

**DIVISION 26**

**Electrical**

26 0500	Basic Methods and Requirements Electrical
26 0519	Wires and Cables
26 0526	Grounding
26 0529	Supporting Devices
26 0530	Electrical Connections for Equipment
26 0533	Raceways
26 0535	Electrical Boxes and Fittings
26 0553	Electrical Identification
26 2416	Panelboards
26 2616	Circuit and Motor Disconnects
26 2726	Wiring Devices
26 2813	Overcurrent Protective Devices
26 3213	Engine Generators – Installation Only
26 3600	Automatic Transfer Switches – Installation Only
26 4313	Surge Protection Devices

**ROBERT C. ANSTON, P.E. 40858**

*TO THE BEST OF MY KNOWLEDGE, THESE  
DRAWINGS AND THE PROJECT MANUAL ARE  
COMPLETE AND COMPLY WITH THE 2020  
FLORIDA BUILDING CODE*

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## SECTION 26 0500 – BASIC METHODS AND REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.
- B. Furnish and install all electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, cable, panelboards, etc., and arrangement for specified items in general are shown on drawings.
- C. All ampacities herein specified or indicated on the drawings are based on copper conductors, with the conduit and raceways accordingly sized. Aluminum conductors are not permitted.

#### 1.2 MINIMUM REQUIREMENTS

- A. References to the National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), Florida Building Code, and National Fire Protection Association (NFPA) are a minimum installation requirement standard. Design drawings and other specification sections shall govern in those instances where requirements are greater than those specified in NEC.
- B. The rules and regulations of the Federal, State, local, civil authorities and utility companies in force at the time of execution of the contract shall become a part of this specification. In addition, the following codes and standards shall apply:
  - 1. Florida Building Code (FBC) 7th Edition (2020) with the 2022 Supplement: This code includes the 2020 FBC Building, Mechanical, Plumbing, Energy Conservation, Fuel Gas, Accessibility, and Test Protocols volumes. Further, see "Referenced Standards" in the FBC Building Chapter 35; FBC Mechanical Chapter 15; FBC Plumbing Chapter 14; FBC Energy Conservation Chapter 6; and FBC Fuel Gas Chapter 8) (Effective December 31, 2020).
  - 2. 7th Edition of the Florida Fire Prevention Code (FFPC): This code also includes the Florida versions of NFPA 1 and NFPA 101. (Effective December 31, 2020).
  - 3. 2017 National Electric Code.
- C. No work shall be done unless the Superintendent of the Contractor is on the job site. Work shall be properly protected, all rubbish removed promptly, and exposed work shall be carefully cleaned prior to final acceptance.
- D. The term "provide" shall include labor, materials, and equipment necessary to furnish and install, complete and operable, the item or system indicated.
- E. In decisions arising from discrepancies, interpretation of Drawings and Specifications, substitutes, and other pertinent matters, the decision of the Owner's representative's approval shall be final.

#### 1.3 SPECIFICATIONS AND DRAWINGS

- A. Plans show location of fixtures and equipment and are intended to depict the general intent of the work in scope, layout and quality of workmanship. They are not intended to show in minute detail every or all accessories intended for the purpose of executing the work, but it is understood that such details are a part of this work.
- B. Where Drawings and Specifications conflict, it shall be the responsibility of this Contractor to bring such conflict to the attention of the Architect/Engineer for clarification. In general, the Architectural Drawings shall take precedence over the Mechanical Drawings with reference to building construction. All changes from the Drawings necessary to make the work conform with the building as constructed and to fit the work of other trades or to conform to the rules of authorities having jurisdiction, shall be made by the Contractor at his own expense.
- C. Keep a record of the locations of concealed work and of any field changes in Contract Drawings and Specifications for each trade and, upon completion of the job, supply "As-Built" Drawings and Specifications showing in pencil on sepia reproducibles, any deviations from the original Drawings, indicating in the Specifications each manufacturer's name underlined or inserted whose product was used on the job. These Drawings shall indicate dimensions of buried utility lines from building walls. One set of sepia reproducibles of the original tracings will be furnished upon request for this purpose.

#### 1.4 STANDARDS

- A. All material and equipment shall be listed, labeled or certified by Underwriters Laboratories, Inc., where such standards have been established. Equipment and material which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if

inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.

B. Definitions:

1. Listed: Equipment is "listed" if of a kind mentioned in a list which:
  - a. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
  - b. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.
2. Labeled: Equipment is labeled if:
  - a. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
  - b. The laboratory makes periodic inspections of the production of such equipment.
  - c. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.
3. Certified: Equipment is "certified" if:
  - a. Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
  - b. Production is periodically inspected by a nationally recognized testing laboratory.
  - c. It bears a label, tag, or other record of certification.
4. Nationally recognized Testing Laboratory: A testing laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.5 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least five years, unless otherwise noted elsewhere in the specifications or on the drawings.
- B. Product Qualification:
  1. Manufacturer's product shall have been in satisfactory operation on three installations of similar size and type, as this project, for approximately three years.
  2. The Owner reserves the right to require the contractor to submit a list of installations where the products have been in operation before approval of said products.
- C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.6 MANUFACTURED PRODUCTS

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts should be available. Items not meeting this requirement, but which otherwise meet technical specifications, and merits of which can be established through reliable test reports or physical examination of representative samples, will be considered.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
  1. All components of an assembled unit need not be products of the same manufacturer, however, the assembled unit shall be the responsibility of a single manufacturer and warranted as such.
  2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  3. Components shall be compatible with each other and with the total assembly for the intended service.
  4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. All factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

1.7 EQUIPMENT REQUIREMENTS

- A. Equipment voltage ratings shall be in accordance with the requirements indicated on the drawings or as specified.
- B. Prior to bid, written approval shall be obtained by the Contractor for any equipment that differs from those specified on the drawings and specifications. The Contractor shall be prepared to submit samples of the equipment when requested at no cost to the Architect/Engineer.
  1. The Contractor shall furnish drawings showing all installation details, shop drawings, technical data and other pertinent information as required to determine that the equipment is equivalent in quality and function to the equipment specified.
  2. Approval by the Architect/Engineer of the equal equipment does not relieve the Contractor of the responsibility of furnishing and installing the equipment at no additional cost to the Owner.

3. Any other items required for the satisfactory installation of the equal equipment shall be furnished and installed at no additional cost to the Owner. This includes but shall not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and correlation with other work, subject to the jurisdiction and approval of the Architect/Engineer.
- C. Catalogue numbers, where given, are intended to give a basis for design, quality and function. Any other incidental equipment needed for a complete and functional installation shall be provided at no additional cost.

#### 1.8 EQUIPMENT PROTECTION

- A. Equipment and material shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.
- B. During installation, equipment, controls, controllers, circuit protective devices, etc., shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing, operating and painting.
- C. Damaged equipment shall be, as determined by the Architect/Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
- D. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.
- F. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

#### 1.9 WORK PERFORMANCE

- A. Arrange, phase and perform work to assure electrical service for other buildings at all times.
- B. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions.
- C. Coordinate location of equipment and conduit with other trades to minimize interferences.
- D. Obtain and pay for all required installation inspections and deliver certificates approving installations to the Owner unless directed otherwise.

#### 1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings. Where architectural features govern location of work, refer to architectural drawings.
- B. Working spaces shall not be less than specified in the National Electrical Code for all voltages specified.
- C. Inaccessible Equipment:
  1. Where the Owner/Architect/Engineer determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
  2. "Conveniently accessibility" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and duct work.
- D. Equipment and Material:
  1. New equipment and material shall be installed, unless otherwise specified.
  2. Equipment and material shall be designed to assure satisfactory operation and operating life for environmental conditions where being installed. NEC and other code requirements shall apply to the installation in areas requiring special protection such as explosion-proof, watertight and weatherproof construction.
- E. Utility Services:
  1. Contact Tampa Electric and schedule all required transformer shut-down and turn-on work. Make any necessary application and coordinate all work with TECO.
  2. Include all costs for temporary service, temporary routing of service or any other requirements of a temporary nature associated with the utility/main service.
- F. Continuity of Service:
  1. No service shall be interrupted or changed without permission from the Architect and the Owner. Written permission shall be obtained before any work is started.
  2. When interruption of services is required, all persons concerned shall be notified and a prearranged time agreed upon.
  3. Provide any required temporary power or communications circuits or extensions necessary to accommodate the phasing of construction in order to keep any existing buildings in operation during construction.
- G. Concrete Work:
  1. Provide all cast-in-place concrete shown on the documents unless noted otherwise. Concrete work shall conform to all applicable Division 2 and 3 specification sections.
  2. Provide all anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of electrical equipment.

1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the National Electrical Code, install an identification nameplate which will clearly indicate information required for use and maintenance of items such as switchboard, panelboards, cabinets, safety switches, separately enclosed circuit breakers, motor starters, communications systems cabinets, control devices and other significant equipment.
- B. Nameplates shall be laminated phenolic resin with engraved lettering, a minimum of 3/16-inch high. Nameplates that are furnished by manufacturer as a standard catalog item, or where other method of identification is herein specified, are exceptions. Hand written marker is not acceptable.
  1. Nameplates shall be red with white letters for all 480Y/277 volt equipment and black with white letters for all 208Y/120 volt equipment.

1.12 SUBMITTALS

- A. The Architect/Engineer's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site. Submittals shall be made for all equipment and systems as indicated in the respective specification section.
- B. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Architect/Engineer to ascertain that the proposed equipment and materials comply with specification and drawing requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- C. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval. Submittals shall be submitted for all applicable products and materials specified in each individual section of these specifications.
- D. Make submittals for the equipment and materials in accordance with the following:
  1. Mark the submittals, "SUBMITTED UNDER SECTION \_\_\_\_\_".
  2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  3. The submittals shall include the following:
    - a. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required. Provide any additional information specifically requested in the individual specification section or on the drawings.
    - b. Elementary and interconnection wiring diagrams for fire alarm, sound system, TV system and other communication systems and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
    - c. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
  4. Electronic PDF submittal files shall be named utilizing the specification number followed by a sequential number for the submittal made under the given specification number followed by "r#" if it is a resubmittal, and then followed by a brief description of the submitted item.
    - a. The description shall indicate the actual item submitted, shall not be general in nature, and does not have to be that of the specification section heading.
    - b. Using the example, "230235-4r2 Differential Pressure Gauge"; 230235 – Meters and Gauges is the relevant specification, the "4" shows it was the fourth submittal for specification section 230235 02,"r2" shows it was the second resubmittal, and the description indicates what item is submitted.
    - c. Each specification item shall be submitted in a separate PDF file. PDF files with multiple specification items will be returned without review.
    - d. Each file shall have sufficient space allowance for the Architects and Engineer's review stamp(s).
    - e. Each file shall have the Construction Managers review stamp(s) and indicate information required by specification 260500.1.12.D.3 above.
- E. Operation and Maintenance Manuals:
  1. Maintenance manuals shall be complete and shall be furnished in a loose leaf binder or in the manufacturer's standard binder. Information shall be sufficient to enable a qualified technician to perform normal first line maintenance and repair. A parts list shall be included which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
  2. Operation manuals shall be clear and concise and shall describe, in detail, the information required to properly operate the equipment specified. The manuals shall include complete catalog cuts and as-built wiring diagrams.
  3. Operation and maintenance manuals shall be submitted for approval prior to final close-out.

- F. In addition to the requirement of SUBMITTALS, the Owner reserves the right to request the manufacturer to arrange for the Owner's representative(s) to see typical active systems in operation, when there has been no prior experience with the manufacturer or the type of equipment being submitted.
- 1.13 CUTTING, PATCHING, EXCAVATION, BACKFILL, AND LAYOUT
- A. Provide openings and excavation required for the installation of the electrical work. Patch work and backfill as required. Finished work shall match the existing adjoining work.
  - B. Verify all conditions affecting the work to be performed under this contract.
  - C. Carefully verify measurements at the site, determine the exact location of chases and openings required. Provide sleeves, inserts, and hangers as required. No columns, beams, joists, building foundations nor any other structural building component shall be cut, drilled or disturbed in any way. Conflicts shall immediately be brought to the attention of the Architect/Engineer.
  - D. All excavation on sites containing existing buildings and existing services, shall be done with hand shovel to avoid damage to existing services. Where hand shovel is not practical extreme caution shall be taken when performing excavation. The contractor will be responsible for locating any existing utilities and adjusting manhole locations and conduit routing as necessary. Any damage incurred by the Contractor shall be repaired by the Contractor in a manner approved by the Architect/Engineer at no cost to the Owner and with no extension of time limitation.
- 1.14 EXPERIENCE
- A. The Contractor performing this work shall be a licensed, reputable firm, regularly performing the type of work incorporated in this project and who also maintains, as part of the firm, a service department with qualified personnel who regularly perform this type of work. The Contractor shall, upon request, show evidence of at least two jobs of similar character and size installed within the preceding two years.
- 1.15 ELECTRICAL WORK FOR MECHANICAL SYSTEMS
- A. Factory installed starters, controllers, and control equipment mounted in manufactured mechanical equipment necessary for mechanical equipment operation shall be furnished under Division 23 Mechanical.
  - B. Power wiring for motors and installation of starters shall be under Division 26 Electrical.
  - C. Temperature, humidity, pressure and similar controls essential to the operation of mechanical systems, and wiring and conduit thereof, including interlock wiring, shall be under Division 23 of Specifications, installed in accordance with requirements of Division 26.
  - D. Motors shall be furnished under Division 23 Mechanical of capacity required to operate equipment specified, but shall not be less than that specified.
  - E. All low voltage (120V and under) temperature control wiring for Division 23 equipment shall be provided under by Division 23.
  - F. Division 23 shall provide conduit when required for control wiring, installed in accordance with Division 26 requirements.
- 1.16 MOTORS
- A. All motors shall be furnished and installed under Division 23 Mechanical and shall be wired under Division 26 Electrical.
- 1.17 REMOVAL OF RUBBISH
- A. Contractor shall keep premises free from accumulations of waste material or rubbish caused by his employees or work. At completion of work, he shall remove all his tools, scaffolding, surplus materials, and rubbish from building and site. He shall leave premises and his work in a clean orderly condition acceptable to the Architect/Engineer.
- 1.18 QUIET OPERATION AND VIBRATION
- A. All equipment provided under this section shall operate under all conditions of load free of objectionable sound and vibration. Sound and vibration conditions considered objectionable shall be corrected in an approved manner.
  - B. Vibration and sound control shall be by means of approved vibration eliminators or sound attenuators in a manner as specified and as recommended by the manufacturer.
- 1.19 CLEANING AND ADJUSTMENTS
- A. Upon completion of the work, Contractor shall clean and re-lamp all light fixtures, clean and identify all equipment, adjust and test all equipment and apparatus which he has installed and make certain such apparatus and mechanisms are in proper working order and ready to test.
  - B. During construction protect all conduit and equipment from damage and dirt. Cap the open ends of all conduit and equipment.

