

UPDATE LOG FOR TECHNICAL PROVISIONS

Date	Item(s) Changed	Page
08/2021	<p>TECHNICAL PROVISIONS DIVISION 6 – ELECTRICAL SPECIFICATIONS</p> <p>The entire technical provisions document has been revised. Please replace the entire document dated 10/12 with the attached document dated 08/2021</p> <p>The font and format throughout the entire document has been revised to reflect that of the new branding.</p>	All
08/2021	<p>DIVISION 6 – ELECTRICAL SPECIFICATIONS</p> <p>The following sections have been revised:</p> <ul style="list-style-type: none"> 6.1.5 Record Drawings 6.1.8 Shop Drawings and Catalog Data 6.1.10 Utility Service Facilities 6.1.11 Grounding 6.1.12 Housekeeping Pad 6.1.13 Conductor and Equipment Identification 6.1.14 Finish 6.2.1 General 6.2.2.2 Installation 6.2.3.1 Material 6.2.5 Conduit Fittings 6.2.6 Process Control Devices 6.2.6.1 Pressure Switches 6.2.76 Test, Inspections, Clean-up, and Spares 6.3.2.1 General 6.3.2.3 Motor Control Equipment 6.3.2.4 Magnetic Starter Unit 6.3.2.6 Control Devices 	<ul style="list-style-type: none"> 6-2 6-3 6-5 6-6 6-7 6-8 6-9 6-10 6-12 6-13 6-14 6-16 6-17

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DIVISION 6

ELECTRICAL SPECIFICATIONS

6.1 Electrical Work - General

6.1.1 Scope

This section of the Specifications describes the material, management, and methods to be utilized by the Contractor for the installation of the work and systems described in other Sections.

The work includes the work of the Sections listed below, as well as the connection of equipment furnished under Sections not specifically mentioned herein. The work includes all appurtenances required for a complete facility ready for service.

- a. Section 6.2 - Power, Lighting, and Other Electrical Systems
- b. Section 6.3 - Distribution and Motor Control Equipment

6.1.2 Submittals

6.1.2.1 Contractor shall submit with his bid the following:

- a. Four (4) copies of outline drawings and basic material lists.

6.1.2.2 Prior to fabrication or manufacture of any selected electrical component, Contractor shall submit the following to Owner:

- a. Informational shop drawings within three (3) weeks of award. Switchboard shall not be shipped until informational drawings have been returned to the vendor and corrections made to the equipment. Seven (7) copies of as-built drawings shall be shipped with the switchboard. Informational drawings shall include anchoring requirements, stub-up locations, schematic and wiring diagrams showing wire number assignments, and material lists.

6.1.3 Codes and Standards

All equipment and materials shall conform to and be underwritten in the latest revision of the following standards:

- a. National Electrical Code
- b. Institute of Electrical and Electronic Engineers (IEEE)
- c. National Electrical Manufacturers Association (NEMA)
- d. Underwriters' Laboratories (UL)
- e. Insulated Power Cable Engineers Association (IPCEA)
- f. American Society for Testing and Materials (ASTM)

All electrical equipment and materials and the design, construction, and installation thereof, shall comply with all applicable provisions of the OSHA Safety and Health Standards (29CFR1910 and 29CFR1926, as applicable), NFPA Section 110.16 Hazard Warning, State Building Standards, and applicable local codes and regulations.

Where the Contract Documents require a higher degree of workmanship or better quality of material than implied by the above Codes and Standards, then the Contract Documents shall prevail.

6.1.4 Working Drawings

The electrical Drawings constitute an integral part of this Contract and serve as the working drawings. They indicate general arrangements and locations.

All items not specifically shown on the Drawings, but obviously required to obtain a workable installation, shall be included.

6.1.5 Record Drawings

In addition to the record drawing requirements, the Contractor shall show depths and routing of all concealed below-grade electrical installations. This set of record drawings shall be available to the Owner's Representative during construction. After final inspection, the Contractor shall transfer all record drawings information to a set of reproducible tracings and a set of electronic drawings in an AutoCad format, which shall then be delivered to the Owner.

6.1.6 Equipment, Materials, and Workmanship

It is the intent of the Contract Documents to establish quality standards for all equipment and materials and to require first-class workmanship in order to facilitate trouble-free operation and minimum maintenance of the project.

