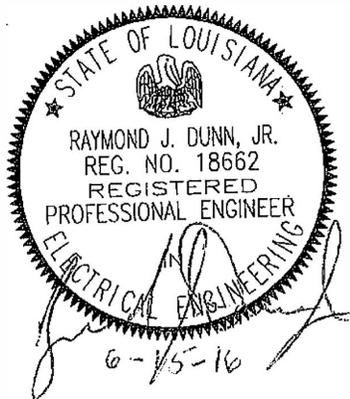


**LIFE SAFETY ELECTRICAL UPGRADES  
FOR UNITS 7B & 7C-PATIENT DORMITORIES  
CENTRAL LOUISIANA STATE HOSPITAL  
PINEVILLE, LOUISIANA**

DIVISION 16  
ELECTRICAL SPECIFICATIONS

SECTION 16050 BASIC ELECTRICAL MATERIALS AND METHODS  
SECTION 16402 INTERIOR DISTRIBUTION SYSTEM  
SECTION 16610 STANDBY DIESEL POWER SYSTEM



ELECTRICAL ENGINEER

Life Safety Electrical Upgrades  
for Units 7B & 7C - Patient Dormitories  
Central LA State Hospital  
Pineville, Louisiana

**SECTION 16050  
BASIC ELECTRICAL MATERIALS AND METHODS**

**PART 1 GENERAL**

**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

ASTM D 709 (2013) Laminated Thermosetting Material

**INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)**

IEEE C2 (2012; Errata 2012; INT 1-4 2012; INT 5-6 2013) National Electrical Safety Code

IEEE C57.12.28 (2005; INT 3 2011) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standard Terms

**NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)**

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA ICS 6 (1993; R 2011) Industrial Control and Systems: Enclosures

NEMA MG 1 (2011; Errata 2012) Motors and Generators

**NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)**

NFPA 70 (2011) National Electrical Code

**1.2 RELATED REQUIREMENTS**

This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

**1.3 DEFINITIONS**

- A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.
- C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

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#### 1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 277/480 volt, three phase, four wire, 60 Hz, and 120/208 volts three phase, four wire. Final connections to the power distribution system at the existing panelboards and new weatherheads shall be made by the Contractor as directed by the Design Professional.

#### 1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of the Submittals Section and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

##### A. Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

##### B. Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

##### C. Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

##### D. Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

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1. Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

2. Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Design Professional. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

E. Material and Equipment Manufacturing Date

Products manufactured more than three years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 QUALITY ASSURANCE

A. Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

B. Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

C. Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

D. Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

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E. Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

F. Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Design Professional.

### 1.7 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each panelboard, and transfer switch; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

### 1.8 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

## PART 2 PRODUCTS

Not used.

## PART 3 EXECUTION

### 3.1 PAINTING OF EQUIPMENT

A. Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

B. Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

### 3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets, or industrial adhesive.

**\*\*\* END OF SECTION \*\*\***

**SECTION 16402**  
**INTERIOR DISTRIBUTION SYSTEM**

**PART 1 GENERAL**

**1.1 REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

**AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)**

- ANSI C80.1 (2005) Electrical Rigid Steel Conduit (ERSC)
- ANSI C80.3 (2005) Steel Electrical Metallic Tubing (EMT)

**AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

- ASTM B 1 (2013) Hard-Drawn Copper Wire
- ASTM B 8 (2011) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- ASTM D 709 (2013) Laminated Thermosetting Materials

**INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)**

- NETA ATS (2013) Acceptance Testing Specifications

**NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)**

- NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
- NEMA ICS 1 (2000; R 2008; Errata 2010) Industrial Control and Systems; General Requirements
- NEMA ICS 4 (2010) Industrial Control and Systems: Terminal Blocks
- NEMA ICS 6 (1993; R 2011) Industrial Control and Systems: Enclosures
- NEMA KS 1 (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- NEMA MG 1 (2011; Errata 2012) Motors and Generators
- NEMA ST 20 (1992; R 1997) Dry-Type Transformers for General Applications
- NEMA TC 2 (2013) Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
- NEMA TC 3 (2013) Polyvinyl Chloride PVC Fittings for Use with Rigid PVC Conduit and Tubing
- NEMA TP 1 (2002) Guide for Determining Energy Efficiency for Distribution Transformers
- NEMA WD 1 (1999; R 2005; R 2010) General Color Requirements for Wiring Devices