1.20 STORAGE OF MATERIALS

- A. All materials stored on site shall be properly protected from injury or deterioration. Materials shall not be stored in contact with ground or floor.
- B. Do not remove manufacturer's packing materials until ready to install. Materials showing signs of corrosion, improper handling or storage shall be replaced at no cost to the Owner.
- C. Provide continuous protection for all equipment already installed.

1.21 WATERPROOFING

- A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Owner before the work is done.
- B. Provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight. Waterproof flashing materials shall be compatible with base materials.

1.22 TESTS

- A. Contractor shall make all tests required to establish the adequacy, quality, safety, completed status and satisfactory operation of all systems to the satisfaction of the Architect/Engineer. Provide all instruments, labor and services necessary to conduct tests.
- B. All conductors for major feeders and services (400 amps and up) shall be megged to test insulation and connection integrity prior to permanent energization. Provide a written report of these tests upon Engineer's request.

1.23 INSTRUCTIONS

- A. Fully instruct Owner's personnel in the care and operation of electrical systems, including all communications, sound and fire alarm systems and furnish a letter to the Architect/Engineer advising the particular person(s) who have received such instruction.

1.24 GUARANTEE

- A. Equipment shall be started, tested, adjusted, and placed in satisfactory operating condition. Furnish a letter addressed to the Architect/Engineer advising that the completed systems have been installed in accordance with the Plans and Specifications and that they are in proper operating condition. The Owner shall receive a written guarantee covering all defects in workmanship and material for a period of one year from date of final acceptance. Any defects appearing within this year period shall be repaired without additional cost to the Owner. See specific specification sections for additional warranty coverage requirements. The most stringent shall apply.

1.25 ACCEPTANCE

- A. Before requesting final inspection:
  - 1. Complete all work required. If any items are held in abeyance as incomplete for final inspection, list such items together with explanation for delay.
  - 2. Submit statement that equipment is properly installed, adjusted, tested and operation is satisfactory.
  - 3. Certify in writing to the Architect/Engineer that the Owner's representative has been instructed as to the care and operation of the system and that catalog service and maintenance information has been turned over to the Architect/Engineer.
  - 4. Submit copy of written guarantee.
  - 5. Submit copy of other data as may be outlined in these specifications.
- B. Copies of the above data shall be submitted to the Architect/Engineer prior to requesting final inspection.

1.26 SINGULAR NUMBER

- A. Where any device or part of equipment is referred to in these specifications in the singular number (such as "the switch"), such reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.28 MULT-WIRE BRANCH CIRCUITS

- A. All multi-wire branch circuits shall comply with Article 210.4 National Electrical Code. Provide all required handle ties where applicable multi-wire branch circuits are indicated on the drawings and share a neutral.

**END OF SECTION**



## SECTION 26 0519 - WIRES AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-23 and -26 section making reference to electrical wires and cables specified herein.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of electrical wire and cable work is indicated by drawings and schedules.
- B. Types of electrical wire, cable, and connectors specified in this section include the following:
  - 1. Copper conductors.
  - 2. Fixture wires.
  - 3. Flexible cords and cables.
  - 4. Wirenut connectors.
- C. Applications of electrical wire, cable, and connectors required for project are as follows:
  - 1. For motor-branch circuits.
  - 2. For power distribution circuits
  - 3. For lighting circuits
  - 4. For appliance and equipment circuits

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.
- C. NEC Compliance: Comply with NEC requirements as applicable to construction, installation and color coding of electrical wires and cables.
- D. UL Compliance: Comply with applicable requirements of UL Std 83, "Thermoplastic-Insulated Wires and Cables", and Std 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors".
- E. UL Compliance: Provide wiring/cabling and connector products which are UL-listed and labeled.
- F. NEMA/ICEA Compliance: Comply with NEMA/ICEA Std Pub/ No.'s WC 5, "Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy", and WC-30, "Color Coding of Wires and Cables", pertaining to electrical power type wires and cables.
- G. IEEE Compliance: Comply with applicable requirements of IEEE Stds 82, "Test Procedures for Impulse Voltage Tests on Insulated Conductors", and Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to wiring systems.
- H. ASTM Compliance: Comply with applicable requirements of ASTM B1, 2, 3, 8, and D-753. Provide copper conductors with conductivity of not less than 98% at 20oC (68oF).

### PART 2 - PRODUCTS

#### 2.1 AVAILABLE MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
  - 1. Wire and Cable:
    - a. American Wire and Cable Co.
    - b. Anaconda-Ericsson Inc; Wire and Cable Div.
    - c. Belden Div; Cooper Industries
  - 2. Connectors:
    - a. AMP, Inc.
    - b. Appleton Electric Co.
    - c. Burndy Corporation
    - d. Thomas and Betts Corp.

#### 2.2 WIRES, CABLES, AND CONNECTORS

- A. General: Provide electrical wires, cables, and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20oC (68oF).

- B. Building Wires: Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following UL types, those wires with construction features which fulfill project requirements:
1. Type THHN, THWN, THHW, XHHW, THHN/THWN: Unless otherwise indicated, all conductors for dry locations requiring a conductor temperature rating 75oC (167oF) or less. Insulation shall be flame retardant, moisture and heat resistant, thermoplastic. Conductor shall be annealed copper.
  2. Type THWN, THHW, XHHW, THHN/THWN: Unless otherwise indicated, all conductors for wet or dry locations requiring a conductor temperature rating of 75oC (167oF) or less. Insulation shall be flame retardant, moisture and heat resistant thermoplastic. Conductor shall be annealed copper.
  3. Type THHN, THHW, XHHW: Unless otherwise indicated, all conductors for dry locations requiring a conductor temperature rating of 90oC (194oF) or less. Insulation shall be flame retardant, moisture and heat resistant thermoplastic. Conductor shall be annealed copper.
  4. Type XHHW-2: Unless otherwise indicated, all conductors for wet locations requiring a conductor temperature rating of 90oC (194oF) or less. Insulation shall be flame retardant, moisture and heat resistant thermoplastic. Conductor shall be annealed copper.
  5. Conductors for use at 600 volts or below shall be 600 volt rated. Wire No. 12 and smaller may be solid or stranded and wire No. 10 and larger shall be stranded only. Stranded conductors shall terminate in crimp type lugs.
  6. Motor circuit branch wiring and associated control wiring: Provide type THHN insulation in dry and damp locations. Provide type THHW insulation in wet locations. All motor wiring to be stranded copper.
  7. Wiring in fluorescent fixture channels: Provide conductors with a 90°C temperature rating, type THHN or TFFN insulation.
- C. Cables: Provide UL-type factory-fabricated cables of sizes, ampacity ratings, and materials and jacketing/sheathing as indicated for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements, NEC and NEMA standards.
- D. Connectors:
1. General: Provide UL-type factory-fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following, those types, classes, kinds, and styles of connectors to fulfill project requirements:
    - a. Type: Pressure.
    - b. Class: Insulated.
    - c. Kind: Copper (for Cu to Cu connection).
    - d. Style: Butt connection.
    - e. Style: Elbow connection.
    - f. Style: Combined "T" and straight connection.
    - g. Style: "T" connection.
    - h. Style: Split-bolt parallel connection.
    - i. Style: Tap connection.
    - j. Style: Pigtail connection.
    - k. Style: Wirenut connection.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF WIRES AND CABLES

- A. General: Install electrical cables, wires, and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, UI, and NECA's "Standard of Installation", and in accordance with recognized industry practices.
- B. Coordinate wire/cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables with other work.
- C. Pull conductors simultaneously where more than one conductor is being installed in the same raceway.
- D. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation.
- E. Use pulling means including, fish tape, cable, rope and basket weave or wire/cable grips which will not damage cables or raceway. Any cable damaged during installation shall be completely replaced.
- F. Keep conductor splices to minimum. No joints shall be made in conductor except at outlet boxes or splice boxes. Newly installed conductors shall not be spliced unless specifically noted on the drawings. Splices shall not be permitted underground.
- G. Install splices and tapes which possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced.
- H. Use splice and tap connectors which are compatible with conductor material.

- I. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A and B.
- J. At least eight inches (8") of slack wire shall be left in every outlet box whether it be in use, or left for future use.
- K. The Engineer prefers the use a fully colored insulation jacket in lieu of taped or otherwise marked feeder conductors. Encore Wire (and other manufacturers) manufacturer fully color coded insulation jacketed conductors. Contact Mike Mitchell at J & M Electrical Sales for price and availability. Provide the fully color coded jacketed conductors, providing that the price and delivery schedule are equal to or better than the black jacketed insulation. Color code wiring as follows:
  - 1. 120/208 volt, 3 phase, 4 wire: phase A-black, phase B-red, phase C-blue, neutral-white; ground conductor-green.
  - 2. 277/480 volt, 3 phase, 4 wire: phase A-brown, phase B-orange, phase C-yellow, neutral-gray; ground conductor-green.
- L. Wire and cable boxes and reels shall bear the date of manufacture and must not bear dates by more than one year preceeding contract date.
- M. Minimum conductor sizes, except as specifically identified on the drawings, shall be as follows:
  - 1. No. 12 - Branch circuits of any kind, except as specified otherwise below.
  - 2. No. 14 - Signal systems, fire alarm system, unless specifically noted otherwise.
  - 3. No. 10 - Exit light circuits, emergency circuits, security lighting, and exterior light circuits.
- N. Increase conductor sizes by one size (i.e. #12 awg to #10 awg) for any 120 volt, 20 amp circuits over 125 feet, including increasing the ground conductor.

### 3.2 FIELD QUALITY CONTROL

- A. Prior to energization, test wires and cables for electrical continuity and for short-circuits. See section 26 05 005.

**END OF SECTION**

TOURNAMENT SPORTSPLEX  
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OCTOBER 5, 2023  
CONSTRUCTION DOCUMENTS

## SECTION 26 0526 - GROUNDING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Electrical Materials and Methods section apply to work of this section.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of grounding work is indicated by drawings and schedules.
- B. Types of grounding specified in this section include the following:
  - 1. Solid grounding
- C. Applications of grounding work in this section including the following:
  - 1. Underground metal water piping
  - 2. Metal building frames
  - 3. Grounding electrodes
  - 4. Grounding rods
  - 5. Service equipment
  - 6. Enclosures
  - 7. Equipment
  - 8. Communications systems

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors, terminals and fittings, of types and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods and plate electrodes, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer: Qualified with at least 3 years of successful installation experience on projects with electrical grounding work similar to that required for project.
- C. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment and wiring. Provide grounding products which are UL-listed and labeled.
- D. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical grounding and bonding.
- E. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on grounding systems and accessories.
- B. Shop Drawings: Submit layout drawings of grounding systems and accessories including, but not limited to, ground wiring, copper braid and bus, ground rods, and plate electrodes.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering grounding products which may be incorporated in the work include, but not limited to, the following:
  - 1. Burndy Corp.
  - 2. Crouse-Hinds Co.
  - 3. Electrical Components Div.; Gould Inc.
  - 4. Thomas and Betts Corp.

#### 2.2 GROUNDING SYSTEMS

- A. Materials and Components:
  - 1. General: Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for complete installation. Where more than one type unit meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, and established industry standards for applications indicated.
- B. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC.

- C. Ground Rods: Solid copper or copper clad, minimum 3/4" dia. x 10'. Provide longer rods if necessary for required resistivity.
- D. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type services indicated.
- E. Provide exothermic weld connections for all ground rod connections, and where otherwise indicated.
- F. All ground rods shall be installed in ground test wells.
- F. Ground Inspection Test Well: Ground test wells shall be polymer type concrete with 10,000 pound traffic rated cover. EriTech T416B and T416C or similar. Provide size as required for location. Adjust test well locations to coordinate with other site utilities, pavement and landscaping. Locate test wells in non-traffic, non-paved areas when possible.
  - 1. Ground test wells shall be provided at all main service entrance ground rods and all lightning protection system ground rods.

### PART 3 - EXECUTION

#### 3.1 INSPECTION

- A. Installer must examine areas and conditions under which electrical grounding connections are to be made and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

#### 3.2 INSTALLATION OF ELECTRICAL GROUNDING

- A. General: Install electrical grounding systems where shown, in accordance with applicable portions of NEC, with NECA's "Standard of Installation", and in accordance with recognized industry practices, to ensure that products comply with requirements and serve intended functions.
- B. Coordinate with other electrical work as necessary to interface installation of electrical grounding system work with other work.
- C. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.
- D. All ground connections to water service entrance shall be installed to be exposed and visible for inspection at all times. Insulation shall not be installed over ground connections.
- E. A water pipe, by itself, is not an adequate grounding electrode and must be supplemented by dual grounding electrodes, a minimum of 8 feet apart, and effectively bonded together. The supplemental ground shall be per Code with the "Footing type electrode" installed as required by current National Electrical Code. Provide a new service entrance grounding electrode system including bonding to metallic cold water pipe, structural steel and building re-bar, if available.
- F. All ground connections shall be made on surfaces which have been cleaned of all paint, dirt, oil, etc., so that connections are bare metal to bare metal contact. All ground connections shall be tight and shall be made with U.L. listed grounding devices, fittings, bushings, etc.
- G. Duplex receptacles of any amperage shall be grounding type and shall have a separate grounding contact. A separate jumper shall be installed between the grounding terminal on the device and the metallic box. The Contractor may provide U.L. listed self-grounding receptacles in lieu of providing the separate jumper.
- H. Single and duplex receptacles shall have all grounded metal mechanically bonded together. Pressure bonding only is not acceptable.
- I. All receptacles in kitchens and shops will be installed with the grounding contacts up.
- K. In all cases where flexible metallic conduit, nonmetallic rigid conduit or liquid tight flexible conduit is used, a green wire ground conductor shall be used to provide ground continuity between the equipment of device and the conduit raceway system.
- L. Provide a separate green wire ground conductor for each branch circuit originating from each panelboard. This ground shall be used to ground the device or load fed, and shall be bonded to components of the raceway system, such as junction boxes, starter or disconnect switch enclosures, equipment cases, etc. The green wire ground conductor shall terminate in the panelboard at the green wire ground bus. Ground conductors for branch circuits shall be of size indicated in NEC, except minimum size ground conductor shall be No. 12 AWG.
- M. Each branch feeder originating at the switchboard(s) shall have a green wire ground conductor originating at the ground bus in the switchboard and terminating at the green wire ground bus in the panelboard. This green wire ground conductor shall be of size indicated in NEC except in no instance smaller than No. 8 AWG.
- N. The green wire ground conductor is in addition to the neutral conductor and in no case shall the neutral conductor serve as the grounding means.
- O. Multiple conductors in a single lug not permitted. Each grounding conductor shall terminate in its own terminal lug.

