

Section 16010

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. General:

1. The CONTRACTOR shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, installation, testing, and operation of all electrical work and appurtenant work necessary to provide a complete and operable system, all in accordance with the requirements of the Contract Documents.
2. The provisions of this Section shall apply to all electrical items specified in the various sections of Division 16 and all other divisions specifying electrical items of these Specifications, except where otherwise specified or shown in the Contract Documents.

B. Responsibility:

1. The CONTRACTOR shall be responsible for:
 - a. Complete systems in accordance with the intent of these Contract Documents.
 - b. The CONTRACTOR shall coordinate the details of facility equipment and construction for all Specification divisions which affect the work covered under Division 16, Electrical.
 - c. The CONTRACTOR shall furnish and install all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
 - d. The CONTRACTOR shall lay out electrical work prior to placing floors and walls to properly locate all penetrations, and shall furnish and install all sleeves and openings required for passage of all raceways.
 - e. The CONTRACTOR shall furnish and install all inserts and hangers required to support raceways and other electrical equipment and materials.
 - f. The CONTRACTOR shall notify the ENGINEER in writing 48 hours in advance of energizing any new electrical equipment. If the energization is rescheduled later than 48 hours from the originally scheduled time, a new notification shall be made. The CONTRACTOR shall not proceed without approval from the ENGINEER.

- g. Temporary Power.: The CONTRACTOR shall furnish, install and maintain all temporary power and lighting systems needed for construction. This temporary system shall include weatherproof panel(s) for the CONTRACTOR's main circuit breakers and power distribution system, and ground fault interrupting equipment. All connections shall be watertight with wiring done with Type SO portable cable as a minimum. The CONTRACTOR shall remove all temporary power equipment and devices after construction is completed.
- h. Electrical System Protective Device Coordination: During the Contract period, the ENGINEER shall perform a preliminary and a final coordination study to determine the proper settings for all protective relays, circuit breakers and fuses. This study may include all devices starting at the utility service, and including the secondary devices on all transformers, and extending to include all feeder and branch circuits, including low-voltage circuits from 120 V to 480 V. This study may be completed for both short-circuit and ground fault protective devices. The CONTRACTOR shall provide complete cooperation to the ENGINEER to support any such effort.

C. Existing Conditions:

- 1. The electrical drawings were developed from past record drawings and information supplied by the DISTRICT. Contractor shall field verify the existing conditions.
- 2. Carry out any work involving the shutdown of existing services to any piece of equipment now functioning or the tie-in of equipment to the existing system at such time as to provide the least amount of inconvenience to the DISTRICT. Do such work when directed by the ENGINEER.
- 3. Construction Coordination and Electrical Downtime: See the General Requirements of these Specifications regarding scheduling of electric power interruptions.
 - a. Before any work is performed in manholes containing medium voltage circuits, these circuits shall be de-energized. All such efforts must be coordinated with the ENGINEER.
 - b. After award of Contract, confer with ENGINEER to verify each area of construction activity and location of existing underground utilities. Protect all existing underground utilities during construction.
- 4. No work shall be started that involves the existing electrical system without first obtaining and completing all coordination forms required by the facility. All such coordination forms shall be submitted with drawings and procedures showing information about what, where, why and how the work will be done in accordance with the General Requirements.
- 5. Prior to starting any underground work the CONTRACTOR shall obtain all the information of the underground utilities or obstructions from the ENGINEER and take proper precautions to locate the utilities by potholing or other approved means.

6. The Contract Documents are not intended to show every offset and fitting, or every structural and mechanical obstruction that will be encountered during the installation of the work. The alignment of equipment and raceways shall be varied due to architectural changes, or to avoid work of other trades. Electrical system installations shall be integrated with all existing facilities and the work of other disciplines in this Contract. Accommodation of existing conditions and conditions developed by the CONTRACTOR shall be at no extra cost to the DISTRICT.
7. All raceway sizes and numbers of cables and conductors in each raceway, as shown on the Contract Documents, may vary in accordance with actual field conditions and equipment installed. The CONTRACTOR shall make all changes required at no extra cost to the DISTRICT. See Section 16220, Electric Motors, of these Specifications for additional requirements for motor installation.
8. The equipment to be furnished under this specification shall meet the seismic requirements outlined in Chapter 23 of the Uniform Building Code, for Occupancy Category I, Essential Services, in Seismic Zone 4.
9. All electrical equipment and materials shall be capable of operating successfully at full-rated load, without failure, at an ambient temperature of 40°C (104°F). All materials installed in tunnels shall be suitable for outdoor wet/corrosive area installation.
10. A Material Safety Data Sheet (MSDS) shall be provided for each type of paint solvent, cleaner, oil, etc. supplied. See Section 09900, Coating Systems, and Division 01, General Requirements, Environmental Controls, of these Specifications for reporting requirements.

