

SECTION 16000

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section includes specifications for furnishing and installation of all electrical systems, including the checkout and startup of the systems.

1.02 GENERAL

- A. Provisions specified in this Section apply to all Division 16, Electrical.
- B. The types of systems covered by this Section include AC normal and emergency power supply equipment; railroad signals, train control, and communications; station lighting, communications, and amenities; fire alarm systems; and power supply to HVAC systems. Systems include electrically driven motors and pumps.
- C. The general extent of the electrical work includes furnishing and installing the following items:
 - 1. Raceways, conduit, junction boxes, wire, cable and connectors required to inter-connect and place all equipment in complete operation.
 - 2. Power distribution systems, overcurrent protection, load transfer switches, electrical panels and switchboards, fused and unfused disconnects, receptacle outlets, switching, and circuits as indicated on the Contract Drawings.
 - 3. Complete grounding systems.
 - 4. Site electrical service conduits, equipment pads, manholes, handholes, splice boxes, excavation, trenching, backfill, and compaction.
 - 5. Lighting including fixtures, lighting poles, outlets, switching, and circuits.

1.03 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

1.04 DESIGN REQUIREMENTS

- A. Design anchorage and secure electrical equipment in accordance with applicable code. In addition, design anchorage and secure equipment to withstand a lateral force of 0.6 times the weight of the equipment, if such requirement is more stringent.

- B. Size conduits, raceways, and junction boxes with minimum 20 percent spare or expansion capacity.
- C. Locate electrical equipment in a manner suited to the application and install per the original equipment manufacturers' (OEM) recommendations and applicable code.
- D. Provide circuit schedule for all lighting and power panel boards.
- E. Unless designed or rated for exterior use or provided with its own housing or enclosure, install electrical equipment in a manner such that it is adequately protected from the local environment (such as rain and dust). Provide temperature controls (ventilating fans or air conditioning) in the enclosed space if the temperature will exceed the OEM recommended operating temperatures.

1.05 SUBMITTALS

- A. Material List: Submit list of materials and equipment proposed for use in the work. Except as specified herein for "rough-in" materials, submit complete list at one time and include all proposed alternatives.
 - 1. Include name of manufacturer and where applicable, brand name, type and/or catalog number of each item. Do not list more than one manufacturer for any one item of equipment. Do not list items "as specified", without both make and model or type designation.
 - 2. "Rough-in" materials, such as conduit, fittings, junction boxes, 600V power conductors, and outlets, need not be included in the Material List, provided that these items are as specified and are listed by UL.
- B. Shop Drawings and Descriptive Data: As soon as practical after submission of Material List, submit shop drawings and descriptive data of equipment listed hereinafter, and the required wiring diagrams. Include copies of catalog cuts including complete description, information, and performance data.
- C. Panelboard Directories: Submit for approval.
- D. Calculations: Submit structural calculations showing that equipment anchorage will withstand applicable lateral force. Submit other calculations as specified in individual Sections. Calculations shall be signed and sealed by professional engineer licensed in the State of California.
- E. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces according to applicable code and other Contract requirements, whichever is most stringent. Include the following:
 - 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. The term "withstand" means the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event.
 3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Qualifications: Submit evidence of qualifications of electrical field engineer.
- G. Test Procedures: Submit test procedures for testing electrical equipment installation and operation.
- H. Test Reports: Submit test reports within 30 days of completion of test.

1.06 PROJECT RECORD DOCUMENTS

- A. Refer to Section 01720, Contract Record Documents, for general requirements. Mark Project Record Documents daily to indicate all changes made in the field.
1. In addition, indicate on Contract Drawings any changes on equipment locations and ratings, trip sizes and settings on magnetic-only circuit breakers, alterations in raceway runs and sizes, changes in wire sizes, circuit designations, installation details, one-line diagrams, control diagrams and schedules.
 2. Accurately record on Contract Drawings the actual locations and exact routing of duct bank. Locate underground conduit stubbed-out for future use, underground feeder conduits, and feeder pull box locations using building lines.
 3. Show pull box number, conduit layout with number of bends, total number of cables and wires in each conduit, and indicate spare or empty conduits.
 4. Use same symbols as used on Contract Drawings.

1.07 REGULATORY REQUIREMENTS

- A. Comply with the following codes and regulatory requirements:
1. California Code of Regulations (CCR)
 2. California Public Utilities Commission (CPUC) General Orders and Regulations
 3. Institute of Electrical and Electronics Engineers (IEEE):
IEEE C2 National Electrical Safety Code

4. National Fire Protection Association (NFPA):
NFPA 70 National Electrical Code (NEC)

1.08 QUALITY ASSURANCE

- A. Field Engineer: Provide a qualified field engineer with a minimum of 10 years of experience in the installation of electrical equipment and systems. The Field Engineer shall perform the following:
 1. Prepare detailed Shop Drawings. Review submittals prior to submitting to the Engineer.
 2. Inspect equipment for compliance with specified requirements and accepted Shop Drawings at worksite.
 3. Prepare field inquiries and work to resolve identified field issues related to installation of electrical equipment and systems.
 4. Prepare and coordinate approval with the Engineer any recommended field modifications to controls and equipment received at Worksite.
 5. Oversee and monitor electrical work installation, and design and installations of temporary electrical systems in accordance with NFPA 70.
 6. Perform or witness specified field tests.
 7. Interpret Contract Documents for subordinates.
 8. Witness vendor equipment performance tests and inspection.
 9. Identify and track work non-conformances and assist with corrective action to remove non-conforming work.
- B. Equipment shall be standard products of manufacturers regularly engaged in the production of such equipment and material. In addition to the requirements for an "equal" specified under the General Provisions, for a standard product to be considered an equal to equipment specified, such products shall have been proven in commercial service for a period of at least two years.

