilled in this type work and left in first class operating condition.

##### 1.3 CODES AND STANDARDS

- A. Latest effective publications of following standards, codes, etc., as they apply, form part of these specifications as if were written fully herein and constitute minimum requirements. Minimum requirements shall not relieve the Contractor of the responsibility of furnishing and installing higher grade materials and workmanship than herein specified. The following will be referred to throughout in abbreviated forms.
  - 1. National Electrical Code, (NFPA 70) (NEC)
  - 2. Standard Rules of Institute of Electrical and Electronic Engineers (IEEE)
  - 3. Rules and Regulations of Local Electric Utility Company
  - 4. Applicable Standards of the National Electrical Manufacturer's Association (NEMA)

5. Applicable Standards of the American National Standards Institute (ANSI)
6. Applicable Local Codes
7. Virginia Uniform Statewide Building Code
8. Applicable Standards and Lists of the Underwriter's Laboratories, Inc. (UL)
9. Applicable Standards of the National Fire Protection Association (NFPA)
10. International Building Code (IBC)
11. The Americans with Disabilities Act (ADA)
12. International Electrical Testing Association (NETA)

#### 1.4 SCOPE OF WORK

- A. Provide all work required for this Division including all labor, materials, equipment, appurtenances and services to provide complete electrical systems as shown on the drawings and specified in this Division of the specifications. The word "Provide" shall mean "Furnish and Install Complete and Ready for Use". The work includes, but is not limited to the following:
  1. Interior and exterior electrical lighting system including fixtures, lamps, time switches, photoelectric cells, contactors and other control devices and equipment.
  2. Power wiring system, including outlets, receptacles, switches, wire, conduit, junction boxes, panelboards, switchboards and new electric service.
  3. Disconnect switches and power wiring up to and including motor connections for all equipment provided under other Divisions of this specification shall be included in this Division. In general, motors will be provided with the equipment they drive and are not part of this work under this Division, except that they shall be connected hereunder.

- B. The following work is not included in this Division:
  - 1. Heating, ventilating, and air conditioning equipment and all associated motors and magnetic motor starters.
  - 2. Plumbing equipment except as specifically indicated.
  - 3. Control, interlock, and internal equipment wiring regardless of voltage.

## 1.5 DRAWINGS AND SPECIFICATIONS

- A. The drawings are diagrammatic and indicate the general extent, character and arrangement of equipment, fixtures and conduit and wiring systems. If any departures from the contract drawings are deemed necessary, submit details of such departures and the reasons therefore as soon as practicable after award of contract to the Engineer for approval. Make no such departures without prior written approval of the Engineer.
- B. It is the intention of these specifications and drawings to fully cover all work and materials for a complete, first-class electrical installation, and any devices such as pull boxes and disconnect switches, usually employed in this class of work, though not specifically mentioned or shown on the drawings or in this specification, but which may be necessary for the satisfactory completion of the work, shall be furnished and installed by the Contractor as a part of his total work under this Division. Consult the specifications and drawings of all other trades and perform all electrical work required therein. Cooperate with all other contractors or subcontractors to furnish complete workable systems.
- C. In case of conflicting information on the drawings and/or in the specifications, the proper interpretation shall be made by an authorized City representative.
- D. Disagreements occurring between trades covering various phases of the work shall be referred to general Contractor for final decision.
- E. Changes and additions to scope of the work under this contract shall be submitted to the Engineer and his written approval obtained before proceeding with the changed work.
- F. During construction, the Electrical Subcontractor shall keep an accurate record of all deviations between the work as shown on the contract drawings and that which is actually installed. He shall secure a set of blue line prints of the electrical drawings for this purpose, and note changes thereon with red marks, in a neat and accurate manner, thus making a complete record of all changes and revisions in

the original design which exist in the completed work. The cost of furnishing above prints and preparing these record drawings shall be borne by the subcontractor, and shall be included in the contract price. When all revisions have been shown on these prints to indicate the work as finally installed, the prints shall be delivered to the Engineer, before final payment.

## 1.6 PERMITS, INSPECTION AND TESTS

- A. The right is reserved to inspect and test any portion of the installation/equipment during the progress of its erection. Test all wiring for continuity and grounds before connecting any fixtures or devices. Perform insulation resistance tests on wiring #6 or larger. Test the entire system when the work is finally completed to insure that all portions are free from short circuits and grounds. Provide all equipment necessary to conduct the above tests.
- B. Secure and pay for all required permits and inspections. Inspection certificates from local authorities having jurisdiction shall be delivered to the Owner before final payment.