D. Intent of Drawings:

1. Electrical plan drawings show only general locations of equipment, devices, and raceway, unless specifically dimensioned. The CONTRACTOR shall be responsible for the proper routing of raceway, subject to the approval of the ENGINEER.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. All electrical equipment and materials shall be designed, manufactured and installed in accordance with the latest published edition of the applicable standards of the following standards making organizations. Specific standards are identified in the various sections for specific types of equipment and materials.

IEEE	Institute of Electrical and Electronic Engineers (IEEE)
ANSI	American National Standards Institute (ANSI)
NEMA	National Electrical Manufacturers Association (NEMA)
ASTM	American Society for Testing and Materials (ASTM)

ICEA	Insulated Cable Engineers Association (ICEA)
NETA	International Electrical Testing Association (NETA)
NECA	National Electrical Contractors Association (NECA)
AEIC	Association of Edison Illuminating Companies (AEIC)
UL	Underwriters Laboratories, Inc. (UL)
FM	Factory Mutual Research Corp. (FM)
CSA	Canadian Standards Association (CSA)

B. Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the applicable requirements of the National Electric Code (NEC); provided, where a local code or ordinance is in conflict with the NEC, the provisions of said local code ordinance shall take precedence.

C. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these Specifications.

1. Codes and Standards: Electrical work, including connection to electrical equipment integral with mechanical equipment described elsewhere in these Specifications, shall be performed in accordance with the latest published edition of the following codes:

NEC	National Fire Protection Association (NFPA) –70 National Electrical Code (NEC), latest adopted edition.
CCR	Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders, California Code of Regulations.
CCR	Title 24, Part 3, State Electrical Code, California Code of Regulations (CCR),
UBC	Uniform Building Code (UBC)

2. Any county or municipal codes, where applicable

3. Commercial Standards:

Material, equipment, construction, installation, and testing procedures shall conform to applicable standards of NEMA, ANSI, and IEEE, except where modified or supplemented by these Specifications.

- D. All equipment furnished by the CONTRACTOR shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, and (UL) or of an independent testing laboratory acceptable to the ENGINEER.
 - 1. Identification of Listed Products: Electrical equipment and materials shall be listed for the purpose for which they are to be used by an independent testing laboratory. Three such organizations are Underwriters Laboratories (UL), Factory Mutual Research Corp. (FM), and Canadian Standards Association (CSA). Independent testing laboratories are acceptable to the ENGINEER.
- E. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the Cal-OSHA Safety orders (Title 8, CCR), State Building Standards, and applicable local codes and regulations.

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with the GENERAL REQUIREMENTS.
- B. The CONTRACTOR shall submit complete material lists for the work of this Section. Such lists shall state manufacturer and brand name of each item or class of material. The CONTRACTOR shall also submit shop drawings for all grounding work.
- C. Shop drawings are required for materials and equipment listed in this and other sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
 - 1. Front, side, and rear elevations, footprints, top views, and internal component layout with dimensions
 - 2. Location and size of conduit entrances and access plates
 - 3. Component data
 - 4. Elementary diagrams, electronic diagrams, block and logic diagrams, panel layouts, and interconnection diagrams
 - 5. Method of anchoring and embedded structural members; weight
 - 6. Finish
 - 7. Nameplates
 - 8. Temperature limitations, as applicable
 - 9. Rating of equipment as per specifications and drawings
 - 10. NEMA rating of enclosures
 - 11. Approved listing
 - 12. Recommended spare parts lists as described below.