All equipment and materials shall be new, shall be listed by UL and shall bear the UL label where UL requirements apply. All equipment and materials shall be products of reputable, experienced manufacturers. Similar items in the project shall be the products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction, shall be of sturdy design and manufacture, and shall be capable of long, reliable, trouble-free service.

All work, including installation, connection, testing, and adjustment, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The final completed installation shall display superior work, employing industrial standards and methods.

6.1.7 Testing

The Contractor shall perform on-site tests, in the presence of the Owner's Representative, to demonstrate compliance with the requirements of this Specification; submittal procedure shall be as required for shop drawings. Such testing shall include:

- a. Testing for the ground resistance value specified under Grounding;
- b. Insulation resistance tests, as specified under Wire and Cable;
- c. Operational testing of all equipment furnished and/or connected in Sections 6.2 and 6.3; and
- d. Standard test reports for mass-produced equipment shall be submitted with the shop drawing for such equipment; test reports or testing specifically required for individual pieces of equipment shall be submitted and approved prior to final acceptance of the project.

6.1.8 Shop Drawings and Catalog Data

All submittals required by this Section shall be made in accordance with the General Conditions.

Within thirty-five (35) days after execution of the contract, the Contractor shall submit complete material lists for the work of this Section. Such lists shall state manufacturer and brand name of each class of material.

Shop drawings are required for material and equipment, which are listed in the appropriate sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material for the intended use and for compliance with this Specification; data shall include:

- a. Front, side, rear elevations, and top views;
- b. Location of conduit entrances and access plates;
- c. Component data;
- d. Connection diagrams, terminal diagrams, internal wiring diagrams, conductor size, etc.;
- e. Method of anchoring, weight;
- f. Finish; and
- g. Nameplates.

Catalog data shall be submitted to supplement the shop drawings. Catalog cuts, bulletins, brochures or the like, or photocopies of applicable pages thereof, or shop drawings, 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, and the model number and options shall be marked in space designated for such data in the stamp.

6.1.9 Area Designation

6.1.9.1 Wet Location

In this area classification, raceway shall be rigid steel PVC coated conduit; entrances shall be threaded; fittings shall have gasketed covers; and covers shall be vertical or preferably horizontal at a low point to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel; mounting brackets galvanized. Attachments or assembly by welding must be galvanized after fabrication. Control cabinets, panels, and motor control equipment located outdoors shall be "Weatherproof."

6.1.10 Utility Service Facilities

Electric service to the facility will be by Southern California Edison Company. Service and metering installation shall comply with their requirements. All cable charges and other connection charges levied by the utility shall be borne by the Owner. Contractor shall furnish and install all materials and devices that are shown on the Drawings and as required by the electric utility company. Excavation and backfill of trenches shall also be by the Contractor.

Facilities provided for telephone service shall comply with the requirements of the utility and as specified herein:

- a. The sum of the bends in any section of conduit shall not be greater than one hundred eighty (180) unless specified, or through mutual agreement; otherwise, a suitable pullbox shall be provided. (Conduit access fittings shall not be used).
- b. Underground telephone conduit placed in the same trench with electric light or power conduit shall be separated by not less than twelve (12) inches when surrounded by earth. The separation may be reduced to three (3) inches if the conduits are separated by concrete and if the power conductors operate at less than 750 volts.
- c. Underground conduit shall have a minimum cover of twenty-four (24) inches unless specified otherwise.
- d. Telephone outlet locations shall be verified with the Owner before installation.
- e. A galvanized pull wire no smaller than a No. 12 AWG wire or a 3/16-inch polypropylene pull cord shall be left in each conduit from end to end.

6.1.11 Grounding

All raceways and conduits shall have a ground wire. Ground continuity throughout the facility shall be maintained by installing an electrically continuous grounding conductor. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. All raceway containing d-c conductors operating at more than 50 volts to ground and any a-c conductors shall contain a copper grounding conductor either bare, or green if insulated; such conductor shall be bonded to terminal and intermediate metallic enclosures.

Metal equipment platforms that support any electrical equipment shall be bonded to the switchgear ground bus; this grounding requirement is in addition to the raceway grounding required in the preceding paragraph.

Ground rods shall conform to UL Specification 467 and shall be 3/4-inch copperclad steel, sectional-type, joined by threaded copper alloy couplings. Locations shall be as shown on the drawings; length of rods forming an individual ground array shall be equal in length and of a length as required to obtain a maximum ground resistance of 5 ohms. Top of ground rod shall be fitted with a coupling and steel driving stud. Rods and fittings shall be Copperweld, Blackburn, Weaver, or equal.

