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**Construction Specification****SERVICE AND DISTRIBUTION**

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**PART 1 - GENERAL****1.01 SUMMARY**

- A. This specification covers the electrical characteristics and general requirements for installation of the switchgear and related components

**1.02 GENERAL**

- A. The switchgear together with all required factory hardware, accessories, enclosures, pull sections, auxiliary sections, C.T. compartments, pulse-meter, barriers, bolted pressure switches, fuse clips, nameplates, panelboards, ground bars, transformers, transformer mounting kits, disconnect switches, safety switches, separate starters, combination starters, thermal overloads, contactors, service entrance transient voltage surge suppressors, lugs, bussing, controls, fuses, fusible switches, breakers, GFI monitors, relays, etc. shall be furnished and installed by the electrical contractor, under this Section.
- B. The external electrical equipment (loose gear) shall be furnished by the electrical equipment vendor and installed by the Contractor and shall include, but is not limited to:
1. Lighting and appliance panels w/breakers
  2. Self-contained transformers
  3. Disconnect switches w/fuses (as applicable)
  4. Contactors and Relays (as scheduled)
  5. Radiant heater manual switches
  6. Radial arm/panel saw components (i.e. disconnect switches).
  7. Battery charger pushbuttons.
  8. Sales area 6" x 6" hinged wireway systems (mounting hardware shall be provided by electrical contractor per installation details).
  9. Shunt trip protection, if required.
  10. Raceways

**Note:** Electrical contractor shall provide all other electrical devices (not listed) as required per construction documents. Refer to 1.02°C (this spec) for additional information.

- C. Any additional required devices or accessories not factory-installed such as the mounting hardware, vibration isolators, support rods, straps, support channel, external cabinet conduit, boxes, connectors, couplings, interface wiring between devices, line power circuits, internal wiring between devices, accessory relays, etc. shall be provided by the electrical contractor.
- D. Electrical contractor shall include in his price all labor and equipment rental necessary to completely install the switchgear as indicated on the plans, and shall perform all warranty work required during the warranty period.
- E. All conduit, wire, couplings, connectors, clamps, adapters or any other required electrical accessories not factory-installed shall be provided by the electrical contractor as indicated on the plans. Major wireways that cross the store sales area serving rack power and lighting shall be furnished by and installed by the electrical contractor.

**1.03 APPARATUS**

- A. All apparatus and equipment specified hereinafter in this section shall fully conform to current standards of NEMA to the extent applicable to each type and class of equipment and apparatus described; and shall individually bear the seal of the Underwriter's Laboratories. When being utilized in Canada, all apparatus and equipment shall individually bear the CSA seal. Labeled equipment shall meet or exceed all of the requirements of performance testing under UL 891.
- B. All apparatus and material shall be of one and the same manufacturer, unless specifically indicated otherwise.
- C. The types, classes, and catalog numbers of materials and devices hereinafter stated are employed to establish the quality of apparatus and equipment required for this work.

**PART 2 - PRODUCTS****2.01 MAIN DISTRIBUTION PANELBOARDS**

- A. The Contractor shall install as herein specified, and where indicated on the plans, series-rated, indoor, totally-enclosed, dead front, low-voltage, distribution panelboards in accordance with the latest applicable standards of NEMA and UL. Panelboards shall be listed as suitable for use as service entrance equipment. Rating shall be for 480/277 volts, 3 phase, 4 wire service, in the ampere capacity as indicated on the plans.
- B. Panelboard enclosure shall be constructed of steel with rigidity and gauge in accordance with UL 50. Trims on equipment in the enclosed electrical room shall be complete without doors, while all other equipment outside of this room shall be

complete with doors containing three-point latch and vault lock. All locks shall be keyed alike. Enclosure and trims shall be finished with rust inhibiting prime coat with baked-on enamel finish coat in manufacturer's color, or as an unpainted metal treated to equally withstand rusting as a painted enclosure, whichever is more cost effective. Wiring gutters shall be sized in accordance with UL 67. Integrated sections may be 1/8" brushed aluminum with strength and rigidity in accordance with UL891.