- D. Catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass-produced, non-custom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.
- E. Manuals: The CONTRACTOR shall furnish manuals as specified under Operation and Maintenance Manuals of the General Requirements.
- F. CONTRACTOR shall show depths and routing of all concealed below-grade electrical installations as required in Division 01 "General Requirements" of the these specifications.
- G. The CONTRACTOR shall submit as part of the shop drawings a list of recommended spare parts for each piece of equipment according to the provisions of Shop drawing Submittals of the General Requirements. The DISTRICT will order appropriate spare parts for use after acceptance of the facilities. The CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.
1. During the term of this Contract the CONTRACTOR shall notify the ENGINEER in writing about any manufacturer's modification of the identified spare parts, such as part number, interchangeability, model change or others.
- H. The CONTRACTOR shall coordinate all necessary material and equipment inspection and testing with the DISTRICT as specified under Samples and Tests of the General Requirements and Section 16080, Electrical Testing.
- I. The CONTRACTOR shall clearly state deviations from the specifications and/or drawings on the first page of the submittal.
- J. In addition to the basic information described in "Control of Work" of the General Requirements, the CONTRACTOR shall submit the following drawings, catalog sheets, device specifications, etc.:
1. Shop Drawings. The CONTRACTOR shall review the Contract Documents and request any clarification before submitting shop drawings. Shop drawings of all electrical equipment, cable, devices, etc. shall be submitted as a complete submittal, and shall meet the requirements of the Contract Documents.
 2. Catalog sheets for conduits, conduit fittings, boxes, enclosures, cable tray, cable, relays, pushbuttons, receptacles, face plates, circuit breakers, motor starters, contactors, touchplate controls, lighting fixtures, transformers, panelboards, switchboards, switchgear, etc. shall be submitted with the required specification data to substantiate that each item meets the requirements of the Contract Documents.
 3. All control panel equipment submittals shall include: dimensional equipment arrangement drawings, including plan, side and elevation views, layout, electronic diagrams, block and logic diagrams, interconnection diagrams and all item locations, designations, and a complete nameplate, material, and item list with part number, manufacturer, and description; control panel elementary (schematic) diagrams.

Control panel elementary diagrams shall be based on the contract drawings and shall show all control items, wire numbers, terminal numbers, interconnections with external control items, designation of each item, and line numbers; control panel wiring (connection) diagrams showing all connections, devices, terminal numbers, wire size, and item designations. These diagrams should show the various components in their relative physical location.

Refer to Sections 16442, Control Panels, and 17405, Process Instrumentation and Control, of these Specifications as applicable. Also adhere to the following:

- a. Drawing sheet sizes shall be 8½" x 11", 11" x 17", 17" x 22", or 22" x 34". Maximum drawing sheet size shall be 22" x 34". All drawings shall be legible when printed as half-size drawings.
 - b. Develop a grounded neutral from the secondary side of the control power transformer when 120VAC control voltage is utilized.
 - c. Show fuse sizes and transformer VA on the elementary diagram.
 - d. The conductor identification shall be the rung number of the first rung which depicts the wire. Where more than one conductor identification is required for a rung, the conductor identification shall be the rung number of an adjacent rung.
4. All medium- and high-voltage (5 kV, 15 kV and higher) class equipment and all (both low- and medium-voltage) motor control center (MCC), panelboards, switchgear, variable frequency drives, and similar equipment submittals shall include: outline drawings showing installed devices, major features, and required minimum clearances; front and side elevation views; elementary diagrams; connection diagrams differentiating between factory and field installed wiring; detailed one-line and three-line diagrams; material lists (bills of material); interconnection diagrams; nameplate schedules; certified test reports of all factory tests performed; and operating and service manuals for all breakers, meters, switches, relays, including all special tools, handles, cranks, spring charging motors, etc. required.
 5. Contract circuit number designations shall be included on all shop drawing one-line, three-line diagrams and control elementary (schematic) diagrams, wherever these circuits appear.
 6. Information required by the ENGINEER to perform preliminary and final coordination studies is specified in Section 16431, Electrical Systems Analyses and Measurements, of these specifications.