NEMA WD 6 (2012) Wiring Devices - Dimensional Requirements

NEMA Z535.4 (2006; R 2011) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2011) National Electrical Code

NFPA 70E (2012; Errata 2012) Electrical Safety in the Workplace

UNDERWRITERS LABORATORIES INC. (UL)

UL 1 (2005; Reprint Jul 2012) Flexible Metal Conduit

UL 6 (2007; Reprint Nov 2010) Electrical Rigid Metal Conduit - Steel

UL 20 (2010; Reprint Feb 2012) General-Use Snap Switches

UL 50 (2007; Reprint Apr 2012) Enclosures for Electrical Equipment

UL 67 (2009; Reprint Jan 2013) Panelboards

UL 83 (2008) Thermoplastic-Insulated Wires and Cables

UL 360 (2013; Reprint May 2013) Liquid-Tight Flexible Steel Conduit

UL 467 (2007) Grounding and Bonding Equipment

UL 486A-486B (2013) Wire Connectors

UL 486C (2013) Splicing Wire Connectors

UL 489 (2013) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 506 (2008; Reprint Oct 2013) Specialty Transformers

UL 508 (2008; Reprint Oct 2013) Industrial Control Equipment

UL 510 (2005; Reprint Jul 2013) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

UL 514A (2013) Metallic Outlet Boxes

UL 514B (2012) Conduit, Tubing and Cable Fittings

UL 651 (2011; Reprint Mar 2012) Schedule 40 and 80 Rigid PVC Conduit

UL 797 (2007; Reprint Dec 2012) Electrical Metallic Tubing -- Steel

UL 869A (2006) Reference Standard for Service Equipment

UL 1242 (2006; Reprint Jul 2012) Electrical Intermediate Metal Conduit -- Steel

UL 1561 (2011; Reprint Sep 2012) Dry-Type General Purpose and Power Transformers

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## 1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein

### 1.3 SUBMITTALS: Submit the following:

#### A. Manufacturer's Catalog Data

1. Transformers

#### B. Drawings

1. Panelboards
2. Transformers

## 1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Design Professional.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

### 2.2 CONDUIT AND FITTINGS

Shall be rigid steel (zinc-coated) conduit, rigid nonmetallic conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT), flexible metal conduit, and liquid-tight flexible conduit, conforming to the following:

- A. Rigid Steel Conduit (Zinc-Coated): ANSI C80.1, UL 6.
- B. Rigid Nonmetallic Conduit: PVC Type EPC-40 in accordance with NEMA TC 2.
- C. Intermediate Metal Conduit (IMC): UL 1242, zinc-coated steel only.
- D. Electrical Metallic Tubing (EMT): UL 797, ANSI C80.3.
- E. Flexible Metal Conduit: UL 1.
  1. Liquid-Tight Flexible Metal Conduit, Steel: UL 360.
- F. Fittings for Metal Conduit, EMT, and Flexible Metal Conduit: UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.
  1. Fittings for Rigid Metal Conduit and IMC: Threaded-type. Split couplings unacceptable.
  2. Fittings for EMT: Steel or Die Cast compression type.

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G. Fittings for Rigid Nonmetallic Conduit: NEMA TC 3.

2.3 OUTLET BOXES AND COVERS: UL 514A, cadmium- or zinc-coated.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

A. Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

1. Minimum Conductor Sizes: Minimum size for branch circuits shall be No. 12 AWG.

B. Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

1. 208/120 volt, 3-phase (1) Phase A - black (2) Phase B - red (3) Phase C - blue
2. 480/277 volt, 3-phase (1) Phase A - brown (2) Phase B - orange (3) Phase C - yellow

C. Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

D. Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A-UL486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A-UL486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

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- A. Temperature Limitations: Contractor shall comply with the temperature limitations included in NEC Article 110-14(c). Ampacity rating of conductors shall be computed at the temperature rating of the equipment termination.
- B. Disconnect Switches: NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches.