- C. Bus structure and main breaker shall have current ratings as indicated on the drawings. The bus bars shall be of such size, quantity and spacing so that, under fully loaded conditions, the temperature rise shall not exceed 50°C above ambient. Heat tests shall be conducted in accordance with UL 67.
- D. All bus bars shall be silver-plated copper having a conductivity of not less than 98% of that of pure copper. Plating shall not blister or peel, and shall be resistant to corrosion if scored or scratched. Bus plating shall be resistant to galvanic action between copper and dissimilar metals.
- E. Each panelboard, as a complete unit, shall have a short circuit rating equal to or greater than the minimum integrated AIC rating indicated on the drawings. The short circuit rating may be determined on a "Series Rated System" basis. The panelboard series rating shall be determined for the main circuit breaker and branch circuit breaker combination tested in accordance with UL 489. If series rated system is provided, each panelboard shall be clearly labeled as such with a warning describing selection of acceptable replacement circuit breakers.
- F. The main distribution panelboards shall have a ground bus and 100% neutral bus. Provide with full size grounding strap connecting the ground and neutral bus. Interconnection between these two busses shall occur only in panelboards used as service entrance equipment.
- G. All distribution circuit breakers shall be manually operated, thermal-magnetic, automatic tripping, of the ampacity and poles as scheduled on the plans, and quick-make/quick-break type. Breakers shall be over-the-center toggle operating type, with the handle going to a position between "ON" AND "OFF" to indicate automatic tripping. All multi-pole breakers shall have internal common trip.
- H. All circuit breakers, including any connectors to the main bus shall be bolt-on type and rigidly braced.
- I. All feeder breakers within the main distribution switchboard/panelboards shall be factory wired to the associated panelboards. Wire markers shall be utilized to identify the conductors and matched on both ends with panel designation and phase markings. Where shipping splits are shown, provide adequate wire and associated barriers, conduit, and other necessary materials for contractor connection. The switchboard/panelboard manufacturer shall connect and secure either the line or load side of each connection on shipping splits.
- J. Spaces for future installation of molded case circuit breakers are specified by the frame size. The spaces shall be complete with all bus and required bus connectors such that future breakers can be installed without adding or changing bus connectors on the main bus and without using a larger (frame size) or more expensive breaker than the trip size and interrupting capacity would require.
- K. A pulse-meter that is compatible with Novar shall be provided, installed, and connected to the EMS wiring harness by the panel manufacturer vendor. Pulse meter current transformers shall be bus mounted or mounted upstream of secondary phase lugs. Panel manufacturer shall also provide, install, and wire current transformer shorting blocks. Shunt block shorting bars shall be in the shorting position when the panel assemblies are shipped. All phase related wiring shall be color coded per Wiring and Cabling Specification 16120. Panel manufacturer shall also provide, install, and wire all required disconnects and fuses for the meter power supply.

## 2.02 STANDARD PANELBOARDS

- A. Panelboards shall be of the automatic circuit breaker type, factory assembled by the manufacturer of the circuit breakers. Panelboards shall be new and the manufacturer's latest standard catalogued design. Panelboards shall be the product of the same manufacturer as the cabinets and shall bear UL labels. Panelboard bussing shall be 98% conductivity silver-plated copper.
- B. Panelboards shall be for service voltage with number of branch circuits of capacity scheduled. Unless otherwise indicated, panels and sections thereof shall have main lugs only of capacity equal to or greater than the rating or setting of the over current protective device next back on line.
- C. Panelboard boxes shall be constructed of code gauge steel, 20" minimum width by 5¼" deep. Panels having through feed shall have 8" bottom and side gutters. Where used as a raceway, provide additional space in panelboard box to meet NEC 384-25.
- D. Panelboard trims shall be flush or surface type as scheduled on the plans, constructed of code gauge steel, finished with rust inhibiting prime coat and baked-on enamel finish, or raw metal with a rust-inhibitor of the same quality as painting, whichever is more cost effective. Trims shall be complete with indicating adjustable trim clamps, door with chromium plated combination cylinder lock and catch, and directory of glass or clear plastic. All locks shall be keyed alike. Directory shall be type-written with spares indicated in pencil. All panel trims shall have an angle bracket welded to the back near the bottom to support the weight of the trim. Trims exceeding 48" in height shall have vault handle and three point latch system. The trims on all flush mounted 20" wide panels shall have trim clamps and hinges concealed when the door is

closed. Trims shall not be removable with the door in the locked position. Trims on panelboards located within the enclosed electrical room require no door, and shall not be provided with one.

- E. Circuit breakers shall be thermal-magnetic molded case type quick-make/quick-break both on manual and on automatic operation. Breakers shall be of the over-the-center toggle operating type, with the handle going to a position between "ON" and "OFF" to indicate automatic tripping. All multi-pole breakers shall have internal common trip, and have all load side connectors off the same gutter. These shall be bolt in type, heavy-duty devices.
- F. Panel boards shall be as scheduled. Circuit breakers in panelboards shall have interrupting capacity as scheduled. Breakers intended to interrupt more than 10,000 amperes shall be labeled to conform to N.E.C. Article 240-83. Low voltage panels shall have main breakers as scheduled on the drawings.
- G. Special panelboard arrangements shall be provided as indicated on the drawings.
- H. Minimum clearance between circuit breaker and vertical panel section shall be three (3) inches.
- I. Panel board sections greater than forty-five inches shall have hinged door sections.