## 1.7 SUBMITTALS

- A. Submit Shop Drawings, Product Data and Samples within thirty (30) days of award of contract and in accordance with the General Conditions and Supplementary Conditions, and the City of Suffolk Public Facilities Manual, Volume II. Review of submittals by the Engineer and any associated action taken by the Engineer does not relieve the contractor of any requirements set forth by the contract documents. Submittals are required for the following items in addition to those specified in the City of Suffolk Public Facilities Manual, Volume II.
  - 1. Panelboards
  - 2. Circuit Breakers
  - 3. Lighting Fixtures
  - 4. Surge Protection Device (SPD)
- B. Submittals shall contain:
  - 1. The date of submission and of any previous submissions.
  - 2. The project title and number.

3. Contract or project identification.
4. The names of:
  - a. Contractor.
  - b. Supplier.
  - c. Manufacturer.
5. Identification of the product, and specification section.
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features or materials.
8. Applicable standards.
9. Identification of deviations from Contract Documents.
10. Identification of non-complying features and reason for the non-compliance. The reason shall be specific in nature.
11. Identification of revisions on resubmittals.
12. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.

C. SUBSTITUTIONS

1. For a period of 10 days after Contract date, Engineer will consider written requests from Contractor for substitution of products.
2. Submit a separate request for each product, supported with complete data, with drawings and samples as appropriate, including:
  - a. Comparison of the proposed substitution with that specified.
  - b. Changes required elsewhere because of the substitution.

- c. Effect on the construction schedule.
  - d. Cost comparison of the substitution and product specified.
  - e. Availability of maintenance service, and replacement parts.
3. The Engineer shall be the judge of the acceptability of the proposed substitution.
4. A request for a substitution constitutes a representation that the Contractor:
- a. Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.
  - b. Will provide the same warranties or bonds for the substitution as for the product specified.
  - c. Will coordinate the installation of an accepted substitution into the work, and make such other changes as may be required to make the work complete in all respects.
  - d. Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURING STANDARDS

- A. Materials shall be new and approved and labeled by UL wherever standards have been established by that agency. Defective equipment or equipment damaged in the course of installation or test shall be replaced or repaired in a manner meeting the approval of the Engineer. Materials to be furnished under this specification shall be the standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design. All items of the same type and rating shall be identical.

### 2.2 TRADE NAMES

- A. Unless specifically identified otherwise, manufacturers' names and catalog numbers indicated herein and on the drawings are not intended to be proprietary designations. They are to indicate general type and quality of materials and equipment required. Equipment and materials by other manufacturers which in

the opinion of the Engineer are of equal quality and which will produce the same results with regard to both their ability to perform the required technical functions as well as to their appearance in the specific location on this project will be considered.

### 2.3 MOTORS AND EQUIPMENT

- A. All motors shall have disconnecting means, controller and thermal overload protection. All three phase motors shall have power loss, phase outage, and phase reversal protection features.
- B. Provide motors, controllers, integral disconnects, and contactors with their respective pieces of equipment. Motors, controllers, integral disconnects, and contactors shall conform to the requirements defined under the electrical provisions of the specifications. Extended voltage range motors shall not be permitted. Control voltage for controllers and contactors shall not exceed 120 volts nominal. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.
- C. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment under the electrical provisions of the contract. Control wiring and conduit shall be provided under the section specifying the associated equipment. Wiring and conduit for power systems and control systems shall conform to the requirements defined under the electrical provisions of the specifications.

### 2.4 ELECTRICAL SERVICE

- A. Provide the electrical service as indicated. All arrangements shall be as indicated with proper extension, terminations, provisions and necessary materials for final connections by the local power company. Service and all metering shall be provided in accordance with the latest regulations of the local power company. The local power company may provide the meter and current transformers and may participate in the cost of supplying service to the building. Consult the local power company and determine limit of this participation. The bid on electrical work shall reflect this participation except that any charges which the local power company proposes to make for supplying service will be paid directly by Owner and will not be part of this contract.

- B. Short circuit ratings for all panelboards, main disconnect switches, etc. shall be suitable to accommodate the Power Company's available fault current.