## 2.7 PANELBOARDS

UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit of panelboard. Directories shall also indicate source of service (upstream panel, switchboard, motor control center, etc.) to panelboard. Type directories and mount in holder behind transparent protective covering.

### A. Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

### B. Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

- 1. Multipole Breakers: Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

## 2.8 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 1 enclosure. Transformer shall have 220 degrees C insulation system with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

## 2.9 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

## 2.10 NAMEPLATES

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

#### **A. Service Entrance Identification**

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

##### **1. Labels**

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

#### **B. Wiring Methods**

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits.

##### **1. Restrictions Applicable to EMT**

- a. Do not install underground.
- b. Do not encase in concrete, mortar, grout, or other cementitious materials.
- c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.
- d. Do not use outdoors.

##### **2. Nonmetallic Conduit**

- a. Restrictions applicable to PVC Schedule 40
  - 1) Do not use above slab or grade.

##### **3. Restrictions Applicable to Flexible Conduit: Use only as specified in paragraph entitled "Flexible Connections."**

##### **4. Underground Conduit**

Rigid steel; steel IMC; PVC, Type EPC-40. Convert nonmetallic conduit to rigid, or IMC, steel conduit before rising through floor slab or above grade.

#### **C. Conduit Installation**

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel

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with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

1. Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems must be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

2. Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3. Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200 pound tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

4. Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

5. Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for equipment subject to vibration, noise transmission, or movement. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquidtight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, or movement. Provide separate ground conductor across flexible connections.

#### D. Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, and when specifically indicated. Boxes in other locations shall be sheet steel. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

##### 1. Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet.

##### 2. Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

#### E. Mounting Heights

Mount panelboards, circuit breakers, and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor.

#### F. Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

#### G. Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

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H. Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. Make ground connection to driven ground rods on exterior of building.

1. Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Design Professional for further instructions.

I. Repair of Existing Work

Repair of existing work , demolition, and modification of existing electrical distribution systems shall be performed as follows:

1. Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

2. Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3. Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, back to equipment's power source as indicated.

4. Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

J. Panelboard Modifications

At the completion of the project, the Contractor shall provide a new typed index for all panels affected this work.

3.2 FIELD QUALITY CONTROL

A. Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

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**B. 600-Volt Wiring Test**

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

C. Transformer Tests: Perform test classified as routine in accordance with NEMA ST 20 on each transformer.

**D. Grounding System Test**

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall.

**\*\*\* END OF SECTION \*\*\***

**SECTION 16610**  
**STANDBY DIESEL POWER SYSTEM**

**PART 1 GENERAL**

1.1 SCOPE

- A. This Contractor shall furnish and install a complete extension to the existing standby diesel drive electrical power system consisting of new feeders and an automatic transfer switches which shall call for the generator to start up in the event of a power failure. The transfer switches shall be provided with load shedding capabilities.

1.2 SUBMITTALS

- A. Provide three sets of Engineering Submittals for approval, prior to production release, showing all components, in addition to the engine and generator. Submittals shall include compliance with these specifications.