### 2.03 "SMART" PANELBOARDS

- A. "Smart" Panelboards shall meet the same requirements as stated under 2.02, except as specifically stated herein.
- B. "Smart" Panelboards shall be defined as containing the following components:
  - 1. Panel Board Interior
  - 2. Chassis
  - 3. Lugs or main breaker as required by series rating
  - 4. Smart bus strips or backplate with cables
  - 5. Power supply and associated cables
  - 6. Dead front cover
  - 7. Novar controller
  - 8. Controllable breakers as required
  - 9. Standard breakers as required
- C. "Smart" circuit breakers shall be as manufactured by Square D. The "SmartBreakers" shall be suitable for remote operation via an interface with the approved NOVAR lighting panel controller. Each breaker shall be capable of individual control from the local Novar control panel. Local hard override "ON" of individual breakers shall not be permitted. Each breaker shall be capable of providing feedback status consisting manual off, auto on / off, and auto tripped to the local Novar control panel.
- D. Minimum clearance between circuit breaker and vertical panel section shall be three (3) inches.
- E. Panel board sections greater than forty-five inches shall have hinged door sections.

### 2.04 DRY-TYPE TRANSFORMERS

- A. Dry-type transformers shall have capacity, voltage ratings and characteristics as shown on the plans. Dry-type transformers shall conform to the requirements as herein specified.
- B. All transformers located within the enclosed electrical room shall be incorporated into the integrated switchboard/panelboard assembly. Cabling or bussing shall be as noted in section 2.01.
- C. All transformers located outside of the enclosed electrical room shall be stand alone dry-type transformers as described below.
- D. Transformers shall be provided with either (4) or (6) 2½%-rated KVA taps on the primary winding. The dry-type transformers herein specified shall have noise levels not exceeding 45 dB for transformers rated 50 KVA and below. Noise levels shall be determined in accordance with NEMA standards for specialty dry-type transformers. The transformers shall be supported on approved vibration and noise dampening supports.
- E. All conduit connections to the transformers shall be made with flexible metallic raceway or shall be made with other approved vibrationless connectors. The length of the flexible metallic raceway in use shall be not less than 18".
- F. Each dry-type transformer shall be provided with a terminal lug compartment (lugs ordered separately, field installed) for transformers above 25 KVA, and factory installed terminal lugs for transformers rated 25 KVA and below, supported and arranged for the feeder terminations and for side or bottom entrance of the terminal compartment. Temperature in compartment shall not exceed 75°C at rated load with an ambient of 40°C. Lugs for transformers shall be provided separately with the transformer.
- G. Transformers shall have primary and secondary voltages as indicated on the plans, with a minimum of (2) 5% FCBN taps up to 15 KVA and (4) 2½% FCBN on all sizes larger. Transformers shall have UL recognized 220°C insulation system

and shall be so designed that under full load the average conductor temperature rise does not exceed 150°C rise above 40°C or ambient at any point on the enclosure. Conduit entrances and terminal board shall be located at the bottom of the enclosure.

- H. The design, manufacture, testing, method of conducting tests and preparation of reports shall be in accordance with the latest revision of NEMA Standards Publication for Specialty Transformers No. ST 1-4 (ASA C89.1), modified to require separate primary and secondary winding for each dry-type transformer.

## 2.05 DISCONNECT SWITCHES

- A. Sub-feeder switches and disconnect switches shall be "Heavy-Duty" rated, except as otherwise noted, and in damp locations or exposed to the weather shall be NEMA-3R (Raintight). Disconnect switches shall be horsepower rated for the motor installed.
- B. Manual starters for single phase motors sized 1 horsepower and below shall be NEMA-1 general purpose for dry locations and NEMA-4 watertight for damp locations or where the switch may be exposed to the weather. Provide with number of poles as noted on drawings where used for control of multiple circuits/motors.
- C. All disconnect switches shall have factory installed provisions for padlocking in either the "ON" or "OFF" position.
- D. Unless otherwise noted, disconnect switches shall be of the same manufacture as the main switchboard and panelboards.
- E. All switches shall have nameplates as specified in another section of this specification.

## 2.06 PADLOCKS

- A. The electrical contractor shall provide (2) forged brass padlocks on all fused and non-fused disconnect switches located outside of the building at grade level. One lock shall be used to lock the switch door to prevent unauthorized opening, and the other shall be used to lock switch in the "OFF" or "ON" position.
- B. Padlocks shall be pull-on operation, seven-pin tumblers, equal to Best Manufacturing Company. All locks shall be keyed alike and furnish (2) keys to owner's representative for each lock.