- P. Grounding connections shall be tested and certified by the installer. The service entrance ground and each building ground shall have a maximum of 5 ohms resistance to ground. Supplemental grounding shall be provided if necessary. Provide written test results.

**END OF SECTION**

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OCTOBER 5, 2023  
CONSTRUCTION DOCUMENTS



## SECTION 26 0529 – SUPPORTING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Electrical Materials and Methods section, and is a part of each Division-26 section making reference to electrical supporting devices specified herein.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of supports, anchors, sleeves, and seals is indicated by drawings and schedules and/or specified in other Division-26 sections.
- B. Types of supports, anchors, sleeves, and seals specified in this section include the following:
  - 1. Clevis hangers
  - 2. C-clamps
  - 3. I-beam clamps
  - 4. One-hole conduit straps
  - 5. Round steel rods
  - 6. Lead expansion anchors
  - 7. Toggle bolts
  - 8. Wall and floor seals
- C. Supports, anchors, sleeves, and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly in other Division-26 sections.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of supporting devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of electrical supporting devices.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURED SUPPORTING DEVICES

- A. General: Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Installer's option.
- B. Supports: Provide supporting devices of types, sizes, and materials indicated; and having the following construction features:
  - 1. Clevis Hangers: For supporting 2" rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod; approximately 54 pounds per 100 units.
  - 2. Reducing Couplings: Steel rod reducing coupling, 1/2" x 5/8"; black steel; approximately 16 pounds per 100 units.
  - 3. C-Clamps: Black malleable iron; 1/2" rod size; approximately 70 pounds per 100 units.
  - 4. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 pounds per 100 units.
  - 5. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
  - 6. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 pounds per 100 units.
  - 7. Round Steel Rod: Black steel; 1/2" dia.; approximately 67 pounds per 100 feet.
  - 8. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.
- C. Anchors: Provide anchors of types, sizes, and materials indicated, with the following construction features:
  - 1. Lead Expansion Anchors: 1/2", approximately 38 pounds per 100 units.
  - 2. Toggle Bolts: Springhead; 3/16" x 4", approximately 5 pounds per 100 units.
- D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering anchors which may be incorporated in the work include, but are not limited to, the following:
  - 1. Abbeon Cal Inc.
  - 2. Ackerman Johnson Fastening Systems, Inc.
  - 3. Elcen Metal Products Co.
  - 4. Ideal Industries, Inc.

5. Joslyn Mfg. and Supply Co.
6. McGraw Edison Co.
7. Rawplug Co., Inc.
8. Star Expansion Co.
9. Expansion Bolt Co.
- E. Sleeves and Seals: Provide sleeves and seals, of types, sizes, and materials indicated, with the following construction features:
  1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or buting passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
- F. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 12-gage hot-dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard finish, and with the following fittings which mate and match U-channel.
  1. Fixture hangers
  2. Channel hangers
  3. Thinwall conduit clamps
  4. Rigid conduit clamps
  5. Conduit hangers
  6. U-bolts
- G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering channel systems which may be incorporated in the work include, but are not limited to, the following:
  1. Greenfield Mfg. Co.; Inc.
  2. Midland-Ross Corp.
  3. OZ/Gedney Div.; General Signal Corp.
  4. Power-Strut Div.; Van Huffel Tube Corp.
  5. Unistrut Div.; GTE Products Corp.
- H. Pipe Sleeves: Provide pipe sleeves of one of the following:
  1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal: 3" and smaller, 20-gage; 4" to 6", 16-gage; over 6", 14-gage.
  2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
  3. Iron Pipe: Fabricate from cast-iron or ductile-iron pipe; remove burrs.
  4. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.
- I. Sleeve Seals: Provide sleeves for piping which penetrates foundation walls below grade, or exterior walls. Calk between sleeve and pipe with non-toxic, UL-classified calking material to ensure watertight seal.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF SUPPORTING DEVICES**

- A. Install hangers, anchors, sleeves, and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.
- B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work. Coordinate support locations with other structural and mechanical trades. Supports shall not be attached to mechanical or electrical piping, conduit, ductwork, ceiling grid system or any other non-structural member.
- C. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacings indicated and in compliance with NEC requirements.

**END OF SECTION**

## SECTION 26 0530 – ELECTRICAL CONNECTIONS FOR EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-23 and -26 section making reference to electrical connections for equipment specified herein.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.
- B. Applications of electrical power connections specified in this section include the following:
  - 1. From electrical source to motor starters.
  - 2. From motor starters to motors.
  - 3. To lighting fixtures.
  - 4. To grounds including earthing connections.
  - 5. To equipment of communication, CCTV and alarm systems.
- C. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division-23 and other Division-26 sections, and are work of this section.
- D. Motor starters and controllers, not furnished as integral part of equipment, are specified in applicable Division-26 sections, and are work of this section.
- E. Refer to Division-23 specification sections and drawings for motor starters and controllers furnished integrally with equipment; not work of this section. Connections to this equipment is work of this section.
- F. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division-26 sections, and are work of this section.
- G. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division-26 sections, and are work of this section.
- H. Refer to other Division-26 and Division-23 sections for low voltage control system wiring; not work of this section.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 2 years of successful installation experience with projects utilizing electrical connections for equipment similar to that required for this project.
- C. NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.
- D. IEEE Compliance: Comply with Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.
- E. ANSI Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.
- F. UL Compliance: Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors", including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL-listed and labeled.
- G. ETL Compliance: Provide electrical connection products and materials which are ETL-listed and labeled.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
  - 1. AMP Incorporated
  - 2. Appleton Electric Co.
  - 3. Arrow-Hart Div., Crouse-Hinds Co.
  - 4. Burndy Corporation
  - 5. General Electric Co.
  - 6. Gould, Inc.
  - 7. Harvey Hubbell Inc.

8. Square D Company
9. Thomas and Betts Corp.

## 2.2 MATERIALS AND COMPONENTS

- A. **General:** For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wirenuts, and other items and accessories as needed to complete splices and terminations of types indicated.
- B. **Metal Conduit, Tubing, and Fittings:**
  1. **General:** Provide metal conduit, tubing, and fittings of types, grades, sizes, and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Division-26 basic electrical materials and methods section "Raceways", and in accordance with the following listing of metal conduit, tubing, and fittings:
    - a. Rigid steel conduit.
    - b. Rigid metal conduit fittings.
    - c. Electrical metallic tubing.
    - d. Liquid-tight flexible metal conduit.
    - e. Liquid-tight flexible metal conduit fittings.
    - f. Flexible metal conduit.
    - g. Flexible metal conduit fittings.
- C. **Wires, Cables, and Connectors:**
  1. **General:** Provide wires, cables, and connectors complying with Division-26 basic electrical materials and methods section "Wires and Cables".
  2. **Wires/Cables:** Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).
  3. **Connectors and Terminals:** Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

### 3.2 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation", to ensure that products fulfill requirements.
- B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- D. Provide the following electrical work as work of this section, complying with requirements of Division 23 sections:
  1. Power supply wiring from power source to power connection on chiller, fans, air handling units, pumps, duct heaters, water heaters, air compressor, air dryer, and unit control panels. Include starters, disconnects, time clocks, receptacles and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer. Make all final electrical connections.
- E. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Owner, or Architect/Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.
- F. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced. No new conductors shall be spliced unless specifically noted on the drawings.

- G. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
  - H. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing, and maintenance.
  - I. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.
  - J. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.
  - K. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:
    - 1. Exterior location.
    - 2. Moist or humid atmosphere where condensate can be expected to accumulate.
    - 3. Corrosive atmosphere.
    - 4. Water spray.
    - 5. Dripping oil, grease, or water, including kitchen areas.
- 3.3 FIELD QUALITY CONTROL
- A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

**END OF SECTION**



## SECTION 26 0533 - RACEWAYS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-26 section making reference to electrical raceways specified herein.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of raceway work is indicated by drawings and schedules. Types of raceways specified in this section include the following:
  - 1. Electrical metallic tubing (EMT).
  - 2. Liquid tight flexible metal conduit.
  - 3. Rigid metal conduit.
  - 4. Flexible metal conduit.
  - 5. Rigid non-metallic conduit.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with electrical raceway work similar to that required for this project.
- C. Codes and Standards:
  - 1. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publications pertaining to raceways.
  - 2. UL Compliance and Labeling: Comply with applicable requirements of UL safety standards pertaining to electrical raceway systems. Provide raceway products and components which have been UL-listed and labeled.
  - 3. NEC Compliance: Comply with applicable requirements of NEC pertaining to construction and installation of raceway systems.

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including specifications and installation instructions, for each type of raceway system required. Include data substantiating that materials comply with requirements.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUIT AND TUBING

- A. General: Provide metal conduit, tubing, and fittings of types, grades, sizes, and weights (wall thicknesses) for each service indicated.
- B. Rigid Steel Conduit: Provide rigid steel, zinc-coated, threaded type conforming to FS WW-C-581, ANSI C80.1 and UL 6.
- C. Rigid Metal Conduit Fittings: Cast malleable iron, galvanized or cadmium plated, conforming to FS W-F-408, ANSI C80.4.
  - 1. Use compression type fittings for raintight connections.
  - 2. Use compression type fittings for other miscellaneous connections.
- D. Electrical Metallic Tubing (EMT): FS WW-C-563, ANSI C80.3 and UL 797.
- E. EMT Fittings: FS W-F-408, ANSI C80.4. Die cast or malleable iron.
  - 1. Use compression fittings for raintight connections.
  - 2. Use compression type for concrete type connections.
  - 3. Use compression type fittings for miscellaneous connections.
  - 4. Set screw fitting may be used only where conduits and associated fittings are concealed from view. Set screw type shall be steel. Die cast fittings are not permitted.
- F. Liquid-Tight Flexible Metal Conduit: Provide liquid-tight flexible metal conduit; construct of single strip, flexible, continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC). Shall be Sealite or equal. Acceptable manufacturer: Alfalex
- G. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 3, Style G. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or non-insulated throat.

- H. Flexible Metal Conduit: FS WW-C-566 and UL 1. Formed from continuous length of spiral wound, interlocked zinc-coated strip steel. Acceptable manufacturer: Alflex
  - I. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.
    - 1. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
    - 2. 45o or 90o Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.
- 2.2 NONMETALLIC CONDUIT
- A. General: Provide nonmetallic conduit, ducts, and fittings of types, sizes, and weights for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements which comply with provisions of NEC for raceways.
  - B. Electrical Plastic Conduit:
    - 1. Heavy Wall Conduit: Schedule 40, 90 C, UL-rated, construct of polyvinyl chloride and conforming to NEMA TC-2, for direct burial, UL-listed and in conformity with NEC Article 347, ANSI C33.91.
  - C. PVC Conduit and Tubing Fittings: NEMA TC 3, mate and match to conduit or tubing type and material.
- 2.3 MANUFACTURERS
- A. Subject to compliance with requirements, provide conduit bodies of one of the following:
    - 1. Appleton Electric; Div of Emerson Electric Co.
    - 2. Arrow-Hart Div; Crouse-Hinds Co.
    - 3. Bell Electric Div; Square D Co.
    - 4. Gould, Inc.
    - 5. Killark Electric Mfg. Co.
    - 6. O-Z/Gedney Div; General Signal Co.
    - 7. Spring City Electrical Mfg. Co., or equivalent.

### PART 3 - EXECUTION

- 3.1 INSPECTION
- A. Examine areas and conditions under which raceways are to be installed, and substrate which will support raceways. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- 3.2 INSTALLATION OF RACEWAYS
- A. General: Install raceways as indicated; in accordance with manufacturer's written installation instructions, and in compliance with NEC, and NECA's "Standards of Installation". Install units plumb and level, and maintain manufacturer's recommended clearances.
  - B. Coordinate with other work including wires/cables, boxes, and panel work, as necessary to interface installation of electrical raceways and components with other work.
- 3.3 INSTALLATION OF CONDUITS
- A. General: Install concealed conduits in new construction work, either in walls, slabs, or above hung ceilings. Run conduits concealed, unless specifically indicated on the drawings to be permitted to be exposed.
    - 1. Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings, and cabinets to provide electrical continuity and firm mechanical assembly.
    - 2. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
    - 3. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways every 200' of linear run or wherever structural expansion joints are crossed.
  - B. Conduit Installation: Follow minimum requirements in all areas as follows:
    - 1. Use rigid steel galvanized conduit where exposed in the central plant, where exposed to weather or subject to saturation with liquids, and where exposed to potential mechanical damage. Also use rigid steel galvanized conduit for all risers (2" and larger) from underground. All rigid elbows and rigid risers to cabinets shall be applied with bitumastic paint where below grade.
    - 2. Use steel EMT above hung ceilings in offices, corridors, toilets, and other areas with hung ceilings. EMT may be used inside indoor mechanical and electrical rooms, except for the central plant and other areas requiring rigid steel galvanized conduit as in (1.) above.
    - 3. Use PVC heavy wall direct buried rated (Schedule 40) when raceways run below grade, under floors on grade or in concrete. All bends and elbows greater than 45 degrees shall be galvanized rigid steel