**PART 2 PRODUCTS**

2.1 TRANSFER SWITCHES

- A. General: To be approved as a transfer switch manufacturer, the manufacturer shall have been regularly engaged in the production of UL 1008 listed transfer switches (that are brand names, documented, and offered for sale on the open market,) for a minimum of five (5) years, and shall provide factory trained parts and service support through a factory authorized distributor or service center that is regularly doing business in the area of the installation.
  - 1. The manufacturer shall supply printed literature containing diagrams, parts lists and description sufficient for the Owner's personnel, or subcontract supplier to install, operate, and perform normal service on the equipment.
- B. Ratings: All transfer switches shall be UL listed per standard 1008. Transfer switch supplied shall be suitable for use on emergency and legally required standby system in accordance with ANSI-C1, rated for total system load. Transfer switch shall be rated to carry 100% of rated current continuously in the enclosure. Transfer switches which must be derated when installed inside enclosure (due to integral over-current devices or any other reasons) do not meet this specification. Transfer switch shall be rated for continuous operation in ambient temperatures of -40°C to +67°C. Main power switch contact shall be rated for 600 V.A.C.
- C. Operation: The transfer switch automatically starts the generator on interruption of normal power and transfers the load circuits when the set reaches proper speed and voltage. When normal power is restored, the automatic switch transfers the load back to the line and stops the generator set. The source being connected to the load supplies the switching power. A time delay circuit shall be supplied to provide a transition between de-energizing the generator and engaging utility power on retransfer.
  - 1. Load Shedding Function: Transfer switches shall be provided with load shedding capability using three (3) CR2RL-151 (150:5) current transformers, and three (3) CR4395-EH-120-110-A-CD-ELR-1 current sensing relays with form C, normally open contacts, attached to the emergency power feeder within the generator's wiring compartment. The current sensing relays shall be connected in parallel to each transfer switch, and have trip setting adjusted to 80% of maximum generator rated output current. Tripping of the current sensing relays shall cause the transfer switches to operate from STANDBY to NORMAL position, so that the generator continues to run, providing power only to the existing emergency lighting transfer

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switches. A manual reset shall be required at the transfer switches if tripped by the current sensing relays. Utilized a load bank at the generator to adjust the current sensing relay trip setting.

2. Transfer Action: Switch shall feature two operating coils electrically interlocked to provide positive, electrically guided action from NORMAL to STANDBY position. A mechanical interlock mechanism shall be provided to prevent both sources from supplying the load simultaneously.
3. The transfer switch main contacts shall double break design, solid silver cadmium oxide, mechanically held on the line side, permitting the operating coil to be de-energized, eliminating AC hum or vibration. Contact pressure shall be maintained by coil springs not subject to weakening or distortion as part of the current path. Individual heat resistant contact chambers shall prevent cross arcing. All models shall be rated for all classes of load, both inductive and non-inductive, at 600 volts, 250 volts tungsten lamp load. NO DERATING.
4. Transfer switches shall be 125 amp, 3 pole, 277/480 volt.
5. Control Circuit: Start/stop circuit shall close the 2 or 3-wire remote circuit to start the standby set on interruption of normal line power and open the circuit again to stop the set on return of normal line power. Generator can have either 12 or 24 volt starting systems. Transfer switch pilot circuit shall initiate transfer to standby power when standby output reached approximately 90 percent of rated voltage. Line recovery contacts shall provide immediate retransfer to normal power if emergency power interrupts when supplying load, by bypassing time delay retransfer. Instant transfer relay to provide immediate retransfer to the line when normal power restores, eliminating the few seconds delay otherwise necessary for standby voltage to drop sufficiently. A test transfer switch shall simulate power outage. A terminal block shall be provided for remote test switch. A control circuit disconnect plug shall be provided for use when servicing control circuit of transfer switch which disconnects control circuits from the line without operating transfer switch.
6. The following relays shall be included: Adjustable solid state time delay start, time delay transfer, time delay retransfer, time delay stop, and adjustable solid state under-voltage sensors. Phase loss relay and generator pickup relay shall be included.
7. Enclosure: The transfer switch and control components shall be mounted in a single door enclosure, NEMA 1 construction, wiring space to comply with 2002 NEC Table 312.6(A). Meters and lamps are to be front mounted and readable with the cabinet closed. The cabinet is to be designed for wall mounting and will be provided with padlock hasps.
8. Normal and emergency lights shall be included.

### **PART 3 EXECUTION**

#### **3.1 TESTING**

- A. Prior to acceptance of the equipment, it shall be tested to show it is free of any defects and will start automatically.

#### **3.2 START-UP**

- A. Start-up and Instructions: On completion of the installation, the start-up shall be performed by the engine manufacturer's trained dealer service representative. Operating and maintenance instruction manuals shall be supplied and procedures explained to operating personnel.

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### 3.3 WARRANTY

- A. Equipment furnished under this section shall be guaranteed against defective parts and workmanship under terms of the manufacturer's and dealer's standard warranty and shall include parts, labor and travel time for necessary repairs at the jobsite.

**-- END OF SECTION --**