Connection to ground electrodes and ground conductors shall be exothermic welded where concealed and shall be bolted pressure-type where exposed. Connectors shall be of copper alloy and shall be made up wrench-tight.

Grounding cable shall be copper and sized in accordance with Code requirements, when not sized on the Drawings.

Insulated grounding bushings shall be employed for all grounding connections to steel conduits in motor control equipment and elsewhere where conduits do not terminate at a hub or a sheet metal enclosure.

Where insulated bushings are required, they shall be installed in addition to double lock-nuts.

6.1.12 Housekeeping Pad

Concrete housekeeping pad is required for floor-standing electrical equipment. Housekeeping pad shall be two (2) inches above surrounding finished grade unless otherwise shown and shall be two (2) inches larger on each end and the back of the panel and extend thirty-six (36) inches in front of the panel than the supported equipment unless otherwise shown, including future units, as shown on the Drawings. The front step shall be sloped 2 percent to provide drainage away from the panel.

6.1.13 Conductor and Equipment Identification

Completed electrical installation shall be provided with adequate identification to facilitate the proper control of circuits and equipment and to reduce maintenance effort.

The Contractor shall assign to each control wire and cable a unique identification number. This number shall be assigned to all conductors having common terminals and shall be shown on all shop drawings. These numbers shall appear within three (3) inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, or signal purposes, or connect switch or relay contacts, or relay coils.

- a. The method of identification shall be durable, smudge and fade resistant, imprinted heat shrink tubing.
- b. Multi-conductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number will form a part of the individual wire number. Individual control conductors shall all be identified at pull points as described above.

All 480/277-volt system feeder cables and branch circuit conductors shall be color coded as follows:

Brown, Phase A
Orange, Phase B
Yellow, Phase C
Natural Gray, Neutral.

120/240-volt system conductors shall be color coded as follows:

Black, Phase A
Red, Phase B
Blue, Phase C
White, Neutral.

Color coding tape shall be used where colored insulation is not available. For sizes larger than #2 awg, the branch circuit switch shall be yellow. Insulated ground wire shall be green, and white for neutral. Color coding and phasing shall be consistent throughout the site, with bus bars at panelboards, and the motor control center shall be connected by Phase A-B-C, top to bottom, or left to right facing connecting lugs.

Motor Control Cabinet (MCC) and Field Conductors

- a. General purpose a-c control conductors shall be red. General purpose d-c control conductors shall be blue.
- b. All spare conductors shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

- c. Nameplates shall be provided for panelboard, panel, starter, switches, pushbutton stations, etc. In addition to the nameplates shown on the Drawings, control devices shall be equipped with standard collar-type legend plates, as required.
- d. Control devices within enclosures shall be identified, in accordance with the Drawings; identification shall be on the mounting plate and shall be similar to the above paragraph.
- e. Terminal strips shall be identified by imprinted labels, attached under the terminal strip.

6.1.14 Finish

Enclosures shall be finished in accordance with the manufacturer's standard procedures; finish color shall be ANSI 61. Contractor to submit color chart for District selection.

6.2 Power, Lighting and Other Electrical Systems

6.2.1 General

The work of this Section shall comply with all applicable provisions of Section 6.1, Electrical Work, General.

This Section sets forth specific requirements for:

- a. Raceway
- b. Conductors
- c. Panelboards
- d. Level, flow, switches
- e. Combination starter
- f. Wiring devices
- g. Finish plates
- h. Outlet and junction boxes

6.2.2 Raceway

6.2.2.1 Material

Raceway shall be rigid steel conduit, unless indicated otherwise. All rigid steel sweeps and conduits shall be full weight, mild steel, hot-dip galvanized and bichromate-coated inside and outside after galvanizing. All steel conduit installed in direct contact with earth and in concrete slabs on grade shall be corrosion protected using PVC coated rigid steel. Corrosion-protected conduit shall be left exposed until inspected and approved by the Engineer.

Flexible metallic conduit shall be fabricated from galvanized interlocked steel strip. Liquid-tight flexible metallic conduit shall have an extruded polyvinylchloride (PVC) covering of the flexible steel conduit. Plastic liquid-tight, flexible conduit shall be UV proof and maintain grounding continuity with a ground wire.