1.4 QUALITY ASSURANCE

A. General:

1. Field Control of Location and Arrangement: The drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items only. Exact locations shall be determined by the CONTRACTOR in the field based on the physical size and arrangement of equipment, finished elevations, required clearances and other obstructions.

Locations shown on the drawings, however, shall be adhered to as closely as possible.

2. All conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown. Where the drawings do not indicate exact locations, the CONTRACTOR shall submit proposed locations to the ENGINEER for review. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the DISTRICT.
3. Workmanship: All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer which have been reviewed by the ENGINEER. The installation shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
4. All work, including installation, connection, calibration, testing, and adjustment, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
5. Protection of Equipment and Materials: The CONTRACTOR shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until acceptable to the ENGINEER..
6. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
7. The CONTRACTOR shall replace or have refinished by the manufacturer, all damaged materials or equipment, including faceplates of panels and switchboard sections, at no expense to the DISTRICT.
8. Tests: The CONTRACTOR shall make all tests as specified. All such tests shall be performed in the presence of the ENGINEER. The CONTRACTOR shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. Operational testing shall be performed on all equipment furnished and/or connected in other sections of Division 16 Electrical, and all other divisions specifying electrical items including furnishing of support labor for testing.
9. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted to the ENGINEER for review prior to final acceptance of the project.
10. Any test failure shall be corrected in a manner satisfactory to the ENGINEER.

11. Factory-trained technical service representatives shall adjust, calibrate, repair, replace, modify, etc. all faulty electrical equipment installed until after reliability test of the system is completed as per the contract and is accepted by the ENGINEER. Factory technical service representatives and electricians shall be provided during start-up of all systems.

B. Area Designations:

1. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the Contract Documents as defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.

a. **General Purpose Dry Locations:** ~~Unless specified otherwise in the product-specific specification section, the enclosures in dry locations shall be NEMA 1 gasketed exclusively for electrical rooms and NEMA 12 for all other general purpose dry locations, unless otherwise noted.~~ DRY locations are specifically called out in the Contract Documents. ~~Unless specified otherwise in the product specific specification section, the enclosures in dry locations shall be NEMA 1 gasketed for exclusively electrical rooms and NEMA 12 for all other general purpose dry locations. The areas that are not designated as "DRY" and not designated as hazardous shall be deemed as "Corrosive and Wet Locations" and shall comply with the requirements specified below. The areas designated as hazardous, are hazardous in addition to "Corrosive and Wet Locations".~~

b. **Corrosive and Wet Locations:** ~~Corrosive locations indoors and outdoors shall have stainless steel threaded hardware; all other electrical hardware, fittings, and raceway systems shall be PVC-coated. Enclosures shall meet NEMA Type 4X 316 stainless steel requirements, unless otherwise noted.~~ Outdoor Locations: ~~In outdoor locations, raceway shall comply with Section 16130, Raceway Systems and Pull Boxes; entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel. Mounting brackets shall be galvanized. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets, panels, shall be NEMA 4 for non-corrosive areas and NEMA 4X for all other outdoor areas in accordance with the respective specification sections. Enclosures shall be mounted 1/4-inch from walls to provide an air space, unless specifically shown otherwise.~~

c.

Area	NEMA Designation
Trickling Filter Pump Station Pump Room	Wet and Corrosive Area
Trickling Filter Pump Station Electrical Room	General Purpose Dry Location
Trickling Filters	Wet and Corrosive Area
PEDS	Wet and Corrosive Area
Blower Room	Wet and Corrosive Area
WS Pump Station Pump Room	Wet and Corrosive Area

Area	NEMA Designation
SC/SR Reactors	Wet and Corrosive Area
TFPDS Pump Station	Wet and Corrosive Area
ML Channel	Wet and Corrosive Area
Clarifiers	Wet and Corrosive Area
RSS Pump Station C Electrical Room	General Purpose Dry Location
RSS Pump Station Pump Rooms	Wet and Corrosive Area
Clarifier Metering Vault	Wet and Corrosive Area
Chemical Areas	Wet and Corrosive Area
SE Flow Meter Vault	Wet and Corrosive Area
Distribution Center J Building	General Purpose Dry Location
Existing Service Center Building	General Purpose Dry Location
Outdoor Locations	Wet and Corrosive Area
Existing Electrical Rooms	General Purpose Dry Location
Vaults or Manholes	Wet and Corrosive Area
Tunnels	Wet and Corrosive Area
All Other Locations	Wet and Corrosive Area