## 2.5 GROUNDING

- A. The entire electrical system, including equipment frames, conduit, switches, controllers, wireways, neutral conductors, and all other such equipment shall be permanently and effectively grounded in accordance with the NEC. Ground rods shall be copper clad steel, 3/4" diameter by 10'-0" long. Grounding of each transformer secondary shall be provided and each shall be considered as a separate service ground. Provide a separate ground conductor in all branch circuit conduits sized in accordance with the N.E.C.

## PART 3 - EXECUTION

### 3.1 SCHEDULE OF WORK

- A. The schedule of the electrical work shall be arranged to suit the progress of work by the other trades and shall in no way retard progress of construction of the project.
- B. Work under this Division shall proceed in advance of the work of others whenever possible, eliminating all cutting and patching. When such procedure is impossible, cutting and patching shall be done in an approved manner. Cutting shall not endanger structural integrity in any way. Patching shall exactly match contiguous work. Actual work of cutting and patching of existing surfaces shall be performed by the subcontractor who originally prepared these surfaces, e.g., cutting and patching of masonry wall will be performed by the masonry subcontractor. Costs of such cutting and patching shall be borne by the Electrical contractor. Cutting shall be carefully done and damage to building, piping, wiring or equipment as a result of cutting shall be repaired by skilled mechanics of trade involved.

### 3.2 STORAGE AND MATERIALS

- A. Space will be assigned to the Contractor by the Owner for the storage of materials. This Contractor will be responsible for the protection and safekeeping of materials, tools, and equipment. All materials and equipment shall be kept in its assigned place until the time of its installation. Excess materials, dirt and refuse shall be promptly removed from the work site.



### 3.3 LABELING OF EQUIPMENT

- A. All panelboards, cabinets, transformers, safety switches, motor disconnect switches, and motor controllers shall be identified by machine engraved laminated plastic designation plates permanently attached thereto with self-tapping screws or rivets. All component parts of each item of equipment or device shall bear the manufacturer's nameplate, giving name of manufacturer, description, size, type, serial and model number and electrical characteristics in order to facilitate maintenance or replacement. The nameplate of a subcontractor or distributor will not be acceptable. Self-adhesive, plastic laminate labels are not acceptable.
- B. All panelboards, industrial control panels, and motor control centers shall be field marked to warn personnel of the potential for Arc Flash. Labels shall state "WARNING – ARC FLASH AND SHOCK HAZARD APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIRED".

### 3.4 OTHER TRADES

- A. Excavation shall be performed in accordance with the section of these specifications which cover excavating, filling and backfilling.
- B. Concrete work shall be performed in accordance with the section of these specifications which cover concrete.
- C. Painting shall be performed in accordance with the section of these specifications which cover painting. Paint all exposed conduit as well as cabinets and related items which are not supplied with a factory finish. Touch up all factory finishes damaged during installation or by adjacent construction work.

### 3.5 COORDINATION

- A. Cooperate and coordinate efforts with all Contractors on the project. This is especially important in determining exact locations of all switches, receptacles and lighting fixtures. Arrange lighting fixtures in accordance with the architectural reflected ceiling plans unless otherwise indicated. Coordinate lighting fixture locations with grilles, diffusers, access panels, etc. Verify ceiling and wall construction and material prior to ordering lighting fixtures or other devices to ensure proper fixture or device is furnished to match construction. This verification must be executed regardless of information placed on the drawings. Any cost incurred which in the opinion of the Engineer, could have been avoided by this step shall be the responsibility of the Contractor. Coordinate switch locations with thermostats, control switches, etc.

- B. Carefully check space requirements with the other subcontractors to insure that electrical equipment can be installed in the spaces allotted for them. Sufficient access and working space shall be provided and maintained about all electrical equipment as required by the National Electrical Code. Consult all applicable drawings for details. Where interferences occur and work must be relocated, relocate without additional cost.
- C. No conduit, outlet box, conduit stub-up, or any other electrical devices shall be installed until the exact location has been determined by the coordinated effort of all Subcontractors and other parties concerned. Any relocating of devices or cutting or patching which becomes necessary due to improper coordination shall be done at this Contractor's expense.
- D. Determine electrical requirements of other Divisions in order to fully understand wiring, and provide as required for complete and satisfactory operation of project. Make connections for other Divisions where indicated.
- E. Obtain approved shop drawings showing wiring diagrams, connection diagrams, roughing-in and hookup details, from other involved contractors for all equipment and comply therewith.