Raceway, which is required to be corrosion protected, shall have a PVC jacket. PVC-jacketed conduit shall be Underwriter's Laboratories listed and all conduit, prior to crating, shall conform to Federal Specification WW-C-581d, ANSI rigid steel conduit specification C80.1-1959, and to Underwriter's Laboratories specifications. The zinc surfaces of the conduit shall remain intact and undisturbed on both the inside and the outside of the conduit through the preparation and application processing. A PVC coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.04 inch (40 mils). A PVC jacketed coupling shall be furnished with each length of conduit. A PVC sleeve equal to the O.D. of conduit shall extend 1½ inches from each end of coupling.

6.2.2.2 Installation

Raceway shall be installed in the locations shown on the Drawings with due regard to field conditions and the work of other trades. Raceway system shall be electrically and mechanically completed before conductors are installed. Bends and offsets shall be smooth and symmetrical and shall be accomplished with tools designed for the purpose intended. Factory elbows shall be used for all 3/4-inch conduit; bends in larger sizes of metallic conduit shall be accomplished by field bends or factory elbows.

Empty conduit terminations not in pullboxes shall be plugged. Exposed raceway shall be installed perpendicular or parallel to building lines. Conduit shall be supported by two-hole straps where concealed and one-hole cast clamps elsewhere at intervals specified by the National Electric Code. Conduit shall be terminated with flush couplings at exposed concrete surfaces. Conduit stubbed up for floor-standing equipment shall be placed in strict accordance with approved shop drawings. Metallic raceway installed below-grade or in wet locations and in concrete shall be made up with conductive waterproof compound applied to threaded joints. Note: See Section 3 of the Special Provisions for an approved compound.

Flexible liquid-tight conduit shall be used for the connection of equipment such as motors, transformers, and valves subject to vibration or movement during normal operation or servicing. Flexible conduit may be used in lengths as required for the connection of recessed lighting fixtures; otherwise, the maximum length of flexible conduit shall be thirty-six (36) inches. Flex conduits shall be by a manufacturer, as shown in the District's Approved Materials List.

6.2.3 Wire and Cable

6.2.3.1 Material

Conductors, including ground conductors, shall be copper. Insulation shall bear manufacturer's trademark, type and voltage rating, conductor size, and be rated for a minimum of 90° C. Wire and cable shall be product of a manufacturer, as shown in the District's Approved Materials List.

Cable assembly and cable testing shall comply with applicable requirements of IPCEA Publication No. S-66-524, S-61-402, S-18-81 and other relevant IPCEA publications. Factory test results shall be submitted similar to shop drawings, prior to shipment of cable. Testing shall include a field testing of insulation resistance and a d-c high potential test; such testing shall be accomplished by a test organization sponsored by any of the cable manufacturers stipulated in the District's Approved Materials List.

Control wire shall be stranded, coated copper machine tool grade UL, Type MTW. Conductors No. 14 and larger shall have 3/64-inch thick insulation. Wire shall be rated at 600 volts at 60 C in wet locations.

Motor feeder conductors shall have type RHW-USE insulation, 600-volt. All other wire shall be 600-volt, type THWN. All wire shall be stranded, not solid.

6.2.3.2 Installation

Conductors shall not be pulled into the raceway until:

- a. Raceway system has been inspected and approved by the Owner's Representative;
- b. Plastering and concrete have been completed in affected areas;
- c. Raceway system has been freed of moisture and debris;
- d. Install all cables complete with proper terminations at both ends. Check and correct for proper phase sequence and proper motor rotation. Check for proper control connection. All electrically common wires shall have the identical wire tag number at all points and ends.
- e. Pulling:
 1. Use insulating types of pulling compounds containing no mineral oil.
 2. Pulling tension shall be within the limits recommended by the wire and cable manufacturer.
 3. Use a dynamometer where mechanical means are used.
 4. Cut off section subject to mechanical means of gripping and pulling.
- f. Bending Radius: Limit to six (6) times cable overall diameter.
- g. Slack: Provide maximum slack at all terminal points.

Conductors No. 1 and smaller shall be hand-pulled; larger conductors may be installed using power winches. Wire pulling lubricant, where needed, shall be UL-approved. Wire in panels, cabinets and gutters shall be neatly grouped, using nylon tie straps and fanned out to terminals.