- conduit. All risers from underground to cabinets and boxes when conduit is to be exposed shall be rigid steel conduit.
- a. PVC shall not be exposed above grade anywhere.
  4. Underground telecommunications conduits for voice/data, fire alarm, intercom, and TV may be all direct buried rated Schedule 40 PVC. Long sweeps shall be provided. Risers into rooms and cabinets shall be rigid galvanized steel. Where raceways continue above the floor up to a second or third floor IDF, the raceways may be EMT. All floor penetrations shall be fire rated. See specification section 271500 and other communications systems specifications for more requirements.
  5. Conduit in walls to recessed panels and boxes shall be EMT.
  6. Use flexible conduit in movable partitions and from outlet boxes to lighting fixtures, and final 24" of connection to motors, control items or any equipment subject to movement or vibration, and in cells of precast concrete panels. Flexible conduit shall not exceed 2 feet long. Not permitted in concealed locations
  7. Use liquid-tight flexible conduit where subjected to one or more of the following conditions. Shall not be used in concealed locations and shall not exceed 2 feet long.
    - a. Exterior location.
    - b. Moist or humid atmosphere where condensate can be expected to accumulate. Mechanical rooms.
    - c. Corrosive atmosphere.
    - d. Subjected to water spray or dripping oil, water, or grease, including kitchen equipment connections.
  8. Use hot-dipped galvanized conduit where conduit is routed outdoors or in anyway exposed to weather.
  9. All conduit from underground into the kitchen for devices and equipment shall be galvanized rigid steel.
  10. All underground galvanized conduit shall be coated with 2 coats of bituminous paint.
  11. Electrical contractor will be responsible for the following for all underground conduits:
    - a. Trenching and Excavation
    - b. Backfill
    - c. Compaction
  12. All underground conduit shall be spaced 2 inches apart.
- C. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.
- D. Field bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.
- E. Minimum conduit size shall be 1/2" unless noted otherwise. Homeruns shall be a minimum 3/4".
- F. Fasten conduit terminations in sheet metal enclosures by two (2) locknuts, and terminate with bushings. Install locknuts inside and outside enclosure. Provide ground type bushings where required by code.
- G. Conduits are not to cross pipe shafts, or ventilating duct openings.
- H. Keep conduits a minimum distance of 6" from parallel runs of flues, hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.
- I. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.
- J. Complete installation of electrical raceways before starting installation of cables/wires within raceways.
- K. Install conduits so as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.
- L. Exposed Conduits in Unfinished Areas:
  1. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.
  2. Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.
  3. Support all conduits by use of hangers, clamps, or clips. Support conduits on each side of bends and on spacing not to exceed following: up to 1": 6'-0"; 1-1/4" and over: 8'-0". All conduits shall be adequately supported to prevent any noticable deflection, vibration or rattle.
  4. Run conduits for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.
- M. Conduit Fittings:
  1. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.
  2. Bushings for terminating conduits smaller than 1- 1/4" are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation.
  3. Install insulated type bushings for terminating conduits 1-1/4" and larger. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.
  4. All bushings of standard or insulated type to have screw type grounding terminal.
  5. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs to be specifically designed for their particular application.
- N. Concealed Conduits:

1. Metallic raceways installed underground or in floors below grade, or outside are to have conduit threads painted with corrosion inhibiting compound before couplings are assembled. Draw up coupling and conduit sufficiently tight to ensure watertightness.
  2. Conduit in concrete slabs: Separate conduits by not less than diameter of largest conduit to ensure proper concrete bond. Conduits must have a minimum of three-quarter inch (3/4") concrete cover.
  3. Embedded conduit diameter is not to exceed one-third (1/3) of slab thickness. Conduit shall not be run in slabs less than 3 inches thick.
- O. Painting of Conduit & Boxes:
1. Fire Alarm: All new fire alarm conduit, including underground conduit, shall be spot painted red at a minimum of every 4 feet, nominally. Underground conduit shall be spot painted red after it is laid in trench and made up tight. All fire alarm junction boxes shall be painted red.
  2. Intercom System: All junction boxes above ceiling shall be painted yellow.
  3. Instructional TV System: All junction boxes above ceiling shall be painted black.
  4. Security System: All junction boxes above ceiling shall be painted yellow.
  5. Clock System: All junction boxes above ceiling shall be painted green.
  6. Data System: Raceways shall be spot painted blue. Any associated junction boxes shall be painted blue.
  7. 208Y/120 volt Power: All junction boxes above ceiling shall be painted white.
  8. 480Y/277 volt Power: All junction boxes above ceiling shall be painted orange.
  9. Emergency Power (if applicable): All junction boxes above ceiling shall be painted pink.
  10. EHPA circuit junction boxes shall be marked "EHPA".
  11. Provide a color key chart in all electrical rooms, mounted on the wall.
- P. Provide a continuous yellow marker tape with metallic tracer 6 inches above all underground conduit.
- Q. Underground Duct Banks and Underground Conduits: All underground conduits shall be installed per the National Electrical Code, in accordance with standard industry practices and in accordance with other sections of these specifications. Conduits in duct banks shall be neatly and securely installed in straight lines with manufactured elbows used for all turns and bends. Provide all required trenching, excavation, backfill, compaction, supports, manholes, etc. for a complete installation. Trenching, excavation, backfill and compaction shall be performed in accordance with applicable Division 2 and Division 3 sections of these specifications.
- R. Low Voltage Control:
1. Mechanical contractor (Division 23) to provide and install all necessary wire and raceway (EMT conduit) for low voltage control such as thermostats, timers etc., unless specifically shown otherwise on the drawings. Raceways shall be installed in accordance with Division 26 sections. Final wire connections shall be by mechanical contractor.

### 3.4 INSTALLATION OF RACEWAYS AND WIREWAYS

- A. General: Mechanically assemble metal enclosures, and raceways for conductors to form continuous electrical conductor, and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.
1. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
  2. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
  3. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. No field bends of raceway sections will be permitted.
  4. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported. Supporting conduits from ceiling grid, other conduits, ductwork or other non-structural members will not be permitted.
  5. Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc. shall not be permitted for use with surface raceway installations.
  6. Provide watertight seals in all conduits which cross from one temperature to another temperature extreme, such as coolers and freezers.
  7. All fire wall and smoke wall penetrations shall be sealed using a UL Listed fire stopping method. Method shall be submitted and approved by the Architect/Engineer.
  8. All empty raceways shall contain a pull cord labeled with to/from and the future purpose of the raceway ("SPARE", or "GATE POWER").

### 3.5 COMMUNICATIONS SYSTEMS RACEWAY

- A. Communications systems raceways shall be provided for each intercom, ITV, security, and fire alarm outlet or device indicated on the drawings. Conduit shall be routed to each device, as indicated on the drawings and in the specification section for systems. Voice/Data communications system may be free wired where above accessible ceiling as per specification Section 271500 and the drawings. Provide cable tray for cable bundles of 48 cables or more.

TOURNAMENT SPORTSPLEX  
ADD PERMANENT GENERATOR

OCTOBER 5, 2023  
CONSTRUCTION DOCUMENTS

**END OF SECTION**

TOURNAMENT SPORTSPLEX  
ADD PERMANENT GENERATOR

OCTOBER 5, 2023  
CONSTRUCTION DOCUMENTS

## SECTION 26 0535 – ELECTRICAL BOXES AND FITTINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Electrical Materials and Methods section, and is a part of each Division-26 section making reference to electrical wiring boxes and fittings specified herein.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of electrical box and associated fitting work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings specified in this section include the following:
  - 1. Outlet boxes
  - 2. Junction boxes
  - 3. Pull boxes
  - 4. Floor boxes
  - 5. Bushings
  - 6. Locknuts
  - 7. Knockout closures
  - 8. Manholes and handholes

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings, of types, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects utilizing electrical boxes and fittings similar to those required for this project.
- C. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
- D. UL Compliance: Comply with applicable requirements UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL-listed and labeled.
- E. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2, and Pub 250 pertaining to outlet and device boxes, covers, and box supports.

### PART 2 - PRODUCTS

#### 2.1 FABRICATED MATERIALS

- A. Outlet Boxes: Provide galvanized coated flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.
  - 1. Recessed outlet boxes shall be a minimum 4" square by 2-1/2" deep with reducer ring for a standard outlet coverplate. Where surface mounted devices are necessary provide 2-1/2" x 4" x 2-1/2" deep box to fit a standard coverplate. Shallow boxes shall not be permitted for communications outlet boxes.
  - 2. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.
  - 3. No gangable boxes shall be used.
- B. Device Boxes: Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with cable-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide cable clamps and corrosion-resistant screws for fastening cable clamps, and for equipment type grounding.
  - 1. Recessed outlet boxes shall be a minimum 4" square by 2-1/2" deep with reducer ring for a standard outlet coverplate. Where surface mounted devices are necessary provide 2-1/2" x 4" x 2-1/2" deep box to fit a standard coverplate. Shallow boxes shall not be permitted for communications outlet boxes.
  - 2. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board

- expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.
3. No gangable boxes shall be used.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering outlet boxes which may be incorporated in the work include, but are not limited to, the following:
1. Appleton Electric;
  2. Bell Electric;
  3. Eagle Electric Mfg. Co.; Inc.
  4. Midland-Ross Corp.
  5. OZ/Gedney; General Signal Co.
  6. Pass and Seymour, Inc.
  7. RACO Div.; Harvey Hubbell Inc.
  8. Thomas & Betts Co.
- D. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering raintight outlet boxes which may be incorporated in the work include, but are not limited to, the following:
1. Appleton Electric;
  2. Crouse-Hinds Co.
  3. Bell Electric;
  4. Harvey Hubbell, Inc.
  5. OZ/Gedney; General Signal Co.
  6. RACO Div.
- F. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes; with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers.
- G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering junction and pull boxes which may be incorporated in the work include, but are not limited to, the following:
1. Appleton Electric; Emerson Electric Co.
  2. Arrow-Hart Div.; Crouse-Hinds Co.
  3. Electric; Square D Company
  4. OZ/Gedney; General Signal Co.
  5. Spring City Electrical Mfg. Co.
- H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering floor boxes which may be incorporated in the work include, but are not limited to, the following:
1. Arrow-Hart Div.; Crouse-Hinds Co.
  2. Harvey Hubbell, Inc.
  3. Midland-Ross Corp.
  4. Spring City Electrical Mfg. Co.
- I. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connections, of types and sizes, to suit respective installation requirements and applications.
- J. Available Manufacturers: Subject to compliance with requirements, manufacturers offering bushings, knockout closures, locknuts, and connectors which may be incorporated in the work include, but are not limited to, the following:
1. Arrow-Hart Div.; Crouse-Hinds Co.
  2. Appleton Electric Co.; Emerson Electric Co.
  3. Bell Electric; Square D Co.
  4. Midland-Ross Corp.
  5. OZ/Gedney Co.; General Signal Co.
- K. Manholes and Handholes: Manholes and handholes for exterior use shall be Quasite composite material type with traffic rated covers, as manufactured by Quasite or equal. Manholes and handholes shall be the size necessary for the number of conduits and conductors indicated on the drawings which will enter the enclosure, plus the necessary capacity for the spare conduits and the associated estimated conductor fill. Provide manholes with the appropriate drainage and knockouts for conduits and other necessary access. Traffic covers shall be engraved with the appropriate identification, such as "ELECTRIC" or "COMMUNICATIONS". Provide plastic protective grommet on all conduit ends for all communications systems conduit inside manholes. Fire alarm conduits shall be marked. All spare conduits shall be capped and sealed at both ends.
1. All conductors inside the manhole shall be labeled or otherwise identified by system.

2. Provide ladder racks all around the inside walls of the manholes for conductor support.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS**

- A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide weathertight boxes and fittings for interior and exterior locations exposed to weather or moisture. Provide weatherproof boxes for all exterior outlet boxes for power and systems, including fire alarm and intercom system boxes.
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.
- F. Avoid installing boxes back-to-back in walls. Provide not less than 24" (600 mm) separation.
- G. Position recessed outlet boxes accurately to allow for surface finish thickness. All outlet boxes shall be provided with bracket support behind the box for additional structural support. Mounting boxes directly to the metal framing on one side only is not acceptable. Boxes shall be additionally supported on the back side.
- H. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.
- I. Outlet boxes shall be structurally supported to the metal studs using a back bracket or other additional means of support. Side mounted attachment only to the metal studs is not acceptable.
- J. Each circuit in pull box shall be marked with a tag guide denoting panels which they connect to.
- K. Manholes and handholes shall be installed for all underground conduit installations. The minimum number of manholes and handholes shall be as indicated on the drawings. The contractor shall provide any additional handholes or manholes necessary for ease of installation, code compliance or due to voluntary or required re-routing of the underground conduits at no additional cost to the Owner.

**END OF SECTION**





## **SECTION 26 0553 – ELECTRICAL IDENTIFICATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Electrical Materials and Methods section apply to work specified in this section.

#### **1.2 DESCRIPTION OF WORK**

- A. Extent of electrical identification work is indicated by drawings and schedules.
- B. Types of electrical identification work specified in this section include the following:
  - 1. Electrical power, control, and communication conductors.
  - 2. Operational instructions and warnings.
  - 3. Equipment/system identification signs.

#### **1.3 QUALITY ASSURANCE**

- A. Manufacturers: Firms regularly engaged in manufacture of electrical identification products of types required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.
- C. UL Compliance: Comply with applicable requirements of UL Std 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering electrical identification products which may be incorporated in the work include, but are not limited to, the following:
  - 1. Brady, W.H. Co.

#### **2.2 ELECTRICAL IDENTIFICATION MATERIALS**

- A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

#### **2.3 ENGRAVED PLASTIC-LAMINATE SIGNS**

- A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (white letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
  - 1. Thickness: 1/8", except as otherwise indicated.
  - 2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.
  - 3. Fire alarm pull station signs shall be permanently fastened. Adhesive backing is not acceptable.

#### **2.4 LETTERING AND GRAPHICS**

- A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment.

### **PART 3 - EXECUTION**

#### **3.1 APPLICATION AND INSTALLATION**

- A. General Installation Requirements:
  - 1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.
  - 2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
  - 3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.2 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. General: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and doors of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

3.3 EQUIPMENT/SYSTEM IDENTIFICATION

- A. General: Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/ control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering, on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
1. Switchboard, panelboards, electrical cabinets, disconnect switches and enclosures
  2. Access panel/doors to electrical facilities
  3. Transformers
  4. Intercom system master station
  5. TV Head End Equipment
  6. Fire alarm control panel and terminal cabinets
  7. Each device in main switchboard and motor control center.
  8. Communications systems terminal cabinets; sound, CCTV, clock, telephone, etc.
- B. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate.

**END OF SECTION**

## SECTION 26 2416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Electrical Materials and Methods section apply to work specified in this section.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of panelboard, load-center and enclosure work, including cabinets and cutout boxes is indicated by drawings and schedules.
- B. Types of panelboards and enclosures in this section include the following:
  - 1. Service-entrance panelboards
  - 2. Power-distribution panelboards
  - 3. Lighting and appliance panelboards
- C. Refer to other Division-26 sections for cable/wire, connectors, and electrical raceway work required in conjunction with panelboards and enclosures; not work of this section. Refer to Section 262813 - Overcurrent Protective Devices for circuit breakers to be installed in panelboards.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of panelboards and enclosures, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects utilizing panelboards similar to that required for this project.
- C. NEC Compliance: Comply with NEC as applicable to installation of panelboards, cabinets, and cutout boxes. Comply with NEC requirements pertaining to installation of wiring and equipment in hazardous locations. Comply with all NEC requirements for labeling, including arc fault and arc flash warnings.
- D. UL Compliance: Comply with applicable requirements of Std No. 67 "Electric Panelboards", and Stds No.'s 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide units which are UL-listed and labeled.
- E. NEMA Compliance: Comply with NEMA Stds Pub/No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum), Pub/ No. PB 1, "Panelboards", and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".
- F. Federal Specification Compliance: Comply with FS W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on panelboards. Data must include a complete panel layout indicating the circuit breakers and corresponding circuit numbers. Include ratings of each circuit breaker including short circuit capability. Indicate all options to be supplied with the panelboard. Indicate overall panelboard bus rating and main type and rating. Show complete dimensional information. Any deviation from dimensions shown on the drawings shall be specifically pointed out in the submittal. Indicate the panelboard short circuit capacity rating and specify that it is fully rated. Series ratings are not acceptable.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide panelboard products of one of the following (for each type and rating of panelboard and enclosure):
  - 1. Square D Co.
  - 2. Seimens
  - 3. Eaton
  - 4. General Electric/ABB
- B. All circuit breakers shall be the bolt-on type.