### 3.6 GUARANTEE OF WORK

- A. Contractor guarantees by his acceptance of the contract that all work installed is free from any and all defects in workmanship and/or materials, and that the apparatus will develop capacities and characteristics specified, and that if, during the period of one year or as otherwise specified, from date of certificate of completion and acceptance of the work any such defects in workmanship, material or performance appear, he will, without cost to the Owner, remedy such defects within a reasonable time to be specified in notice from Engineer. In default thereof, the Owner may have such work done and charge cost to Contractor. Equipment guarantees from date of "start-up" will not be recognized.
- B. Comply, also, with the General Conditions and the Supplementary Conditions and the applicable Sections of Division 1 General Requirements.
- C. Provide service for the installation for one year from date of final acceptance. This shall include all emergency service and adjustment. Provide evidence upon request by the Engineer that a factory authorized local service organization is in existence to service and furnish spare and replacement parts for all equipment under this Division of the specifications.

- D. Compile and assemble and provide all shop drawings, maintenance manuals, operation manuals and warranties in a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

### 3.7 CLEANING

- A. Refer to the Division 1 Section “PROJECT CLOSEOUT” or “FINAL CLEANING” for general requirements for final cleaning.
- B. Clean all light fixtures, lamps and lenses prior to final acceptance. Replace all inoperative lamps.

END OF SECTION

## SECTION 16210

### RACEWAY, FITTINGS AND BOXES

#### PART 1 - GENERAL

- 1.1 Provide raceways and fittings for all electrical and related systems where indicated, specified or required to form continuous raceways from the various service entrances to the various outlets.
- 1.2 Provide each outlet in the raceway system with an outlet box to suit the conditions encountered. Each box shall have sufficient volume to accommodate the number of conductors and conduits entering the box.
- 1.3 All wiring shall be in conduit.

#### PART 2 - PRODUCTS

##### 2.1 RACEWAYS

- A. Conduit shall be hot-dipped, zinc coated rigid steel (RS).
- B. Conduits in wet well shall be stainless steel or PVC coated rigid steel.
- C. Flexible conduit shall be galvanized, continuous spiral, single strip type. Flexible conduit shall be covered with PVC jacket in wet or damp locations. Provide suitable fittings with ground connector.

##### 2.2 FITTINGS

- A. All conduit entering or leaving outlet, junction or pull boxes, and cabinets and all conduit stubs shall have bushings. Provide insulating bushings where required by NEC.
- B. Provide expansion fittings with bonding jumper where conduits cross expansion joints.
- C. Fittings shall be threaded type.

## 2.3 SLEEVES

- A. All electrical system conduit shall have sleeves where conduit passes through concrete slabs except concrete slabs in contact with grade. All conduit 1 1/4 inch and larger running concealed above ceiling shall have sleeves where the conduit passes through masonry, tile and gypsum wall construction. All conduit running exposed below ceiling or in area without finished ceiling construction and passing through masonry concrete, tile and gypsum wall construction shall be provided with sleeves.
- B. Sleeves shall be constructed of galvanized steel pipe, Schedule 40.

## 2.4 OUTLET BOXES AND JUNCTION BOXES

- A. Outlet boxes shall be pressed steel, electro-galvanized or cadmium plated with clean cut, easily removable knockouts. Except as noted hereinafter minimum size outlet box shall be 4" square, 1 1/2" deep, and shall be increased in dimensions to accommodate conductors, conduits, and devices as required by the NEC. Shallower boxes may be used where required by structural conditions and when specifically approved by the Architect/Engineer. Provide suitable plaster-rings to match wall construction and device. Ceiling and bracket outlet boxes shall not be less than 4" octagonal, 1 1/2" deep except that smaller boxes may be used where required by particular fixture to be installed.
- B. Outlet boxes in wet or damp locations shall be cast-metal, threaded hub-type with gaskets.
- C. Junction or pull boxes not over 100 cubic inches in volume shall be standard outlet boxes. Junction boxes over 100 cubic inches in volume shall be constructed of code gage, galvanized sheet steel. Junction boxes shall have removable covers and shall be accessible after completion of buildings.

## 2.5 CABINETS

- A. Cabinets shall be zinc-coated sheet steel, constructed with interior dimensions not less than those indicated on drawings, arranged for flush or surface mounting as indicated. Removable trim shall be provided with a hinged door and flush latch and lock. Locks shall be keyed same as panelboards.