6.2.4 Splices and Terminations

Control conductors shall be spliced or terminated only at the locations indicated on the drawings and only on terminal strips or terminal lugs of vendor furnished equipment. For the purposes of this portion of the Specification, "control conductors" are defined as conductors operating at 120 volts or less in circuits that indicate equipment status or that control the electric energy delivered to a power-consuming device.

All 120/240-volt and 480-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the Contractor and approved by Engineer. Motor feeder conductors shall be spliced only at motor terminal boxes and motor starter terminal lugs.

600-volt branch circuit conductors, No. 8 and larger, shall be spliced or terminated with approved compression connectors. These splices shall be insulated with two (2) layers of Scotch tape or equivalent by Plymouth, or equal. Conductors smaller than No. 8 may be spliced with approved pre-insulated springs connectors. Conductors of these types may be terminated on termination lugs or screws normally furnished with vendor-furnished equipment.

Control conductors shall be terminated under terminal screws with approved pre-insulated fork tongue lugs.

Control devices, such as solenoid operated valves, that are normally supplied with conductor pigtailed, shall be terminated, as described for control conductors.

Splices in 600-volt wire and cable which are not pre-insulated shall be taped with two (2) layers, each layer half-lapped, of Scotch No. 33 tape, or equal.

Splices to motor leads in motor terminal boxes shall be taped with Scotch 69 with first layer reversed adhesive side out high-temperature vinyl tape. This shall be over-taped with a layer of Scotch 23 rubber tape. This shall be over-taped with a Scotch 33+ high temperature vinyl tape.

6.2.5 Conduit Fittings

Fittings shall comply with the same requirements as the raceway with which they will be used. Fittings for use with rigid steel conduit shall be cast malleable iron metal. Such fittings, larger than one (1) inch, shall be "mogul size." Covers of fittings shall be closed with gaskets. Surface mounted cast fittings, housing wiring devices in outdoor and damp locations, shall have mounting lugs.

Insulated bushings shall be an approved molded plastic or malleable iron with insulating ring.

Insulated grounding bushings shall be an approved malleable iron with insulating ring and with ground lug.

Approved Erickson couplings shall be used at all points of union between ends of rigid steel conduits which cannot be coupled; running threads and threadless couplings shall not be used.

Approved liquid-tight fittings are described in the District's Approved Materials List.

Hubs, for threaded attachment of steel conduit to enclosures, are described in the District's Approved Materials List.

6.2.6 Tests, Inspections, Clean-up, and Spares

The Contractor shall furnish the labor and equipment to perform the testing described herein; testing shall be accomplished in the presence of the Owner's Representative and shall encompass the following:

- a. Constant speed motor pump system, including automatic start-up and shut-down.
- b. Remote and local controls of all motors and solenoids. Prior to testing of completed systems, or subsystems, the Contractor shall adjust soft starts and variable frequency drives. Adjustment of valve limit switches shall be accomplished under the supervision of a representative of the valve manufacturer.
- c. Rotation of motors.
- d. Resistance to ground of transformer neutrals and switchgear ground bus.
- e. Ground fault tripping shall be tested by using a separate calibrated source of ground current.
- f. Prior to the final or "green tag" electrical inspection, the contractor shall remove all junction box, conduit, switch gear inspection plates, and motor termination box covers. After inspection and approval by the Owner's Representative the contractor shall replace all covers and plates.
- g. During the final or "green tag" electrical inspection, the representatives for the contractor and/or electrical sub-contractor shall be present and shall make available all working drawings.

The project will be subject to continual inspection during construction, but particular attention will be placed on wire terminators, identification, setting of overload devices, cleanup, and record drawings.

Interior and exterior surfaces shall be cleaned of oil, grease, dirt, plaster, concrete, etc.; surface scratches shall be repaired to match factory finishes. Panel board and starter interior shall be vacuum-cleaned. Pullboxes interiors shall be free of all dirt and debris. Cleaning referred to herein describes the condition of equipment at the time of final inspection.

6.3 Distribution and Motor Control Equipment

6.3.1 General

The work of this Section shall comply with all applicable provisions for Section 6.1, Electrical Work - General.