1.09 COORDINATION WITH OTHER WORK AND UTILITIES

- A. Review civil, architectural, and structural Contract Documents. Plan work to conform to conditions shown and specified to provide the best assembly of the combined work.
- B. Work out "tight" conditions in advance.
- C. Where the work of several trades is involved, coordinate all related work to provide each system in complete and proper operating order.

- D. Coordinate electrical service with utility company, including design and installation of load transfer equipment. Verify with the utility company the available fault current at the incoming service connection point and provide appropriately rated service equipment and overcurrent protection devices.
- E. Verify with the phone company their requirements and identify interface points prior to start of work.

PART 2 - PRODUCTS

2.01 NAMEPLATES

- A. Equipment Labels and Nameplates:
 - 1. Construction: Laminated phenolic plastic, black front and back, white core, with lettering etched through outer covering. Use 3/16 inch high lettering at push button stations, thermal overload switches, receptacles, wall switches, and similar devices, where nameplate is attached to device plate. Use 1/4 inch high lettering at all other locations, unless otherwise specified or detailed. Engraving directly on device plates with black enamel filled lettering is acceptable in lieu of separate plastic nameplates. Motor nameplates may be of nonferrous metal, 0.03-inch thick minimum, die stamped.
 - 2. Inscription: If detailed on the Contract Drawings, use inscription exactly as shown; otherwise, describe adequately function or use of equipment involved.
 - a. For Panelboards and Switchboards: Include panel designation, voltage and phase of supply, e.g., "Panel A, 480/277 V, 3 ph."
 - 3. Provide nameplates on the following equipment:
 - a. Metered service pedestal, meter/main service boxes, service switchboards, panelboards, push button stations, control panels, time switches, disconnect switches, thermal overload switches.
 - b. Circuit breakers, contactors, or relays in separate enclosures.
 - 4. Fasteners for Nameplates: No. 4 Phillips round head, cadmium plated steel, self-tapping screws, or nickel-plated brass bolts.
- B. Circuit Panelboard Directories: Create directory after balancing panel board loads. Provide neatly typed schedule (odd numbered circuits on left side, even on right side) under plastic jacket or protective cover to protect the schedule from damage or dirt. Securely mount on inside face of panelboard door. Briefly and accurately define nature of connected load. Do not use sequentially numbered schedules.
- C. One-Line Diagram: Provide approved "one line" for the "As-Built" distribution system.

- D. Empty Conduits: Provide tags with typed description of purpose and location of opposite end, wired to each end of conduits.

PART 3 - EXECUTION

3.01 GENERAL

- A. Fasten nameplates securely to equipment.
- B. Provide pull rope in all conduits, including spare conduits.

3.02 VOLTAGE CHECK

- A. At completion of job, check voltage at several points of utilization on the system that has been installed under this Contract. During test, energize all loads installed.
- B. Set taps on transformers to give proper voltage, which is 118 to 122 volts for 120-volt nominal systems and proportionately equivalent for higher voltage systems.
- C. If proper voltage cannot be obtained, inform the Engineer.

3.03 FIELD QUALITY CONTROL

- A. Perform tests, in accordance with approved procedures, to prove installation is in accordance with contract requirements. Perform tests in presence of the Engineer, and furnish test equipment, facilities, and technical personnel.
- B. Request for Tests: Notify the Engineer a minimum of 24 hours in advance of tests. In the event the Engineer does not witness the test, certify in writing that all specified tests have been made in accordance with the specifications.
- C. Deficiencies: Immediately correct deficiencies, which are evidenced during the tests and repeat tests until system is approved. Do not cover or conceal electrical installations until satisfactory tests are made and approved.
- D. Tests:
 - 1. Test panel and circuits for grounds and shorts with mains disconnected from feeder, branch circuits connected, circuit breakers closed, all fixtures in place and permanently connected, without lamps, and all switches closed.
 - 2. Test each individual circuit at the panel with equipment connected for proper operation.
 - 3. Ground tests:
 - a. Ground tests shall meet requirements of CCR, Title 24.

- b. Perform fall-of-potential test or alternative in accord with IEEE 81 on the main ground electrode or system.
- c. Perform point-to-point tests to determine resistance between main ground system and all major electrical equipment frames, system neutral, and/or derived neutral points.
- d. Test Values: Resistance between main ground electrode and ground shall be no greater than 25 ohms. Additional rods shall be installed and bonded to grounding system and driven to a depth of 50 ft. or refusal, whichever comes first. Investigate point-to-point resistance values that exceed 0.5 ohm.
- e. Record all test values and submit certified copies to the Engineer.

4. Cables:

- a. Make insulation resistance tests on all power cables, using a self-contained instrument such as the direct-indicating ohmmeter of the generator type, or "megger" such as manufactured by J.G. Biddle Company or equal. Insulation resistance values shall be at least 75 percent of shop test records.
- b. Apply the following test voltages for one (1) minute, except where specified otherwise herein, in accord with procedure recommended by manufacturer of test equipment and as specified herein.

Rated Circuit Voltage	Megger Voltage (DC)	Min. Megger Reading
600 Volts	500 Volts	600 Kilo-ohms

- c. Record all test values and submit certified copies to the Engineer.
- d. Replace cables not meeting specified resistance values.

3.04 CLEANING

- A. After other work such as sanding, painting, and similar work has been completed, clean lighting fixtures, panelboards, switchboards, and other electrical equipment to remove dust, dirt, grease, or other marks, and leave work in clean condition.

END OF SECTION