- d. ~~Corrosive and Wet Locations: Corrosive locations indoors and outdoors shall have stainless steel threaded hardware; all other electrical hardware, fittings, and raceway systems shall be PVC coated. Enclosures shall be of fiberglass reinforced polyester and meet NEMA Type 4X requirements.~~

C. Cleanup:

1. In addition to the requirements of Environmental Control of the General Requirements,, all parts of the materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
2. During the progress of the work, the CONTRACTOR shall clean the premises and shall leave the premises and all portions of the site free of debris.
 - a. Cleanliness and Housekeeping: In each room and area that work is performed, the CONTRACTOR shall clean each piece of new and modified electrical equipment, both inside and outside, and retouch the equipment to match the existing paint. The intent of this requirement is to ensure that all electrical equipment, including panelboards, MCCs, switchgear, and control panels are in new condition, and to leave this equipment safe for operators and maintenance personnel.

D. Shop Inspection:

1. All electrical materials and equipment shall be subject to shop inspection and factory witness test by the ENGINEER or representative of a testing agency.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Unless otherwise indicated, provide all new materials and equipment, free from any defects, in unblemished condition, and suitable for the space provided. Provide materials and equipment listed by UL wherever standards have been established by that agency.
- B. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment of the same manufacturer are preferred.
- C. All electrical equipment shall be approved by a testing laboratory recognized by the ENGINEER and shall conform to all applicable requirements of the Contract Documents.

2.2 STANDARD PRODUCTS

- A. Unless otherwise indicated, provide materials and equipment, which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.
- B. Materials and Equipment: All materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Contract Documents shall be new and unused, of current manufacture, and of highest grade consistent with the state-of-the-art. Damaged materials, equipment, and parts are considered to be used and will not be accepted. All equipment and materials shall be of a proven type, and shall have a minimum of one year in service experience in similar service to that utilized in the Contract. No prototype equipment shall be installed. In addition, no equipment that is being phased out of manufacture by the supplier shall be installed during the Contract period.
- C. The fabricator of major equipment assemblies, such as distribution panelboards, switchgear, MCCs, etc. shall also be the manufacturer of the major devices or components contained therein.

2.3 EQUIPMENT FINISH

- A. Provide materials and equipment with manufacturers' standard finish system, in accordance with Division 9 Finishes. Provide manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with Division 9, Finishes with ANSI No. 61, light gray color.

2.4 OUTDOOR EQUIPMENT

- A. Provide equipment and devices to be installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 30 degrees F to 120 degrees F.

2.5 HAZARDOUS AREAS (NOT USED)

2.6 SPECIAL TOOLS

- A. The CONTRACTOR shall provide all special tools required for operation and maintenance of the equipment. The tools shall be considered as part of the product and become the property of the DISTRICT.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work, which has a neat and finished appearance. Carry out work in accordance with NECA Standard of Installation unless otherwise specified.
- B. Coordinate electrical work with the ENGINEER and work of all other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the plant during construction.

3.2 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturers' recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls. Provide temporary heating, sufficient to prevent condensation, in transformers, switchgear, switchboards, motors, and motor control centers, which do not have space heaters.
- B. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the CONTRACTOR'S convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure that adequate protection from these atmospheres is provided that is acceptable to the ENGINEER. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Energize all space heaters furnished with equipment.

3.3 SHIPMENT, STORAGE AND PROTECTION OF EQUIPMENT

- A. All indoor electrical panels, switchgear, MCCs, switchboards, control equipment, etc. shall be shipped in sealed dust- and moisture-proof plastic sheet enclosures. The equipment shall be stored in a weatherproof building until installed, and the sealed shipping enclosure shall be maintained at all times. The equipment shall always be protected with plastic sheet covers until all construction and installation work is complete within the area. This protection shall prevent dust, paint spray, water, etc. from entering the equipment or causing damage to the components or finished surfaces.