This Section sets forth specific requirements for:

- a. Service section
- b. Motor control equipment
- c. Special control panels
- d. Control and terminal cabinets
- e. Control devices
- f. Circuit breakers

6.3.2 Floor Standing Switchgear

6.3.2.1 General

The enclosing NEMA 3R wrap shall be constructed of 12-gauge galvanized steel, with a sloped-to-rear roof line. Slope from front to rear to be minimum 1/2-inch per foot. Doors to be louvered and filtered at top and bottom, and gasketing shall be provided around four door closing flanges. 14-gauge construction is acceptable if the doors have suitable welded-in stiffening pan to prevent deflection of doors. 12-gauge doors without stiffening pan are not acceptable.

Both the Main Service Switchboard and the Motor Control Center shall have the same NEMA 3R design and appearance, and shall be UL approved.

Each Motor Control Center shipping split shall have a 5-inch side extension on each side to provide NEMA 3R parts attachment and 90 degree internal door swing. Each split shall have a minimum of thirty (30) inches working clearance from hinge flange to door closure flange (width of open unobstructed area when door is open).

Internal upper and lower covers, if hinged, must open 90 degrees or be converted to screw-covers.

The rear access screw covers are to be flanged on four sides, and gasketed. One-piece flat or multi-piece flat lipped covers are not acceptable.

A 1-3/8-inch high X 3-inch wide channel iron base for each shipping split is to be provided, enclosing all four (4) sides of equipment. Welded closing plates are required at open ends of channel.

Area in front of sections shall be 12-inch minimum to outer doors.

Finish shall be white polyester powder coat.

A 10-inch diameter exhaust fan to be installed at the upper right or left side of equipment line-up, rated 560CFM @ 120V, and to include a SPST 90-130F thermostat. The external fan hood shall contain an anti-insect filter media at the bottom exhaust point with a removable cover for filter exchange. The fan motor is to be mounted within the 5-inch side extension, and not protrude into any control section area.

Lighting shall be provided for each shipping split, and shall be single-tube fluorescent 24-inch or 48-inch, as necessary for width of split. A light switch shall be provided on side extension for each Motor Control Center shipping split, and shall have a stainless steel cover plate.

Convenience receptacles shall be provided for each Motor Control Center shipping split, and shall be duplex GFCI type, with stainless steel cover.

The switching devices (Light Switch, Thermostat, and GFCI receptacle) shall be mounted on a common hinged door contained within the 5-inch side extension for each shipping split.

Each shipping split shall have lifting angles provided on each of four (4) corners, and shall also be bolted to 4-inch X 4-inch wood skids for forklift handling.

6.3.2.2 Service Section

Service section shall consist of an underground pull compartment and a revenue metering compartment all to Southern California Edison Company requirements. District-approved shop drawings of the service section shall also be submitted to the utility for approval prior to fabrication. Service section shall carry a UL label "Approved for Service Equipment." The service connections from the main service switchboard to the MCC shall be bus bar, not cable, and match the ampere rating as required by UL.

6.3.2.3 Motor Control Equipment

Motor control section shall be furnished as shown in compliance with these Specifications. Motor control section construction shall be NEMA Class II, Type B, Arc-Flash Safety Rated. It shall be suitable for service on a grounded wye system, but power supply and feeder circuits shall be three-wire. Horizontal bus rating is shown on the drawings; vertical bus shall be full length, insulated, 300-ampere minimum. Each assembly shall consist of vertical free-standing sections, each approximately ninety (90) inches high and twenty (20) inches deep minimum. Each unit shall have an individual door with concealed hinges; doors shall be held shut with captive screws. The door of each unit having a disconnect device shall be interlocked so that the circuit cannot be energized when the door is open.

Motor control section shall be fitted with a manufacturer's nameplate that shall include the NEMA Standard electrical rating data and other pertinent data, including sales order number, date of manufacture and place. If more than one (1) voltage source is present in the control section, it shall be tagged "Caution, Foreign Voltage." Motor control equipment shall be Square-D or Cutler/Hammer, no substitutions.

6.3.2.4 Starter Unit

a. Soft Starter

The supplied product shall be a digitally programmable solid-state reduced voltage soft starter with a voltage/current ramp and an anti-oscillation circuit for smooth load acceleration. The unit shall contain silicon controlled rectifiers (SCRs) sized to withstand starting currents of 500% for twenty (20) seconds (Standard Duty) and up to 500% for sixty (60) seconds (Heavy Duty). The soft start shall feature smooth, step-less ramp control to reduce motor inrush current and excessive wear on the mechanical drive train components. Starting torque, ramp time, current limit, dual ramp, and deceleration control shall be standard features on the soft starter unit. Operating parameters shall be input through a programmable keypad for setting the ideal starting cycle and protection features. The starting electrical

characteristics of the motor shall be matched to the mechanical characteristics of the drive train for controlled acceleration of the load by simply adjusting the unit's starting torque, ramp time, and current limit functions. Programmable auxiliary contacts and provisions for interlocking shall also be included.