## PART 3 - EXECUTION

### 3.1 RACEWAY AND FITTING INSTALLATION

- A. Conduits may be run exposed within the structure. Conduit shall be supported at intervals of not more than 8'. Run exposed conduit parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceiling. All conduit to be run under the floor shall be run under the slab. Conduit shall not be run in the floor slab. Do not stack conduits beneath slab. Changes in direction of runs shall be made with symmetrical bends or cast metal fittings.
- B. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways.
- C. Support conduits by pipe straps, wall brackets, strap hangers, or ceiling trapeze.
- D. Conduit run outside of building shall be buried a minimum of 24" below finished grade.
- E. Service entrance conduits shall be direct-buried RS.
- F. Flexible conduit shall be used to connect all motors, transformers and all equipment subject to vibration.

### 3.2 SLEEVE INSTALLATION

- A. Check floor and wall construction and finishes to determine proper length of sleeves for various locations. Make actual lengths to suit the following:
  - 1. Terminate sleeves flush with wall, partitions and ceilings.
  - 2. In areas where conduits are concealed, as in chases, terminate sleeves flush with floor.
  - 3. In finished areas, where conduits are exposed, extend sleeves 1/2 inch above finished floor, except in rooms having floor drains extend sleeves 1 inch above floor.
- B. Fasten sleeves securely in floors and walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into the spaces between conduit and sleeve during construction.

### 3.3 BOX INSTALLATION

- A. Support boxes for fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

END OF SECTION

## SECTION 16220

### CONDUCTORS

#### PART 1 - GENERAL

- 1.1 Provide a complete system of conductors as indicated or necessary to accomplish the required connections. All conductors shall be installed in a neat and workmanlike manner, with care being taken that conductors are not kinked, scarred, or damaged during installation.

#### PART 2 - PRODUCTS

##### 2.1 CONDUCTORS AND INSULATION

- A. Wire and cable shall be soft drawn, annealed copper with 600 volt insulation. Minimum wire size shall be #12 AWG. Insulation for conductor sizes #12 and #10 shall be type THHN-THWN, THW or RHW for installation in ordinary dry locations and type THWN or RHW-2 for installation in wet locations. Wet locations shall include service conduits, conduit underground, raceways installed in concrete floor slabs in direct contact with the earth and raceways regularly subject to moisture or condensation. Conductors sizes larger than #10 shall have type XHHW-2 insulation. Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote-control and signal circuits, classes 1, 2, and 3, may be stranded.
- B. Branch circuit conductors in fluorescent fixture raceways and drops to single fluorescent fixtures shall be type THHN or XHHW.
- C. Provide a separate ground conductor in all raceways sized in accordance with the N.E.C.

##### 2.2 COLOR CODING

- A. All branch circuit, feeder and control wiring shall be color coded in accordance with NEC. Color shall be integral with sheath for sizes 12 through 8. Provide minimum 1/2 inch wide color coded plastic tape strips for conductors size 6 and larger. Strips shall be placed minimum 6 inches on center in all panelboards, junction boxes, pull boxes, conduit fittings, disconnect switches and anywhere the conductors are accessible and visible. Wire shall be color coded as noted below. All other conductors shall be of other colors. Color schedule shall be as follows:



208/120 Volt  
System

Phase A    Black  
Phase B    Red  
Phase C    Blue  
Neutral    White  
Ground    Green

480/277 Volt  
System

Phase A    Brown  
Phase B    Orange  
Phase C    Yellow  
Neutral    Grey  
Ground    Green

### 2.3 JOINTS AND TERMINATIONS

- A. Leave at least 6 inches of free conductor in each outlet- or junction- box for making up joints and making connections to fixtures, devices or equipment.
- B. For conductors #12 and #10 all fixture and branch circuit joints in junction and outlet boxes shall be made with UL listed pressure type connectors rated at 600 volts and 105 degrees C. Connector body shall consist of a cone-shaped, expandable, square-edged, coil-spring insert, insulated with a color-coded, self-extinguishing nylon shell with two wings placed opposite to each other to serve as a "built-in" wrench. Shell shall be molded of one piece. Connectors shall be IDEAL INDUSTRIES "Wing-Nut" or BUCHANNAN "B-CAP", 3M "SCOTCH-LOK" connectors or equal. Wire #8 and larger shall be joined or terminated with solderless pressure connectors properly taped in layers to form a moisture-tight joint.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR INSTALLATION, GENERAL