- B. Condensation shall be prevented at all times. Electrical equipment provided with space heaters shall have the space heater power supply wiring extended to the outside of the equipment protective covering. Space heater power shall be energized from a temporary power source during storage and installation until the permanent source of space heater power is connected and energized. This temporary power source shall be from the CONTRACTOR's temporary power system as described elsewhere in this Section and not the DISTRICT's electric power distribution panels.
- C. All exterior surfaces that are damaged, scratched, etc. shall be repaired and painted with matching paint as supplied by the manufacturer. The touch-up paint application shall not be obvious.

3.4 MATERIAL AND EQUIPMENT INSTALLATION

- A. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between the manufacturers' instructions, codes and regulations, and these Contract Documents, follow ENGINEER's decision. Keep copy of manufacturers' installation instructions on the jobsite available for review at all times.
- B. Use appropriate conduit and conductor entry fittings with enclosures, which maintain the specified enclosure environmental capability after proper installation.
- C. Motor Installation
 1. The CONTRACTOR shall verify all actual motor full-load and locked-rotor current ratings. The minimum necessary equipment, wire, cable and conduit sizes are shown on the Contract Documents. If the CONTRACTOR furnishes equipment with different ratings, the CONTRACTOR shall determine the actual current rating of each motor, and furnish the appropriate motor branch circuit conductor size, the appropriate motor branch circuit overcurrent protective devices (circuit breaker or motor short-circuit protector) size, the appropriate motor branch circuit overcurrent protection setting, the appropriate motor branch circuit running overload protection, and the appropriate motor starter size. Affected conduits shall be increased in size as necessary.
 2. The motor branch circuit conductors shall have a current carrying capacity of not less than 125 percent of the actual full-load current rating of the motor. The size of the motor branch circuit conductors shall be such that the voltage drop from the motor branch circuit overcurrent protective device (breaker or motor short-circuit protector) to the motor shall not be greater than two percent when the motor is running at full-load and rated voltage.
 3. The motor branch circuit overcurrent protective device (circuit breaker or motor short-circuit protector) shall not operate in less than 30 seconds on the locked-rotor current of the motor. This device is intended to protect the motor, motor control device, and branch circuit conductors against overcurrent due to short-circuit or ground faults. The motor control circuits shall have the type of overcurrent protection indicated on the Contract Documents.

4. The motor branch circuit running overload protection devices shall operate in 20 seconds or less at motor locked-rotor current to protect the motor from damage under stalled rotor conditions. The motor branch circuit running overload protection devices shall be rated or selected to trip the motor at no more than 125 percent of the motor full-load current rating for motors marked to have a temperature rise not over 40°C or a service factor not less than 1.15. The motor branch circuit running overload protection devices shall be rated or selected to trip at no more than 115 percent of the motor full-load current for all other motors.
5. The motor starter size shall be coordinated with the current rating and horsepower size of the installed motor per NEMA standards.

D. Equipment Installation

1. All equipment shall be anchored to supporting members by bolts or other connections to accommodate all operating forces and all forces determined by the design requirements of the UBC, Chapter 23, for Occupancy Category I, Essential Services, in Seismic Zone 4. Equipment shall be secured in accordance with the manufacturer's recommendations. Embedded channel shall be installed to anchor enclosures as shown on the Contract Documents. The CONTRACTOR shall submit structural calculations for seismic restraint.
2. As a minimum, each transformer mounted on a floor or concrete pad, floor-mounted switchgear section, motor control section, variable frequency drive section, control panel or other similar equipment shall have at least one ½-inch stainless steel concrete anchor installed in each corner. Equipment shall be installed level and aligned in place. Voids shall be filled with grout. Openings through slabs under equipment shall be sealed around conduit with grout, synthetic rubber sealing compound or other approved means. Conduit passing through these openings shall be sealed with an approved conduit sealant. All floor-mounted electrical equipment shall be installed on a concrete pad at least 4 inches in height above the floor, or as noted on the Contract Documents. Transformers shall be installed with a containment structure adequate for all oil fill.