Soft Start Motor Starters shall be selected from the VMX Series by Motortronics, no equal.

b. Capacitors

Capacitors shall be connected on the line side of the motor overload elements; they shall be fused and shall have integral current draining devices. Case shall be steel with exposed bushings, insulating liquid shall be non-flammable, and capacitors shall be composed of aluminum foil with a draft paper/plastic film separator. Capacitor shall be installed at the rear 10-inch space of each vertical section.

6.3.2.5 Auxiliaries

One (1) vertical section shall contain 120/240, single-phase lighting panel board for lighting, space heating, and for motor-control. Circuit breakers shall have 10,000 ampere interrupting capacity, transformer shall be dry-type, panel board shall have branch circuits, as shown. Panelboards shall be of the same make as of the motor control equipment and shall have a main circuit breaker.

6.3.2.6 Control Devices

As indicated elsewhere, it is the intention of this Specification that products of the same type shall be of the same make. This requirement applies to control devices; insofar as practical, it applies to equipment manufactured on a production basis and does apply without exception to equipment custom fabricated for this project.

One (1) unbussed vertical section shall contain control relays and door mounted pilot devices. Provide sufficient space for future controls and pilot devices, as specified on the Construction Drawings. All control logic shall be 120 volt, as indicated.

a. Switches and Pushbuttons

Selector switch shall be rated 10-amperes at 600 volts, shall be heavy-duty, oil-tight, and shall have the number of positions and poles indicated. Each shall have a factory engraved legend plate, as shown.

b. Indicating Lights

Indicating lights shall be full-voltage L.E.D., push-to-test type, and shall be heavy-duty, oil-tight as specified above for selector switches. Each shall be nickel-plated with screwed-on glass prismatic lens approximately 1-inch in diameter. Approved lamps shall be 125 volt, clear, if not otherwise indicated.

c. Magnetic Relays

Magnetic relays shall be ice cube type with 115-V, AC coils, and 10-amp contacts, unless noted otherwise. Relay bases shall be pin type, DIN rail-mounted.

d. Time Delay Relay

Time-delay relays shall be electronic on-delay / off-delay with calibrated time range dial adjustable as shown on the Drawings, and shall be pin type by CH, Square-D, or IDEC.

e. Terminal Blocks

Terminal blocks for control wiring shall be modular box clamp type with barriers, rated not less than strips, fastened by screws to the molded sections at each block, and shall be provided for circuit designation. Each connected terminal of each block shall have the circuit designation or wire number placed on the marking strip with permanent marking fluid.

Wiring of terminal cabinets and control cabinets shall be accomplished with standard copper conductor rated for 600 volts and UL listed as type MTW. Wires for alarm and indication circuits shall be No. 16 AWG; all others shall be No. 14 AWG. Incoming wires to terminal or relay cabinets shall be terminated on a master set of terminal blocks. All wiring from the master terminals to internal components shall be factory-installed and shall be contained in a plastic raceway having a removable cover. Wiring to the door-mounted devices shall be extra flexible bundled loom and anchored to door using wire anchors cemented in place; exposed terminals of the door-mounted devices shall be guarded.

f. Intrusion Switches

Door/intrusion switches shall be located on all Ethernet cabinets and buildings.

Engraving shall be as shown or as directed by the Engineer. Characters shall be uniform block style not smaller than 1/8-inch. Nameplates shall be black background with white lettering and secured using cadmium plated or other corrosion resistant screws. Adhesive alone is not acceptable.

6.3.3 Testing and Shipping

Motor control equipment shall be wired and tested at the factory. All buses and wiring shall be given a dielectric test, in accordance with the latest NETA, IEEE, and NEMA Standards. Certified test reports shall be submitted to the Owner's Representative before shipment, for record purposes. Testing shall include ground fault trips, energizing of all automatic and manual control circuits, and operation of starters.

6.3.4 Spares

Vendor shall supply six (6) spare fuses of each size less than 30 amperes used in the switchboard, three (3) spare indicator lamp bezels, and one (1) spare starter operating coil.