- A. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Junction boxes shall be provided where required. Home runs may be combined in one conduit, provided all connections are in accordance with NEC requirements and the maximum unbalanced current in the neutral does not exceed the capacity of the conductor. All parallel feeder runs shall be laid out and cut to exact same lengths before pulling into conduits to insure load balance. No additional trimming of parallel conductors will be accepted. Conductors #8 and smaller shall be pulled by hand and without aid of block and tackle or other mechanical device. Only approved equipment for pulling conductors shall be used for #6 and larger conductors. Only approved pulling compounds which will in no way damage the insulation on the conductors or hasten its aging may be used to facilitate pulling of wire into conduit.

Circuiting shown shall be followed unless specific changes are approved by the Engineer.

- B. Where several feeders pass through a common pull box or junction box, the feeders shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation. This same information shall be permanently marked on cover of the box.
- C. All conductors shall be in conduit unless otherwise indicated or allowed.
- D. All conductors and cables shall be labeled.

END OF SECTION

## SECTION 16230

### WIRING DEVICES

#### PART 1 - GENERAL

- 1.1 Provide wiring devices complete with all necessary trim rings or wall plates as shown or as required.

#### PART 2 - PRODUCTS

- 2.1 Wiring devices shall be as manufactured by General Electric, Slater (Medalist), ARROW-HART, BRYANT, HUBBELL or PASS & SEYMOUR. All wiring devices provided on this project shall be by the same manufacturer and shall be "specification grade".
  - A. Local switches shall be single pole, double pole, three way and four way as shown on the drawings, black plastic cup with red plastic cover and brown plastic handle, back or side wired, 20 ampere, 120-277 volts.
  - B. Duplex convenience receptacles shall be brown plastic, 20 ampere, 125 volts, 2 pole, 3 wire NEMA and ASA Standard, grounding type.
  - C. Weatherproof receptacles shall be in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Caps shall be provided with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations."
  - D. Ground fault circuit interrupting receptacles shall conform to NEC, shall be UL listed, brown plastic, shall have a "push-to-test" button and visible indication of a tripped condition, and shall detect a current imbalance in device or equipment plugged-in of approximately 5 milliamperes and trip out under that condition.
  - E. Device plates in normally dry locations shall be zinc-coated sheet steel having rounded or beveled edges. Plates shall be of one piece type to suit device or devices covered. Sectional plates will not be permitted. Screws shall be machine-type with countersunk heads in color to match finish of plate.

### PART 3 - EXECUTION

- 3.1 Devices shall be installed in a rigid manner in outlet boxes. Device plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed vertically and with an alignment tolerance of 1/16 inch.
- 3.2 GROUND-FAULT RECEPTACLE TEST
  - A. Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

END OF SECTION

## SECTION 16250

### SAFETY SWITCHES

#### PART 1 - GENERAL

- 1.1 Provide safety switches wherever shown and whenever required whether specifically shown or not.

#### PART 2 - PRODUCTS

##### 2.1 SWITCHES

- A. Safety switches shall be rated at 600 or 240 volts as required for voltage of system with number of poles and current rating as indicated. Switches shall be fused or non-fused type as indicated, NEMA type GD or HD as required, with full cover interlocks and quick-make, quick-break mechanism.
- B. All fused switches shall be provided complete with fuses and shall have horsepower ratings when serving motor loads.

##### 2.2 FUSES

- A. Fuses rated over 600 amperes shall be U.L. Class "L" fuses, and shall have a minimum time delay of 10 seconds at 500% rating. They shall be Littelfuse Type KLP-C time delay fuses or approved equal. All fuses 600 amperes and below shall be true dual-element time delay fuses with separate spring-loaded thermal overload elements in all ampere ratings. All ampere ratings shall be designed to open at 400 degrees Fahrenheit or less when subjected to a non-load oven test. RK-1 fuses shall be Littelfuse fuses, type LLN-RK or LLS-RK. RK-5 fuses shall be Littelfuse "Slo-Blo" fuses, type FLN-R or FLS-R. Fuses shall be sized as indicated on the drawings or as required by the equipment provided, whichever provides maximum protection.