#### 2.2 PANELBOARDS

- A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL, and established industry standards for those applications indicated.

- B. Power Distribution Panelboards: All service entrance panels that are 400 amps and larger shall be Power Distribution type. All panels 600 amp and larger shall be Power Distribution type. Provide dead-front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for copper conductors. Select unit with feeder connecting at top of panel. Equip with copper bus bars with not less than 98% conductivity, and with full-sized neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections. Provide bolt-on type molded-case main and branch circuit-breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Provide panelboards with bare uninsulated copper grounding bars suitable for bolting to enclosures. Select flush or surface mounted type enclosures, required on the drawings, fabricated by same manufacturer as panelboards, which mate properly with panelboards. Distribution panels shall be a power distribution type panel, Square D I-Line or approved equal. Lighting or appliance type panels will not be acceptable for power distribution. Provide non-linear load type panels where indicated on the drawings (200% neutral type).
- C. Lighting and Appliance Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types, and arrangements shown; with anti-burn solderless pressure type lug connectors approved for copper conductors; construct unit for connecting feeders at top of panel; equip with copper bus bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole or multi-pole circuit-breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral bus for each outgoing feeder required; provide bare copper uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards. Loadcenters are not acceptable. Provide non-linear load type panels where indicated on the drawings (200% neutral type).
- D. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with wire gutters and without multiple knockouts. Provide fronts with adjustable trim clamps, doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for flush recessed or surface mounting, as indicated on the drawings. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed.
- E. Panelboard Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, cartridge and plug time-delay type fuses, circuit-breakers, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated. All panelboards shall be provided with a separate copper ground bus bar.
- F. Panelboard Ratings: All branch circuit panelboards shall be fully rated for the short circuit current indicated or the specific rating specified on the panel schedule, whichever is greater. Service entrance and distribution panelboards shall be fully rated for the short circuit current indicated or the specific rating specified on the panel schedule, whichever is greater. Series ratings will not be acceptable.
- G. Main Circuit Breaker and Feeder Breakers Equal to or Greater Than 1000 amps: Provide stationary mounted, electrically operated, insulated case main circuit breaker of the ampere rating indicated on the drawings. The main circuit breaker shall be 100% continuous duty type. The circuit breaker shall be rated for A.I.C. indicated on the drawings. The circuit breaker shall be provided with the following integral, adjustable settings:
1. Adjustable Instantaneous Trip.
  2. Long time pick-up and adjustable delay.
  3. Short time pick-up and adjustable delay.
  4. Adjustable high instantaneous pick-up.
  5. Adjustable ground fault pick-up and delay
  6. Provide arc-flash mitigation integral with breaker. Provide with energy reducing maintenance switch to allow the breaker to be manually set/switched to "no intentional delay".
- F. Feeder Circuit Breakers (800 amp - 250 frame): Provide factory-assembled, molded-case, group mounted circuit breakers rated as indicated, 600-volts, 60 Hz, 3-poles with the RMS symmetrical interrupting ratings indicated on the drawings. All panelboards shall be fully rated. Series ratings are not acceptable. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in an physical position and operating in an ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated, and with NEMA Type 1 general purpose enclosures.
1. Circuit breaker escutcheon shall have International I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the "ON" or "OFF" position.

2. Breaker handle and faceplate shall indicate rated ampacity. Breaker faceplate shall indicate UL and IEC certification standards with applicable voltage systems and corresponding AIC ratings.
3. Each circuit breaker shall be equipped with a push-to-trip button to mechanically operate the circuit breaker tripping mechanism. Each breaker shall have quick-make, quick-break contacts with an overcenter toggle operating mechanism. Breaker(s) shall not be able to be teased into a neutral position. All circuit breakers shall be equipped with electrical accessories as noted on the drawings.
4. Electronic Trip System (250 amp frame feeder breakers and larger only):
  - a. The entire trip system shall be a microprocessor-based, peak sensing design. MICROLOGIC standard function as manufactured by Square D or equal.
  - b. The integral trip system shall be independent of any external power source and shall contain electronic components to measure ampacity and time the output from internal current sensors and initiate automatic tripping action.
  - c. The continuous ampere rating of the circuit breaker shall be determined by the ampere rating switch position. The ampere rating shall be clearly marked on the face of the circuit breaker.
  - d. Provide a means to seal the trip unit adjustments to discourage unauthorized tampering in accordance with NEC 240-6. The trip unit shall be field interchangeable for future replacement.
  - e. Provide the following time/current curve profile adjustment(s) to maximize system selective coordination. Each adjustment shall have discrete settings and shall be independent from all other adjustments.
    - aa. LSI - Adjustable Ampere Rating Pickup and Delay
    - bb. Adjustable Short Time Pickup and Delay (delay includes 1yt IN)
    - cc. Fixed Instantaneous (High Level Selective Override)
  - f. Provide local visual trip indicators for overload, short circuit and ground fault trip functions.
  - g. The trip system shall include a memory circuit to detect intermittent overcurrent conditions.
  - h. Each circuit breaker trip system is to include an externally accessible test port for use with a Universal Test Set. No disassembly of the circuit breaker shall be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.
  - i. Provide magnetic/thermal backup for all electronic trip circuit breakers.
- G. Provide nameplates to identify switchboard and each feeder breaker by the load served.
- G. Surge Suppression: Where shown on the drawings, panels shall be provided with a surge suppressor mounted externally from the factory panelboard. Internally mounted devices are not acceptable.
  1. Suppressor must meet the requirement of Specification Section 264313.
  2. All required UL Listings shall be maintained for both the panelboards and the surge suppressors.
  3. All warranties shall be maintained for both the panelboards and the surge suppressors.
  4. All National Electrical Code requirements shall be maintained for both the panelboards and the surge suppressors.
  5. Provide a three pole, 30 amp circuit breaker to serve the surge suppressor. Utilize #10 awg conductors for phase, neutral and ground.

### PART 3 - EXECUTION

#### 3.1 INSPECTION

- A. Installer must examine areas and conditions under which panelboards and enclosures are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

#### 3.2 INSTALLATION OF PANELBOARDS

- A. General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standard of Installation", and in compliance with recognized industry practices, to ensure that products comply with requirements.
- B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.
- C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.
- D. Anchor enclosures firmly and securely to walls and structural surfaces, ensuring that they are permanently and mechanically secure and plumb.
- E. Provide properly wired electrical connections within enclosures.
- F. Provide typewritten circuit directory card in panel door upon completion of installation work.
- G. Where panels are mounted flush in the wall, a minimum of three (3) spare 3/4" conduit shall be installed stubbed out a minimum of eight (8) inches above ceiling.
- H. Provide all required labeling, including arc flash labels.

I. Nameplates:

Normal/Optional Standby Power – 480 Volt: Black with white letters  
Normal/Optional Standby Power - 208 volt: White with black letter  
Emergency Power – 480 volt: Red with white letters  
Emergency Power – 208 volt: White with red letters

3.3 GROUNDING

A. Provide equipment grounding connections for panelboards as indicated. Tighten connections to comply with tightening torques specified in UL Stds 486A and B to assure permanent and effective grounds.

3.4 FIELD QUALITY CONTROL

- A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.
- B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
- C. Prior to energization, check panelboards for electrical continuity of circuits for short-circuits.
- D. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.
- E. Prior to final acceptance completely fill out the circuit directories accurately depicting the equipment connected to each circuit. Circuit directories shall be typewritten.

**END OF SECTION**

## SECTION 26 2616 – CIRCUIT AND MOTOR DISCONNECTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Electrical Materials and Methods section, apply to work of this section.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of circuit and motor disconnect switch work is indicated by drawings and schedules.
- B. Types of circuit and motor disconnect switches in this section include the following:
  - 1. Equipment disconnects.
  - 2. Appliance disconnects.
  - 3. Motor-circuit disconnects.
- C. Wires/cables, raceways, and electrical boxes and fittings required in connection with circuit and motor disconnect work are specified in other Division-26 Basic Electrical Materials and Methods sections.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of circuit and motor disconnect switches of types and capacities required whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing circuit and motor disconnect work similar to that required for this project.
- C. NEC Compliance: Comply with NEC requirements pertaining to construction and installation of electrical circuit and motor disconnect devices.
- D. UL Compliance: Comply with requirements of UL 98, "Enclosed and Dead-Front Switches". Provide circuit and motor disconnect switches which have been UL-listed and labeled.
- E. NEMA Compliance: Comply with applicable requirements of NEMA Stds Pub No. KS 1, "Enclosed Switches" and 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)".

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on circuit and motor disconnect switches.
- B. Wiring Diagrams: Submit power and control wiring diagrams for circuit and motor disconnects including connections to power and control panels, and feeders.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering circuit and motor disconnects which may be incorporated in the work include the following:
  - 1. Square D Company
  - 2. Seimens
  - 3. Eaton
  - 4. GE/ABB

#### 2.2 FABRICATED SWITCHES

- A. Heavy-Duty Safety Switches: Provide surface-mounted, heavy-duty type, sheet-steel enclosed safety switches, of types, sizes and electrical characteristics indicated; fusible or non-fusible type as indicated, amperes as indicated, 60 Hz, 3-blades, 4-poles, solid neutral; and incorporating quick-make, quick-break type switches; construct so that switch blades are visible in OFF position with door open. Equip with operating handle which is integral part of enclosure base and whose operating position is easily recognizable, and is padlockable in OFF position; construct current carrying parts of high-conductivity copper, with silver-tungsten type switch contacts, and positive pressure type reinforced fuse clips. Provide NEMA Type 3R enclosures, where applicable. Provide grounding kit. Provide 240 volt rated switches for 208Y/120 volt systems and 600 volt rated switches for 277Y/480 volt systems.
  - 1. Fuses: Provide fuses for safety switches, as recommended by the manufacturer of the equipment to be protected, of classes, types, and ratings needed to fulfill electrical requirements for service indicated. Provide R-clips for all fuse holders.

**PART 3 - EXECUTION**

**3.1 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECT SWITCHES**

- A. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.
- B. Coordinate circuit and motor disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.
- C. Install disconnect switches for use with motor-driven appliances, and motors and controllers within sight of controller position unless otherwise indicated.
- D. Provide a nameplate indicating the equipment served and protected.

**3.2 GROUNDING**

- A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for electrical disconnect switches where indicated.

**3.3 FIELD QUALITY CONTROL**

- A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at project site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest.
- B. Painting: repair all scratches to factory painted and primed finish with factory supplied touch-up paint.

**END OF SECTION**



## SECTION 26 2726 – WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

#### 1.2 DESCRIPTION OF WORK

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.
- B. Types of electrical wiring devices in this section include the following:
  - 1. Receptacles, including surge suppression type if applicable.
  - 2. Ground-fault circuit interrupters
  - 3. Switches
  - 4. Wallplates
  - 5. Plugs and connectors
  - 6. Time Switches / Time Clocks
  - 7. Occupancy Sensors

#### 1.3 QUALITY ASSURANCE

- A. Installer's Qualifications: Firm with at least 2 years of successful installation experience on projects utilizing wiring devices similar to those required for this project.
- B. NEC Compliance: Comply with NEC as applicable to installation and wiring of electrical wiring devices.
- C. UL Compliance: Comply with applicable requirements of UL 20, 486A, 498, and 943 pertaining to installation of wiring devices. Provide wiring devices which are UL-listed and labeled.
- D. IEEE Compliance: Comply with applicable requirements of IEEE Std 241, "Recommended Practice for Electric Power Systems in Commercial Buildings", pertaining to electrical wiring systems.
- E. NEMA Compliance: Comply with applicable portions of NEMA Stds Pub/No. WD 1, "General-Purpose Wiring Devices", WD 2, "Semiconductor Dimmers for Incandescent Lamps", and WD 5, "Specific,-Purpose Wiring Devices".
- F. FS Compliance: Comply FS W-C-596 (Series) and FS W-S-896 (Series) pertaining to electrical power connectors and toggle switches.

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on electrical wiring devices.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide wiring devices of one of the following (for each type and rating of wiring device):
  - 1. Hubbell
  - 2. Leviton
  - 3. Bryant
  - 4. Time Switches: Tork only

#### 2.2 FABRICATED WIRING DEVICES

- A. General: Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated and which comply with NEMA Stds Pub/No. WD 1. Provide white color devices and brushed satin finish stainless steel coverplates, except as otherwise indicated; all color selections to be verified by Contractor with Architect/Engineer prior to ordering.
- B. Receptacles:
  - 1. Heavy-Duty Duplex: Provide extra heavy duty grade duplex receptacles, 2-pole, 3-wire, grounding, 20-ampere, 125-volts, with metal plaster ears, design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-20R unless otherwise indicated. Hubbell HBL5362GY, or equal by Leviton, Bryant.
    - a. UPS Receptacles: Receptacles circuited to UPS shall be orange.
    - b. Normal/Dirty power receptacles shall be white.
    - c. Receptacles circuited to cleanpower panels, but not in UPS ("C" Pabels) shall be gray.