Where practicable, and in accordance with manufacturer's instructions, switchgear, transformers, MCCs, variable frequency drives, control panels and other similar equipment shall be secured to channels embedded in or surface-mounted to the finished floor.

Holes made in existing or new structures to accommodate electrical installations shall be neatly formed without rough edges. Repairs to damage caused during installation shall be made to the satisfaction of the ENGINEER.

- E. Torque on Conductor Terminations: After installation and before energizing electrical equipment, each bolted bus and cable connection shall be torqued to the manufacturer's recommendations. This includes each bolt at each connection, both factory and field installed, for MCCs, variable frequency drives, bus ducts, switchgear, and other similar equipment.

3.5 REMOVAL OR RELOCATION OF MATERIALS AND EQUIPMENT

- A. Where existing materials and equipment are removed or relocated, remove all materials no longer used such as studs, straps, conduits, and wires. Remove or cut off concealed or embedded conduit, boxes, or other materials and equipment to a point at least 3/4-inch below the final finished surface.
- B. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface in a neat and workmanlike manner. Follow any specific instructions given under Division 9, Finishes. Utilize skilled craftsmen of the trades involved.

3.6 CUTTING AND PATCHING

- A. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of ENGINEER. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to original condition. Utilize skilled craftsmen of the trades involved. Carefully coordinate all duct bank penetrations into buildings with Structural and Mechanical drawings to avoid piles, other structural members, and piping.

3.7 LOAD BALANCE

- A. The drawings and specifications indicate circuiting to electrical loads and distribution equipment. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, etc.

3.8 PHASING SEQUENCE

- A. Coordinate motor phasing checks with the INSPECTOR and the CONTRACTOR responsible for the driven equipment. Submit a written report to the INSPECTOR for each motor verifying that phasing has been checked and corrected.

3.9 CLEANING AND TOUCHUP PAINTING

- A. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove all materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the INSPECTOR.
- B. Painting:
 - 1. Electrical equipment such as transformers, switchgear, MCCs, control panels, panelboards, switchboards, etc. shall be painted by the manufacturer with a corrosion-resistant coating system suitable for a wastewater treatment plant environment and shall not be repainted by the CONTRACTOR, except for touch-up paint to repair damage to the factory finish. Color shall be ANSI No. 61, light gray exterior and white interior unless otherwise indicated.

2. Two one-pint spray cans of each coating used shall be furnished for each freestanding panel assembly.

3.10 HAZARDOUS AREAS (NOT USED)

3.11 INSPECTION

- A. Allow materials, equipment, and workmanship to be inspected at any time by the ENGINEER. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the ENGINEER.

3.12 SERVICE CONTINUITY

- A. Maintain continuity of electric service to all functioning portions of the process or buildings to include the existing Electric Service Center (ESC), existing Operations/Control Building, and Distribution Center H (P2-66) during hours they are normally in use. Temporary outages will be permitted during cutover work at such times and places as can be prearranged with ENGINEER and the electric utility company providing service to the facility. Such outages shall be kept to a minimum number and minimum length of time. Make no outages without prior written authorization and notification of the ENGINEER. Include all costs for temporary wiring and overtime work required in the Contract price. Remove all temporary wiring at the completion of the work.

3.13 CHECKOUT AND STARTUP

- A. During checkout and startup of the various plant systems, provide a crew of skilled craftsmen to be available for checkout and troubleshooting activities as required by the ENGINEER. Since coordination with other crafts and contractors will often be required, the craftsmen assigned to checkout must be available outside normal working hours when necessary. Coordinate and provide per GENERAL REQUIREMENTS, Section 01810, Commissioning, and Section 17405, Process Instrumentation and Control.

3.14 TESTS

- A. General: Carry out tests specified hereinafter and as indicated under individual items of materials and equipment specified in other sections.
- B. Operations: After the electrical system installation is completed and at such time as the ENGINEER may indicate, conduct an operating test for approval. Demonstrate that the equipment operates in accordance with the requirements of these specifications and drawings. Demonstrate that protective functions are operating properly and are properly incorporated in control system, circuit breaker, and motor control center circuitry. Perform the test in the presence of the ENGINEER. Furnish all instruments and personnel required for the tests.

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