#### PART 3 - EXECUTION

- 3.1 Switches shall be securely mounted to wall, structure or equipment. Provide miscellaneous accessories for mounting switches, including steel angles or channels where required.

- 3.2 Spare fuses. At the completion of the project the contractor shall deliver to the Owner (and obtain receipt for) spare fuses of each size and type equal to 20 percent of the number installed but not less than 3 or more than 9 of any size and type.

END OF SECTION

## SECTION 16255

### ENCLOSED CIRCUIT BREAKERS

#### PART 1 - GENERAL

1.1 Provide enclosed circuit breakers with ratings as indicated.

#### PART 2 - PRODUCTS

##### 2.1 CIRCUIT BREAKERS

- A. Circuit breakers shall be molded case type having over-center, tripfree, toggle-type operating mechanisms with quick-make, quick-break action and positive handle indication. Two and three-pole breakers shall be common trip. Each circuit breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole. The circuit breaker shall be constructed to accommodate the supply connections at either end. Circuit breaker operating handles shall assume a center position when tripped.
- B. Breakers shall have removable lugs. Lugs shall be UL listed for copper and aluminum conductors. Breakers shall be UL listed for installation of mechanical screw type lugs or crimp lugs.
- C. Neutral bars shall be furnished for circuit breakers as indicated. Neutral bars shall be insulated and be groundable for use in service equipment applications. Neutrals shall have same current rating as circuit breaker.

##### 2.2 ENCLOSURES

- A. Enclosures shall be the NEMA type indicated on the plans.
- B. NEMA 12 gasketed enclosures shall be furnished (with) (without) knockouts. The external operating handle must be an integral part of the box, not the door, so that the external operating handle is always in control of the breaker. Enclosures shall have provisions for three padlocks to lock breaker. Enclosures shall have provisions for three padlocks to lock breaker in the OFF position and dual interlock to prevent unauthorized opening of the breaker door in the ON position or closing the breaker with the door open. Enclosures shall include prominent trip indication. Enclosures shall be fabricated from sheet steel in accordance with UL 98. Enclosures shall be UL listed.

PART 3 - EXECUTION

3.1 CIRCUIT BREAKERS

- A. Circuit breakers shall be securely mounted to wall, structure or equipment. Provide miscellaneous accessories for mounting switches, including steel angles where required.

END OF SECTION



## SECTION 16310

### PANELBOARDS

#### PART 1 - GENERAL

##### 1.1 PANELBOARDS

- A. Panelboards shall be provided with number and size of mains and branch circuits as shown on drawings, shall be mounted as indicated and shall have incoming lugs arranged to receive the conductors shown. Panelboards shall conform to latest UL and NEMA standards and shall bear UL labels.

#### PART 2 - PRODUCTS

##### 2.1 PANELBOARDS

- A. Panelboards shall be dead-front, circuit breaker type equipped with single, double, or three pole thermalmagnetic quick-make, quick-break trip-free on overload or short circuit alternating current circuit breakers with trip ratings and frame size as shown on the drawings.
- B. Main and branch circuit breakers shall provide inverse time delayed tripping on overloads and instantaneous tripping on short circuits. Trip indication shall be clearly shown by the breaker handle taking position between ON and OFF when the breaker is tripped. Double and three pole breakers shall be common trip type. HACR type circuit breakers shall be provided for all circuits serving mechanical equipment.
- C. Bussing shall be such that any three adjacent single-pole breakers are individually connected to each of the three different phases in such a manner that two to three-pole breakers can be installed at any location. All current-carrying parts of the bus assembly shall be plated.
- D. Sub-feed breakers are acceptable, however, if used must be clearly labeled on front panel and on interior of panel enclosure with machine engraved label mechanically attached.
- E. Where a “space, space-only, or provision” is indicated on the drawings or elsewhere, the “space, space-only, or provision” shall be “fully equipped” and ready for the direct insertion of a circuit breaker. Additional hardware, bus

extension kits, strap kits, and so forth shall not be required in order to properly add a circuit breaker to a designated "space".