- d. Emergency power receptacles that are circuited to the emergency power branch shall be red with the standard stainless steel coverplate.
  - e. All colors shall be verified with the architect prior to ordering.
  2. Water Resistant Ground-Fault Interrupters: Provide "feed-thru" type ground-fault circuit interrupters, with heavy-duty duplex receptacles, type WR rated, with zinc die-cast housing, capable of being installed in a 2-3/4" deep outlet box without adapter, grounding type UL-rated Class A, Group 1, rated 20 amperes, 120-volts, 60 Hz; with solid-state ground-fault sensing and indication; with 5 milliampere ground-fault trip level; equip with NEMA configuration 5-20R. Device must have a positive trip identification and reset. Provide white color device. Hubbell GFTR20GY, or equal by Leviton, Bryant
  3. Special Receptacles: Special configuration receptacles shall be standard NEMA plug configuration as specified on the drawings or as required. Provide heavy duty, specification grade receptacles, with black nylon face and brushed satin stainless steel cover plate.
- C. Switches (Line Voltage):
1. Snap: Provide specification grade, general-duty flush single-pole, quiet type toggle switches, 20-amperes, 120-277 volts AC, with mounting yoke insulated from mechanism, equip with plaster ears, switch handle, and side-wired screw terminals.
  2. 2-way: Provide specification grade, general-duty flush double-pole AC quiet switches, 20-amperes, 120-277 volts AC, with mounting yoke insulated from mechanism, equip with plaster ears, switch handles, side-wired screw terminals, with break-off tab features, which allows wiring with separate or common feed.
  3. Three-way: Provide specification grade, general-duty flush 3-way AC quiet type switches, 20-amperes, 120-277 volts AC, with mounting yoke insulated from mechanism, equip with plaster ears, lock type switch handles, sidewired screw terminals, with break-off tab features, which allows wiring with separate or common feed.
  4. Four-way: Provide specification grade, general-duty flush 4-way AC quiet switches, 20-amperes, 120-277 volts AC, with mounting yoke insulated from mechanism, equip with plaster ears, switch handles, side-wired screw terminals, with break-off tab features, which allows wiring with separate or common feed.
  5. Touch Snap: Provide soft-touch snap switches, cap able of effortless-fingertip operation; single-pole AC quiet, with lighted rocker switch handles; sidewired screw terminals for connecting copper-clad aluminum wire, 20-amperes, 120-277 volts rating. Equip with plaster ears.
  6. Switches to be white color with satin finish stainless steel coverplate.
  7. Emergency (emergency egress lighting) circuit switches shall be red.
- D. Combination Devices: Provide specification grade, general-duty 3-way quiet switch, 20-amperes, 120-277 volts AC, with toggle switch handle, and 3-wire grounding receptacle, 20 amperes, 120-volts, equip with plaster ears, and with break-off tab feature which allows wiring with separate or common feed, with NEMA configuration 5-20R.

### 2.3 WIRING DEVICE ACCESSORIES

- A. Wallplates: Provide wallplates for light switches, receptacles, single and combination wiring devices, of types, sizes, and with ganging and cutouts as required. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates. Provide plates possessing the following additional construction features:
1. Material and Finish: 0.04" thick, type 302 satin finished stainless steel.
  2. Weatherproof covers in wet locations (WP) shall be "in-use" type with die-cast metal cover. Plastic covers are not acceptable.
  3. Weatherproof covers in damp locations (designated DL) shall not be in-use type, but shall be a die-cast metal type weatherproof cover with spring-hinge return.
  3. Provide a permanently etched/engraved black stencil label on all coverplates for lighting, receptacles, etc., with the panel name and circuit number.
- B. Floor Service Outlets (Floor Boxes): Provide flush type floor service receptacle outlets and fittings of types and ratings indicated. Construct of die cast aluminum or cast iron, satin finish and of the size necessary for the slab thickness provided. Provide two or three gang box as indicated on the drawings with 20-ampere, 125-volt, duplex receptacle, NEMA configuration 5-20R for power, unless indicated otherwise. Provide data outlets as indicated with a minimum of two 1" diameter bushed hole for data cabling raceways. Boxes shall be sized as required for the number of outlets and number of conductors to enter and leave the box.
1. Provide brass cover plate with screw-in type protective covers which will prevent breakage of the installed wiring devices.
  2. Provide brass tile or carpet flange as required.
  3. Verify cover plate and flange color and material selections with the architect prior to ordering.
  4. Data outlets shall comply with specification section 27 15 00.
  5. Hubbell style/type B423341 or B433361, or approved equal.

6. Provide fire rated poke thru type for second level floors and above. Six (6) inch type with one 20 amp, 120 volt, duplex receptacle (5-20R), two Cat 6A jacks and cables to the business rack, and two Cat 6A jacks and cables to the SCADA rack, brushed aluminum cover assembly, power junction box, 2" EMT raceway sleeve for Cat 6A cabling, with separation compartment of power and data. Provide blank inserts for any spare openings. Verify cover plate and flange color and material selections with the architect prior to ordering. Hubbell System One S1R6PTFIT series or approved equal.

- 2.4 OCCUPANCY SENSORS AND DAYLIGHT SENSORS
  - A. See specification section 26 09 23 – Lighting Control Devices.
- 2.5 TELEPHONE OUTLETS
  - A. See Section 271500.

### **PART 3 - EXECUTION**

- 3.1 INSTALLATION OF WIRING DEVICES
  - A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
  - B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.
  - C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
  - D. Install galvanized steel wallplates on any exposed surface mounted devices.
  - E. Install wallplates after painting work is completed.
  - F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B. Use properly scaled torque indicating hand tool.
  - G. Contractor to provide ground fault protective type receptacles for any location within 2'-0" of sinks or other source of water. Feed through protection from one ground fault protected receptacle on a circuit is not acceptable.
  - H. Mounting height of boxes for devices as shown on legend, unless otherwise noted on the plan. Refer to architectural drawings to avoid interferences with millwork. Where two or more devices are shown at the same location, use gang box and one face plate. Verify all device locations with Owner prior to rough-in. Exact device locations may be adjusted by the Owner to avoid interferences or for general convenience at no additional cost to the Owner.
  - I. Floor boxes shall be installed flush with the slab and shall strictly follow manufacturer's installation instructions. Boxes shall be installed at right angles to the building lines and multiple boxes shall be in-line straight and even. Boxes observed to be installed crooked shall be removed and reinstalled.
- 3.2 PROTECTION OF WALLPLATES AND RECEPTACLES
  - A. Upon installation of wallplates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.
- 3.3 GROUNDING
  - A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std 486 A to assure permanent and effective grounds.
- 3.4 TESTING
  - A. Prior to circuitry, test wiring for electrical continuity, for short-circuits and for grounding. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.
- 3.5 WARRANTY
  - A. All wiring devices, including dimmers and any dimming system, shall have a minimum one year parts and labor warranty.

### **END OF SECTION**



## SECTION 26 2813 – OVERCURRENT PROTECTIVE DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division-26 section making reference to overcurrent protective devices specified herein.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of overcurrent protective device work is indicated by drawings and schedules.
- B. Types of overcurrent protective devices in this section include the following:
  - 1. Circuit Breakers:
    - a. Air, molded-case, for installation in panels.
    - b. Air, molded-case, for individual, separately enclosed mounting.
    - c. For installation in existing panels.
  - 2. Fuses:
    - a. Class RK5, dual-element time-delay.
- C. Refer to other Division-26 sections for cable/wire and connector work required in conjunction with overcurrent protective devices; not work of this section.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of overcurrent protective devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for project.
- C. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of overcurrent protective devices.
- D. UL Compliance: Comply with applicable requirements of UL 489, "Molded-Case Circuit Breakers and Circuit-Breaker Enclosures", and UL 198D, "High-Interrupting-Capacity Class K Fuses". Provide overcurrent protective devices which have been UL-listed and labeled.
- E. NEMA Compliance: Comply with applicable requirements of NEMA Std Pub Nos. AB 1, AB 2, and SG 3 pertaining to molded-case and low-voltage power type circuit breakers.
- F. FS Compliance: Comply with Federal Specification W-C-375B/GEN pertaining to molded-case circuit breakers.

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on overcurrent protective devices, including: amperes, voltages and current ratings, interrupting ratings, current limitations, internal inductive and non-inductive loads, time-current trip characteristics curves, and mounting requirements.
- B. Maintenance Stock, Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 5 installed units, but not less than one unit of each.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
  - 1. Circuit Breakers:
    - a. Square D Co.
    - b. Seimens
    - c. Eaton
    - d. GE/ABB
  - 2. Fuses:
    - a. Bussmann Div.; McGraw-Edison Co.
    - b. Gould, Inc.
    - c. Littlefuse

#### 2.2 CIRCUIT BREAKERS

- A. General: Except as otherwise indicated, provide circuit breakers and ancillary components, of types, sizes, ratings, and electrical characteristics indicated, which comply with manufacturer's standard design,

- materials, components, and construction in accordance with published product information, and as required for a complete installation.
- B. Molded-Case Circuit Breakers: Provide factory assembled, molded-case circuit breakers of frame size indicated; rated 600 volts or 240 volts as required, 60 Hz, 3-poles with interrupting ratings as shown on drawings. Provide breakers with permanent thermal and instantaneous magnetic trips in each pole, and with fault-current limiting protection, ampere ratings as indicated. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Handle ties are not permitted. Provide push-to-trip button on cover for mechanical tripping circuit breakers. Construct breakers for mounting and operating in any physical position and operating in an ambient temperature of 40oC. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated. Circuit breakers shall have the short circuit interrupting rated indicated on the drawings or as required for the short circuit current available.
  - C. Molded-Case Circuit Breakers for Installation in Panelboards: Shall meet the same specifications as in Part B above. Shall be manufactured by the same manufacturer as the panelboard.
  - D. Provide all accessories indicated on the drawings, including accessories indicated on the panel schedules, such as shunt trips, ground fault protection, undervoltage trips, etc. Accessories shall be manufactured by the same manufacturer as the circuit breaker.
  - E. All circuit breakers used to protect heating, ventilation or air conditioning circuits shall be listed HACR type.
  - F. Breakers or switches added to existing equipment shall be manufactured by the manufacturer of the existing equipment and shall the same type and have the same short circuit ratings as the existing breakers. All required mounting hardware and filler plates shall be provided.
  - G. Circuit Breakers Equal to or Greater Than 1000 amps: Provide stationary mounted, electrically operated, insulated case main circuit breaker of the ampere rating indicated on the drawings. The main circuit breaker shall be 100% continuous duty type. The circuit breaker shall be rated for A.I.C. indicated on the drawings. The circuit breaker shall be provided with the following integral, adjustable settings:
    - 1. Adjustable Instantaneous Trip.
    - 2. Long time pick-up and adjustable delay.
    - 3. Short time pick-up and adjustable delay.
    - 4. Adjustable high instantaneous pick-up.
    - 5. Adjustable ground fault pick-up and delay
    - 6. Provide arc-flash mitigation integral with breaker. Provide with energy reducing maintenance switch to allow the breaker to be manually set/switched to "no intentional delay".

### 2.3 FUSES

- A. General: Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time/current and peak let-through current characteristics indicated, which comply with manufacturer's standard design, materials, and construction in accordance with published product information, and with industry standards and configurations.
- B. Class RK5 Dual-Element Time-Delay Fuses: Provide UL Class RK-5 dual element time-delay fuses rated 600 V, 60 Hz, amperes as required by the manufacturer of the equipment being protected, with 200,000 RMS symmetrical interrupting current rating for protecting motors.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

- A. Install overcurrent protective devices as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.
- B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.
- C. Fasten circuit breakers without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.
- D. Set field-adjustable circuit breakers for trip settings as indicated, subsequent to installation of units.
- E. Install fuses, if any, in fused circuit breakers.

### 3.2 ADJUST AND CLEAN

- A. Inspect circuit-breaker operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

### 3.3 FIELD QUALITY CONTROL

- A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

TOURNAMENT SPORTSPLEX  
ADD PERMANENT GENERATOR

OCTOBER 5, 2023  
CONSTRUCTION DOCUMENTS

**END OF SECTION**





**SECTION 26 3213 - ENGINE GENERATORS – OWNER FURNISHED – CONTRACTOR INSTALLED**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other related specification sections, apply to work of this section.
- B. Division-26 Basic Electrical Requirements apply to work specified in this section.

**1.2 DESCRIPTION OF SYSTEM**

- A. It is the intent of this specification to install an owner furnished emergency generator system that has been prototype tested, factory built, production tested, site tested, of the latest commercial design, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein. The equipment supplied and installed shall meet the requirements of the National Electric Code and all applicable local codes and regulations. All equipment shall be new, of current production by a national firm which manufactures the generator and controls, transfer switch, and assembles the generator set as a matched unit so that there is one-source responsibility for warranty, parts, and service through a local representative with factory-trained service personnel.

**1.3 SITE INSPECTION, TESTING, AND STARTUP:**

- A. After the generator has been installed it shall be tested at the site to assure they will function as specified.
- B. The generator manufacturer shall provide a qualified Startup Technician to assist the installing contractor in commissioning and performing the on-site testing of the generator.
- C. The generator set manufacturer shall submit the on-site test procedure to the contractor and consulting engineer for approval prior to the actual testing. Included in the data submitted shall be copies of the blank test forms to be used for recording the test data.
- D. The commissioning and testing shall include a minimum of 1 day of instruction in the maintenance and operation of the equipment.
- E. The contractor shall notify the consulting engineer, operating personnel, and maintenance staff of the time and date of the on-site testing and training.
- F. Upon completion and acceptance of the generator testing, furnish a report, for record, of all data and readings.
- G. Instruct Owner on operation of the entire emergency power system, including transfer switches, fuel supply system, and engine-generators.

**1.4 WARRANTY & MAINTENANCE**

- A. The generator shall be guaranteed against defective workmanship for one year or 2,000 hours, whichever occurs first, from the date of the site start-up and acceptance.

**1.5 DRAWINGS AND MANUALS**

- A. The systems manufacturer shall provide the necessary interconnection diagrams for connecting the engine generators to all other equipment related to the emergency generator system.
- B. Instruction manuals and record drawings shall be furnished for the engine generator sets and their accessories in an electronic PDF format.

**1.6 SUBMITTALS:**

- A. Obtain a copy of the generator manufacturer's submittal and shop drawings and coordinate all requires of the installation.

**1.7 OPERATION AND MAINTENANCE MANUALS**

- A. Provided by generator manufacturer/supplier.

**1.8 QUALITY ASSURANCE:**

- A. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects utilizing generator sets similar to that required for this project. Installer shall be a licensed electrician with experience installing at least three generator sets of equal size and scope. Generator set installers shall be approved and certified to install the supplied manufacturers equipment.

**1.9 CODES AND STANDARDS:**

- A. The engine-generator sets shall be manufactured and installed in accordance with all applicable codes and standards, including but not limited to the following:
  - 1. NFPA 70 - National Electrical Code (NEC).
  - 2. NFPA-110 - Emergency and Standby Power Systems – current edition

1.10 MANUFACTURER

- A. Generator will be owner furnished, contractor installed.