- F. Each panelboard shall be provided with a hinged cover with a flush latch and lock with two keys and keyed the same as all other panelboards.
- G. Each panel shall be equipped with typewritten directory card, card holder, transparent protection and complete identifying data on inside of door. Each circuit shall be identified specifically with load and location spelled out on the directory, i.e. "control room lighting" - (not merely "lighting").
- H. Provide an isolated neutral bus for each panel for connection of both feeder and branch circuit neutral wires. Neutral bus shall have same current ratings as panel mains.
- I. Provide a separate equipment ground bus, bonded to the steel cabinet for each panel for connection of all ground wires and mark with a green stripe along the front of the bus. Equipment ground bus shall have same rating as panel mains.
- J. Ground fault circuit interrupting breakers shall be sized as indicated, shall conform to NEC, shall be UL listed, shall have a "push-to-test" button and visible indication of a tripped condition, and shall detect a current imbalance of approximately 5 milliamperes.
- K. Circuit breakers shall have 100% AIC rating (no series ratings allowed), unless stated otherwise on drawings.
- L. Panelboards shall be equal to SQUARE-D, Type NQOD, NF, or I-LINE (HCN, HCM, HCP, HCW, HCWM, HCP-SU, HCR-U).

### PART 3 - EXECUTION

#### 3.1 PANELBOARDS

- A. Panelboards shall be so mounted that operating handle of top breaker is not more than 78" above the floor. Load on each panel shall be divided as evenly as possible between the phases in the panel.

END OF SECTION

## SECTION 16410

### LIGHTING FIXTURES

#### PART 1 - GENERAL

##### 1.1 LIGHTING FIXTURES

- A. Fixtures shall be UL approved, listed and labeled for the particular installation. Lighting fixtures shall be provided complete with lamps, mounting hardware, accessories, canopies, necessary guards, straps, supports or hangers and other miscellaneous materials and devices to assure satisfactory installation and desired function where installed and shall be approved before installation.

#### PART 2 - PRODUCTS

##### 2.1 FIXTURES

- A. Fixtures shall be as indicated as detailed on drawings. Cuts and descriptions of all fixtures shall be submitted for approval before ordering. When requested, samples of the fixtures, shall be provided.

##### 2.2 LAMPS

- A. Provide as indicated on fixture details.

##### 2.3 BALLASTS

- A. Fluorescent ballasts shall be ETL and UL approved and shall be energy saving electronic type compatible with lamps specified. Fixtures shall be designed for use with these electronic ballasts and shall have thermal characteristics that will minimize operation of ballast over-heat devices under all normally expected operation conditions. Ballasts shall have a Class A sound rating.
- B. HID ballasts shall be of the constant wattage, high power factor type. HPS ballasts shall have solid state igniter/starter.
- C. Ballasts which are not quiet and hum-free will be rejected and shall be replaced by the Contractor at no additional cost to Owner.
- D. Ballasts in unconditioned spaces or outdoors shall be rated for operation in high or low temperature environments.

## PART 3 - EXECUTION

### 3.1 LIGHTING FIXTURES

- A. All surface mounted fluorescent lighting fixtures shall be mounted independent of ceiling construction.
- B. No fixtures shall be hung with zip-clips.
- C. Pendant mounted fixtures and devices shall be supported with swivel type hanger to ensure plumb installation.

END OF SECTION

## SECTION 16670

### LIGHTNING PROTECTION FOR STRUCTURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes lightning protection for structures.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For air terminals and mounting accessories.
  - 1. Layout of the lightning protection system, along with details of the components to be used in the installation.
  - 2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

##### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.
- B. System Certificate:
  - 1. UL Master Label.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

#### PART 2 - PRODUCTS

##### 2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

- A. Comply with UL 96 and NFPA 780.
- B. Roof-Mounted Air Terminals: NFPA 780, Class I, copper unless otherwise indicated.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

- a. East Coast Lightning Equipment Inc.
  - b. ERICO International Corporation.
  - c. Harger.
  - d. Heary Bros. Lightning Protection Co. Inc.
  - e. Independent Protection Co.
  - f. Preferred Lightning Protection.
  - g. Robbins Lightning, Inc.
  - h. Thompson Lightning Protection, Inc.
2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
- C. Main and Bonding Conductors: Copper.
- D. Ground Loop Conductor: The same size and type as the main conductor except tinned.
- E. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A and NFPA 780.
- B. Conceal the following conductors:
  - 1. Down conductors.
  - 2. Interior conductors.
  - 3. Conductors within normal view of exterior locations at grade within 200 feet of building.
- C. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

#### 3.2 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

#### 3.3 FIELD QUALITY CONTROL

- A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION 16670