**PART 2 – PRODUCTS – FOR INFORMATIONAL PURPOSES**

2.1 GENERAL:

- A. The standby diesel generator sets shall be rated standby power (defined as continuous operation for the duration of any power outage) 480Y/277 volts, 3 phase, 4 wire, .8 power factor, 750KW/938KVA as indicated on the drawings, at 3300 feet altitude, 104 degrees Fahrenheit. Vibration isolators shall be

2.2 ENGINE:

- A. The engine shall deliver a minimum of bhp at a governed speed of 1800 rpm to deliver the rated KVA/KW. The engine shall be equipped with the following:
1. Fuel shut-off valve.
  2. Electronic isochronous load sharing governor capable of +/-0.25% steady state frequency regulation over an operating range -40C to +85C.
  3. 24 volt positive engagement solenoid shift-starting motor.
  4. 40-ampere minimum automatic battery charging alternator with solid-state voltage regulation.
  5. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
  6. Dry-type replaceable air cleaner elements.
  7. Engines requiring glow plugs will not be acceptable when NFPA-99 or NFPA-110 Type 10 (ten-second) transfer requirement must be met. Note: 10 second transfer must be met.
  8. The naturally aspirated or turbocharged engine shall be fueled with diesel fuel, and be liquid cooled. An appliance regulator and all associated fuel delivery accessories shall be provided with the generator. A unit-mounted radiator, blower fan, water pump, thermostat, and radiator duct flange (un-housed only) shall properly cool the engine with up to 0.5 inches H2O external static pressure on the cooling system.
  9. Engine shall be Tier IV (or most current ratings in affect for stand-by) DEP/EPA emissions approved and rated. Provide all required documentation, registrations, permits, and approvals. Provide approval and rating required at the time of shipping.

2.3 GENERATOR:

- A. The alternator shall be salient-pole, re-connectable 10 lead, of 2/3 pitch to eliminate the third harmonic, self-ventilated of drip-proof construction with amortisseur rotor windings and skewed for smooth voltage waveform. The insulation material shall meet the NEMA standard (MGI-22.40 and 16.40) for Class H and be vacuum impregnated with epoxy varnish to be fungus resistant per MIL I-24092 or be multiply dipped and baked with nonhygroscopic varnish with a final dip of epoxy. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage within + or - 0.5% at any constant load from 0 to 100% of rating.
- B. The generator shall be capable of sustaining at least 250% of rated current for at least 10 seconds under a 3 phase symmetrical short by inherent design or by the addition of an optional current boost system.
- C. The generator, having a single maintenance free bearing, shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
- D. Gauge Panel: Set- mounted, NEMA 1 dead front, vibration isolated. Gauge panel shall include:
1. Panel illuminating lights.
  2. Battery charging voltmeter.
  3. Coolant temperature gauge.
  4. Oil pressure gauge.
  5. Running time meter.
  6. Local emergency stop button and remote EPO with required wiring.
  7. Dual element electronic speed switch with crank disconnect contact and overspeed contact shall be controlled by a magnetic pickup mounted radially to flywheel ring gear. Terminal blocks shall be provided for all engine/generator pre-alarms and safety shutdowns plus auxiliary functions for interconnect to engine/generator control cubicle. Each terminal shall be permanently marked to match the point to point wiring diagrams.
  8. Provide two Remote Annunciators: Remote annunciator shall be provided and mounted in the main electrical room and in Plant Control. Provide all required conductors and conduit. The conduit shall be a minimum of 1-1/4". Annunciator shall indicate all major generator operating conditions, alarms, and warnings, including fuel level. Remote annunciators located in Plant Control and Server Room shall be flush mounted type, in the wall.
  9. Provide all other annunciation, monitoring and control required by EPA and DEP for the fuel system.
  10. Annunciators shall provide fuel level monitoring to the SCADA control system.
  11. Provide for a network connection and communications to SCADA for all annunciator data.

2.4 WIRING

- A. All control wiring to the dry contacts located in the transfer shall be 18 gauge stranded wire for distances up to 1000 feet.

2.5 ACCESSORIES:

- A. The following accessories shall be provided:
1. Overvoltage protection will shut down the unit after one second of 15% or more overvoltage.
  2. Battery rack, battery cables, 12-volt battery(ies) capable of delivering the minimum cold-cranking amps required at zero degrees Fahrenheit per SAE Standard J-537.
  3. Gasproof, seamless, stainless steel, flexible exhaust connector(s) ending in pipe thread.
  4. Flexible fuel line(s) rated 300 degrees F and 100 PSI ending in pipe thread.
  5. Provide critical rated engine exhaust silencer, coated to be temperature and rust resistant, rated for critical applications. Exhaust noise shall be limited to 68 dba as measured at 10 feet in a free-field environment.
  6. Block heater and jacket heater of proper wattage and 208 volts, single phase, thermostatically controlled to maintain engine coolant at 90 degrees Fahrenheit (32 degrees Celsius) to meet the start-up requirement of NFPA-99 or NFPA-110 Regulations.
  7. 10-Ampere automatic float and equalize battery charger with +- 1% constant voltage regulation from no load to full load over +- 10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from -40 degrees C to +60 degrees C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Battery charger shall have 120 volt input. Provide alarm circuit board to meet the requirements of NFPA-110 for low battery voltage, high battery voltage, and battery charger malfunction.
  8. Break-glass type remote emergency stop stations which meet the requirements of NFPA-110. Provide required control circuit. Locate stations as indicated on the drawings.
  9. Provide 180 MPH, missile impact rated and critical sound attenuated, weatherproof enclosure. Enclosure shall be provided with a full length exterior galvanized steel cat-walk on each side of the generator enclosure along the long dimension, including stairs to a level walkway at the generator height above the fuel tank that allows full access to all doors and compartments. Refer to section 2.6.
  10. Provide an integral in base fuel tank sized for 48 hours of fuel at 75% rated load. Tank shall be UL 142, double wall and shall include a leak detector, low fuel alarm and all required accessories, monitoring, alarms, and annunciation to meet EPA and DEP requirements. Tank shall be filled and topped off with fuel after testing.
    - a. Fuel tank shall be provided with available access to all compartments within the inside of tank for cleaning and applying chemical treatment. Tanks that are compartmentalized or have added structural supports that can block access to each compartment or areas of the tank will not be acceptable. Access to all areas of the tank for cleaning and chemical treatment is imperative.
  12. Provide all required coordination and controls with the automatic transfer switches.

2.6 GENERATOR ENCLOSURE:

- A. Weather Resistant type enclosure shall be provided to house the engine/generator and accessories. The enclosure is to be in complete compliance with the National Electrical Code (NEC), and the National Fire Protection Association (NFPA) with regard to clearances around electrical equipment specified herein. The enclosure shall conform to the following construction and design criteria as set forth herein.
1. - Rigidity wind test equal to 180 MPH, or as required by ASCE-7
  2. - Roof load equal to 30 lbs. per sq. ft.
  3. - Rain test equal to 4" per hour
  4. -Florida Department of Business and Professional Regulation (DBPR) Modular Building Insignia
  6. -Large Missile Impact Resistant per FBC 1626.2 Testing Requirements with Approval Numbers.
- B. Enclosure shall consist of a roof, two (2) side walls, two (2) end walls, and shall be manufactured of formed panel aluminum components. The enclosure is to be provided with a tiedown frame for securely attaching the entire structure to the concrete pad foundation as provided by the installing contractor.
- C. Roof, sidewalls and end walls shall be of formed 0.090 marine grade aluminum panel construction. The roof is to be bolted to both side and end walls to form a complete weather and wind resistance assembly.
- D. The radiator front face shall be sealed to the front wall utilizing a 2" minimum rubber gasket material to minimize recirculation of radiator air discharge and prevent the transmission of vibration from the packaged generator set to the enclosure.
- E. Wall framing shall be incorporated in the panels by forming an open back box structure. Skin material shall be minimum thickness .090" marine grade aluminum. Enclosure shall have a painted finish for maximum corrosion resistance. Exterior skin panels shall be integral to the wall structure and not separate pieces riveted onto framing members. Wall panels shall be no wider than 36" each and shall be removable without the use of special tools. Wall and roof panels shall be designed so that field replacement can be

- accomplished without disassembly of the entire structure if damage should occur. Provide rodent protection from entering from below or up through the fuel tank openings.
- F. A minimum of sixteen colors shall be available for enclosure exterior. Enclosure exterior color shall be WHITE unless otherwise specified.
  - G. Roof assembly shall be Cambered to aid in rain runoff. Roofs with thicknesses of less than 0.090" nominally shall not be considered. Roof assemblies are to be mechanically fastened to the vertical wall sections. Glued or crimped roofs shall not be allowed nor considered as an acceptable alternative.
  - H. Air handling shall be as follows: Air will enter the enclosure through a Hood, Plenum or Sound Attenuated Louvers/Baffles, as determined by the specific application and shall allow for at least 120% of total airflow demand for proper cooling to the generator set package. The cooling air Inlet system shall prevent water intrusion into the enclosure with the generator set operating at full rated load while allowing for a maximum air restriction of less than 0.25" H2O. Radiator discharge shall be through a gravity operated extruded aluminum backdraft type damper and into a vertical discharge plenum or hood. Discharge plenum/hood shall discharge air upward and be provided with a means to positively drain any and all water entering the discharge device. Air discharge devices shall in no event restrict airflow by more than 0.025" H2O. To ensure adequate airflow for cooling and combustion total static restriction over the entire system shall not exceed 0.50" H2O. Both Intake and Discharge shall be provided with removable bird/rodent screening to prevent the entrance of debris, birds, rodents and other vermin.
  - I. Acoustical insulation materials shall consist of a UL Classified Thermofiber® insulation material with a heat/fire resistance rating up to 2400° F and provide superior sound attenuation performance. Acoustical insulation material on interior roof and walls is to be mechanically held in place by 0.032" mill finished perforated aluminum with tuned engineered hole diameter for optimum sound attenuation at 1000 Hz. Interior perforated aluminum material shall protect the insulation material as well as allow noise to permeate the absorptive material.
  - J. Four-point lifting provisions shall be provided and have sufficient capacity suitable for rigging the entire assembly including all installed equipment.
  - K. A minimum of two (2) single personnel access doors shall be provided. Doors shall be manufactured of the same material as enclosure. Doors shall be fully gasketed to form a weather tight perimeter seal. Door hinges shall be full-length stainless steel piano type and shall be attached with stainless steel hardware. Door handles shall be of a corrosion resistant material and shall provide for a lockable, secure entry point into the enclosure. Doors shall be insulated with no less insulation than is provided in the enclosure walls for sound attenuation. Drip ledges are to be provided above each entry door and shall overhang the door on both sides by a minimum of 3".
  - L. Enclosure manufacturer shall provide all necessary hardware to internally or externally mount the exhaust silencer(s) specified herein. Silencer mounting hardware shall at all times maintain the Weather Resistant integrity of the enclosure system. If the silencer is mounted internally it will discharge upward into the radiator discharge plenum where possible, otherwise an aluminum rain collar and rain dress shield shall be provided by the enclosure manufacturer.
  - M. As a minimum the enclosure shall provide an average 15db(A) sound reduction as measured at one meter, five feet above grade level under free field conditions.
  - N. Enclosure must bear the Florida Department of Business and Professional Regulation (DBPR) Modular Building Insignia.
  - O. The Enclosure Components Shall be registered with the State of Florida and Have Approval Numbers to Certify the Enclosure Capable of Meeting the Requirements of the Florida Building Code for Large Missile Impact Resistance per Testing Section 1626.2.
  - P. Provide LED lighting (minimum 6 lights) with light switch at main door entrance. Wire all of the lights and the switch to a junction box at a location to be connected by the electrician on site. Also, provide a minimum of two emergency egress battery back-up type light fixtures (bug-eyes), and wiring them to the un-switched leg of the lighting circuit.
  - Q. Provide a minimum of one 20 amp, 120 volt, GFI receptacle inside the generator enclosure. Receptacle shall be field wired to a circuit by the field electrician.
  - R. Arrange for the exhaust muffler to exhaust in a direction free of any building air intake louvers. Provide additional piping and elbows as necessary.
  - S. Provide lightning protection air terminals on all four corners of the roof of the enclosure, and provide copper horizontal and down conductors to ground rods for lightning protection on the enclosure. Bond to stairs and fuel tank. Refer to specification 26 31 13.
  - T. Provide aluminum stairs, platform, and railings, on both sides of the generator enclosure for access to all doors. Provide for access to fueling and all areas of maintenance, and allow for all doors to fully open.

**PART 3 - EXECUTION**

**3.1 EXAMINATION:**

- A. Examine areas and conditions under which engine-generator and components are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

**3.2 INSTALLATION:**

- A. Install generator on minimum 3" high concrete pad as indicated on structural drawings. Install vibration isolation.
- B. The equipment shall be installed as shown on the plans, in accordance with the manufacturer's recommendations and all applicable codes. Except for the required field installation, and connections, the generator sets, transfer switches, and switchgear shall be shipped to the project site as a "single source" item for which responsibility for overall maintenance, spare parts, and service is available through a local factory distributor.
- C. Site Tests: An installation check, start-up, 100% load bank test, and building load test shall be performed by the manufacturer's local representative. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
  - 1. Fuel, lubricating oil, and antifreeze (liquid cooled models) shall be checked for conformity to the manufacturer's recommendations under the environmental conditions present and expected.
  - 2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. This shall include: engine heaters, battery charger, generator strip heaters, remote annunciator, etc.
  - 3. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.
  - 4. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown.\*Prior to this test, all transfer switch timers shall be adjusted for proper systems coordination. Engine temperature, oil pressure and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test.
  - 5. Test all transfer switch and paralleling gear sequences.
  - 5. Assist the Owner with the registration of the fuel tank. Schedule and perform all tests required by the DEP and EPA in the presence of any required inspectors.
  - 6. Provide load bank for a 100% load test after installation on both generators.
  - 7. Test ground fault indication, if applicable.
- D. Test all monitoring and annunciation equipment and obtain all DEP/EPA permits, inspections and approvals.

**END OF SECTION**

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## SECTION 26 3600 - AUTOMATIC TRANSFER SWITCHES

### AUTOMATIC TRANSFER SWITCHES ARE OWNER FURNISHED – CONTRACTOR INSTALLED

#### PART 1 - GENERAL

##### 1.1 SCOPE

- A. Install automatic transfer switches (ATS) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer of an entire ATS line from 30-4000 Amperes.

##### 1.2 CODES AND STANDARDS

- The automatic transfer switches and controls shall conform to the requirements of:
- A. UL 1008 - Standard for Transfer Switch Equipment
  - B. IEC 947-6-1 Low-voltage Switchgear and Controlgear; Multifunction equipment; Automatic Transfer Switching Equipment
  - C. NFPA 70, NFPA 99, NFPA 110
  - D. IEEE Standard 446
  - E. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches
  - F. UL 508 Industrial Control Equipment

##### 1.3 DRAWINGS AND MANUALS

- A. The ATS manufacturer shall provide the necessary interconnection diagrams for connecting the ATS's engine generator, and all other equipment related to the emergency generator system.
- B. Six (6) sets of instruction manuals and record drawings shall be furnished for the ATS's and their accessories.

##### 1.4 SUBMITTALS:

- A. Obtain a copy of the transfer switch manufacturer's submittal and shop drawings and coordinate all requires of the installation.

##### 1.5 ACCEPTABLE MANUFACTURERS

- A. Transfer switches are owner furnished, contractor installed.

#### PART 2 – PRODUCTS – FOR INFORMATIONAL PURPOSES ONLY

##### 2.1 MECHANICALLY HELD TRANSFER SWITCH

- A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
- B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
- C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
- D. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
- E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
- F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
- G. **Provide four pole, switched neutral transfer switches** as shown on the drawing. Switches shall be compatible with the GFI protection on the normal utility branch and the GFI indication on the emergency branch.

2.2 MICROPROCESSOR CONTROLLER

- A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate via Modbus RTU and an optional serial communication module.
- B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to  $\pm 1\%$  of nominal voltage. Frequency sensing shall be accurate to  $\pm 0.2\%$ .
- C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
- D. All customer connections shall be wired to a common terminal block
- E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility

2.3 ENCLOSURE

- A. The ATS shall be furnished in a NEMA type 3R enclosure unless otherwise shown on the plans.

2.4 BYPASS-ISOLATION SWITCH

- A. Internal manual emergency bypass only.

2.5 SERVICE ENTRANCE RATED

- A. Not required.

2.6 SURGE PROTECTION DEVICES

- A. Provide an internal, integral, factory supplied and installed power (408Y/277 volt, 3 phase, neutral, and ground) surge suppression device.
- B. Provide surge suppression devices on all external communications cabling circuits. Surge devices shall be installed inside the ATS.

**PART 3 – OPERATION**

3.1 CONTROLLER DISPLAY AND KEYPAD

- A. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters.
- B. All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.2 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

- A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Source	Dropout/Trip	Pickup/Reset
Undervoltage	N&E,3 s	70 to 98%	85 to 100%
Overvoltage	N&E,3 $\phi$	102 to 115%	2% below trip
Underfrequency	N&E $\phi$	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

- B. Repetitive accuracy of all settings shall be within  $\pm 0.5\%$  over an operating temperature range of  $-20^{\circ}\text{C}$  to  $60^{\circ}\text{C}$ .
- C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- E. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.



### 3.3 TIME DELAYS

- A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
- B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
- C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
- D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
- E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control.
- F. All time delays shall be adjustable in 1-second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
- G. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

### 3.4 ADDITIONAL FEATURES

- A. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.
- B. A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
- C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source. In addition provide contacts for source availability of both normal and emergency.
- D. LED indicating lights (industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
- E. LED indicating lights (industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
- F. Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
- G. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
- H. An in-phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents when transferring to or from the utility/normal power source do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer.
- I. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
- J. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
- K. System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.
- L. Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

- M. Communications Interface – The controller shall be capable of interfacing, through an optional serial communication module over Modbus.
- N. Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
  - 1. Event Logging
    - a. Data and time and reason for transfer normal to emergency.
    - b. Data and time and reason for transfer emergency to normal.
    - c. Data and time and reason for engine start.
    - d. Data and time engine stopped.
    - e. Data and time emergency source available.
    - f. Data and time emergency source not available.
  - 2. Statistical Data
    - a. Total number of transfers.
    - b. Total number of transfers due to source failure.
    - c. Total number of days controller is energized.
    - d. Total number of hours both normal and emergency sources available.
- O. Communications Module – An interface shall be installed in the ATS controller to enable Modbus communications. This module shall allow for the seamless integration of existing or new communication transfer devices.
- P. Ethernet Communication Card – Provide Ethernet Communication Card to allow for ATS monitoring of switch information including, time delays, switch position, source availability. Communication shall be connected to the SCADA network via RJ-45 Ethernet.
- Q. Provide all required communications to connect to the associated generators. ATS's shall be 100% compatible with the generators supplied.

#### **PART 4 - ADDITIONAL REQUIREMENTS**

##### **4.1 WITHSTAND AND CLOSING RATINGS**

- A. The ATS shall be rated to close on and withstand up to 25,000 AIC RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
- B. The ATS shall be UL listed in accordance with UL 1008 7th Edition and shall include short time based ratings

##### **4.2 TESTS AND CERTIFICATION**

- A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- B. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.
- C. Commissioning. The ATS's shall be commissioned with the UPS and generators in place and operational.

##### **4.3 SERVICE REPRESENTATION**

- A. Provide a minimum of three days (72 hours) of start-up services as required to commission, test and set-up the system, including all coordination with the generators.

##### **4.4 WARRANTY**

- A. The ATS shall be provided with the following warranty. Contractor shall provide the labor warranty.
  - 1. Two (2) Years Parts & Labor
  - 2. Includes parts, labor, and associated travel/lodging expenses if required.
  - 3. Five (5) Years Parts
  - 4. Ten (10) Years Main Contacts

##### **5.0 POWER MANAGER**

- A. Furnish load side ATS data monitors as shown to monitor all functions specified below.
- B. The Power Manager shall be accurate to 1% measured, 2% computed values and display resolution to .1%. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).
- C. Each Power Manager shall be capable of interfacing with an optional communications module to permit information to be sent to central location for display, analysis, and logging.
- D. The Power Manager shall be applied in 3-phase, three wire circuits. All CT's shall be mounted on the load side.

- E. All setup parameters required by the Power Manager shall be stored in non-volatile memory and retained in the event of a control power interruption.
- F. The following metered readings shall be communicated by the Power Manager, via serial communication, when equipped with optional serial communications module:
  - 1. Current, per phase RMS and neutral (if applicable)
  - 2. Current Unbalance %
  - 3. Voltage, phase-to-phase and phase-to-neutral
  - 4. Voltage Unbalance %
  - 5. Real power (KW), per phase and 3-phase total
  - 6. Apparent power (KVA), per phase and 3-phase total
  - 7. Reactive power (KVAR), per phase and 3-phase total
  - 8. Power factor, 3-phase total & per phase
  - 9. Frequency
  - 10. Accumulated Energy, (MWH, MVAH, and MVARH)
  - 11. Provide (8) solid state status inputs.
  - 12. Provide four (4) relay output contacts
- G. The Power Manager shall be equipped with a continuous duty, long-life, 4 line x 20 character LCD backlit display to provide local access to the following metered quantities
- H. Power Manager shall be provided with a Modbus output for interface with building Scada or BAS system.

**END OF SECTION**



## SECTION 26 4313 - SURGE PROTECTION DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes transient voltage surge suppressors for low-voltage (600Volts and below) power equipment
- B. Related Sections include the following:
  - 1. Division 26 Section "Wiring Devices" transient voltage surge suppressors.
  - 2. Division 26 Section "Panelboards"

#### 1.3 SUBMITTALS

- A. Must have ten day prior approval to submit on project.
- B. Request for submittals must be in writing and attached with independent documentation of the following items.
- C. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection notes, wire size and wiring diagram.
  - 1. SPD's with dimensions that exceed the available space to mount the device within the required maximum lead lengths will be rejected and not accepted. Verify maximum lead lengths can be met prior to bid.
- D. Equipment Manual: The manufacturer shall furnish an installation manual with installation notes, start-up and operating instructions for the specified system. Installation instructions shall clearly state whether the system requires an external overcurrent device to maintain the system's UL 1449 listing. SPD requiring external overcurrent devices are not acceptable.
- E. Verification that all SPD are UL 1449 4th Edition listed and rated with a 20kA (1n) nominal discharge rating for compliance to UL96A Lightning Protection Master Label and NFPA 780. Also provide UL 1449 4th Edition VPR showing the following maximum VPR (clamping voltage) as follows:
  - 1. 120Vsystem 600V (L-N)
  - 2. 277Vsystem 1200V (L-N)
- F. SPD manufacturer shall provide UL 4th Edition documentation as part of submittal.
- G. Manufacturer's Warranty Statement, showing a 10 year replacement warranty for modules or unit are damaged by transient voltages

#### 1.4 STANDARDS

- A. Underwriters Laboratories 1449 - (UL 1449 4th edition safety standard for surge protection devices – 2009)
- B. NEC article 285. National Electrical Code 2014 SPD shall be labeled with a minimum 200kAIC rating.
- C. NFPA 780 Standard for the installation of lightning protection systems
- D. UL96A - Lightning Protection System Master Label
- E. IEEE (Institute of Electrical and Electronic Engineering Inc.) C62.41.1 and C62.41.2 – 2002, IEEE C62.45 – 2002, IEEE C62.33 & C62.35
- F. All manufacturers must comply with above listed standards and any additions current revisions of industry standards. All products that do not comply with current industry standards will not be accepted.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.

#### 1.6 PROJECT CONDITIONS

- A. Placing into Service: Do not energize or connect service entrance equipment, panel boards, control terminals, or data terminals to their sources until the surge protective devices are installed and connected.
- B. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Maximum Continuous Operating Voltage (MCOV): Not less than 115 percent
  - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
  - 3. Humidity: 0 to 85 percent, non-condensing.
  - 4. Altitude: Less than 20,000 feet (6000 m) above sea level.

#### 1.7 COORDINATION

- A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

- B. Coordinate surge protective devices with Division 26 Section "Panelboards" and "Switchboards".

1.8 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer shall provide a product warranty for a period of not less than ten (10) years from date of installation. Warranty shall cover unlimited replacement of SPD modules during the warranty period. Those firms responding to this specification shall provide proof that they have been regularly engaged in the design, manufacturing and testing of SPD for not less than five (5) years.

**PART 2 - PRODUCTS**

2.1 ACCEPTABLE MANUFACTURERS

- A. PQ Protection
- B. ASCO/APT

2.2 SERVICE ENTRANCE SUPPRESSORS

<b>Panel Amperage</b>	<b>≥3,000Amps</b>	<b>2500-1600Amps</b>	<b>1200-400Amps</b>
<b>Service Entrance</b>	400kA/Modular	300kA/modular	200kA/modular

- A. Provide service entrance rated, UL Type 1 SPD's as shown and indicated on contract drawings.
- B. Minimum surge current ratings per phase shown above, three phase, wye systems per phase rating shall equal L-N and L-G modes added together. No other methods are acceptable for per phase surge current rating calculations.
- C. SPD's shall be a multi-stage parallel connected device.
- D. SPD's UL 1449 4th Edition VPR (clamping voltage) shall be a maximum rating of:
  - 1. 120Vsystem 600V (L-N)
  - 2. 277Vsystem 1200V (L-N)
- E. SPD's shall mount external to the panel; internally mounted SPD's are not acceptable.
- F. SPD voltages shall be verified by location on drawings, one-line diagrams and equipment schedules.
- G. SPD shall be modular design with field replaceable modules per phase and per mode.
- H. SPD shall have redundant status indicators on the front of the enclosure and shall monitor and indicate whether suppression capabilities have been compromised.
- I. SPD shall contain protective components that utilize multiple thermally protected metal oxide varistors (MOV) per mode.
- J. SPD's relying upon external and/or supplementary installed safety overcurrent protection do not meet the intent of this specification.
- K. SPD's that are limited to being connected to breaker whether or not an integral disconnect switch is supplied do not meet the intent of this specification.
- L. SPD's shall have an UL "In" rating (nominal discharge) of 20kA.
- M. SPD shall have dry contacts for remote monitoring via the Campus security system (Ademco panels). Coordinate the required contact type with the existing security panels.
- N. Service Entrance SPD's shall have audible alarms and surge counters.
- O. SPD's shall have a metal, NEMA 4 rated enclosure.
- P. SPD shall be designed and equipped with integral disconnecting means.
- Q. Protection modes: The SPD shall provide Line to Neutral (L-N) (Wye), Line to Ground (L-G) (Wye or Delta), Line to Line (L-L) (Delta) and Neutral to Ground (N-G) (Wye) protection.

2.3 DISTRIBUTION, BRANCH PANEL AND/OR AUXILIARY PANELS

<b>Panel Amperage</b>	<b>1200-800A</b>	<b>600A</b>	<b>400-100A</b>
<b>Distribution</b>	200kA	200kA	200kA
<b>Branch Panels</b>		100kA	100kA

- A. Provide UL Type 2 SPD's as shown and indicated on contract drawings. Any panel indicated to be 600 amp or larger, and any panel that is the service disconnect panel for the building shall be considered a "Distribution" type.
- B. SPD's minimum surge current ratings per phase shown above, three phase, wye systems per phase rating shall equal L-N and L-G modes added together. No other methods are acceptable for per phase surge current rating calculations.
- C. SPD's shall be a multi-stage parallel connected device.
- D. SPD's shall mount external to the panel; internally mounted SPD's are not acceptable.
- E. SPD voltages shall be verified by location on drawings, one-line diagrams and equipment schedules.

- F. SPD shall be a compact, non-modular design
- G. SPD shall have per phase status indicators on the front of the enclosure and shall monitor and indicate whether suppression capabilities have been compromised.
- H. SPD shall contain protective components that utilize multiple thermally protected metal oxide varistors (MOV) per mode.
- I. SPD's relying upon external and/or supplementary installed safety overcurrent protection do not meet the intent of this specification.
- J. SPD's shall have an UL "In" rating (nominal discharge) of 20kA.
- K. SPD shall have dry contacts for remote monitoring capabilities.
- L. SPD's shall have a metal, NEMA 4 rated enclosure
- M. Protection modes: The SPD shall provide Line to Neutral (L-N) (Wye), Line to Ground (L-G) (Wye or Delta), Line to Line (L-L) (Delta) and Neutral to Ground (N-G) (Wye) protection.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES**

- A. Review all installation information in manufacturer's installation manual prior to installing SPD's.
- B. Verify all voltages before connecting to avoid injury and damage to equipment.
- C. The SPD's shall be installed external to switchboard, distribution and panelboard.
- D. Internally mounted SPD's will not be accepted.
- E. The service entrance/switchboard/switchgear SPD's shall be installed with the shortest lead length possible and shall avoid any unnecessary or sharp bends. SPD's shall be connected to breakers with a 30 amp, 3 pole breaker for connection means.
- F. The distribution, panelboard and auxiliary SPD's shall be installed with the shortest lead length possible from the panel it is protecting and shall avoid any unnecessary or sharp bends. SPD's shall be connected to breakers with a 30 amp, 3 pole breaker for connection means.
- G. Ground resistance shall be 5 Ohms or less.
- H. Refer to manufacturer's installation manual for further installation details.

#### **3.2 FIELD QUALITY CONTROL**

##### **A INSTALLATION**

- 1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with manufacturers' installation instruction requirements and recommendations.

##### **B MANUFACTURERS FIELD SERVICE**

- 1. Engage a factory authorized service representative to inspect equipment installation. Report results in writing
- 2. Verify that electrical wiring installation complies with manufacturer's installation requirements.

**END OF SECTION**