## 2.07 FUSES

- A. All fuses shall be of the same manufacturer. All fuses shall be of the high interrupting rating, current limiting type as manufactured by Bussman or Gould-Shawmut. Fuses shall be provided for each fuse cutout and the specified quantity of fuses shall be furnished for spares.
- B. Circuits of 0 to 600 amperes shall be protected by rejection type, current-limiting BUSSMAN LOWPEAK Dual Element Fuses LPN-RK (250 volts) or LPS-RK (600 volts). All dual-element fuses shall have separate overload and short-circuit elements. Fuse shall incorporate element having a 284°F melting point alloy and shall be independent of the short-circuit clearing chamber. The fuse shall hold 500% of rated current for a minimum of 10 seconds and be UL-listed, with an interrupting rating of 100,000 amperes RMS symmetrical. The fuses shall be UL Class RK-1.
- C. Motors, transformers or other circuits with heavy inrush currents of 0 to 600 amperes shall be protected by rejection type, current limiting BUSSMAN LOWPEAK Dual Element Fuses FRN-R (250 volts) or FRS-R (600 volts). All dual-element fuses shall have separate overload and short-circuit elements. The fuse shall hold 500% of rated current for a minimum of 10 seconds and be UL-listed, with an interrupting rating of 100,000 amperes RMS symmetrical. The fuses shall be UL Class RK-5.
- D. Circuits of 601 to 6000 amperes shall be protected by current-limiting BUSSMAN HI-CAP Time Delay Fuses KRP-C. Fuses shall employ "O" rings as positive seals between the end bells and the glass melamine fuse barrel. The terminals shall be peened. Fuses shall be time-delay and shall hold 500% of rated current for a minimum of 4 seconds, clear 20 times rated current in 0.01 seconds or less and be UL-listed, with an interrupting rating of 100,000 amperes RMS symmetrical. The fuses shall be UL Class L.

## 2.08 EQUIPMENT ANCHORING

- A. All items of electrical equipment, such as main service switch, transformers etc., shall be securely anchored to the building structure. The anchoring shall be accomplished by utilizing a minimum size of ½" steel threaded rods secured to the structural steel in the structure and to the item of equipment. A minimum of (2) rods shall be provided on each side of each item of equipment with the following exceptions:
  - 1. If the equipment manufacturer provides more than (2) anchor holes per side in the base frame of the equipment item, then there shall be one anchor for each anchor hole.
  - 2. If the equipment manufacturer recommends a particular quantity greater than two (2) per side, then that quantity of anchors shall be utilized by the contractor.

## 2.09 CONTACTORS

- A. Contactors for the control of branch circuits and branch circuit panelboards as shown shall have number of poles, throws and ampere ratings as indicated. Contactors shall be provided with proper enclosures for surface or flush mounting as shown. Emergency contactors shall be electrically held with normally closed contacts. Non-emergency contactors shall be provided as called out on the design drawings. Contactor coil voltages shall be 120 VAC. Control circuits shall be properly coordinated with energy management system and other control devices and all necessary relays and control miscellaneous appurtenances shall be furnished. All contactors shall be furnished with manual override.

## 2.10 WIRING/TERMINATIONS

- A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc, shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- B. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.
- C. The switchboard manufacturer shall wire and mark as factory-installed all panelboards, transformers and/or automatic transfer switches from the associated feeder breaker (in the Main section of the switchboard) to the panelboard as noted on drawings. This wiring shall not be done in the field
- D. Pre-wired terminal blocks shall be provided in the switchgear lineup for interconnection of devices controlled by energy management. Separate terminal blocks for Class 2 and 120 VAC wiring shall be provided. Class 2 connections and 120 VAC connections shall not be allowed on the same terminal strip. Terminals shall be numbered and terminated as per Home Depot drawings. Terminal blocks shall be located in the front portion of the panel section so as not to interfere with feeders or branch circuit conductors.
- E. All wiring shall comply with the Home Depot Wiring and Cabling Specification 16120. Any Class 2 cabling internal to the integrated panel assemblies shall be 18 AWG shielded cable with 600 Volt insulation.
- F. Interconnection of Novar Class 2 wiring and Novar contactor control wiring between panel shipping splits shall be modular plug and play connections. Class 2 connectors shall have a different number of pin connections compared to line voltage connections so that it is physically impossible to connect Class 2 wiring connectors to line voltage connectors.
- G. Panel manufacturer shall provide detailed, easy to understand assembly instructions with integrated panel assembly for electrical contractor use. Wiring diagrams and text instructions shall be provided as required for proper assembly.

## 2.11 WIREWAYS

- A. Wireways 8" and larger shall be 14 gauge galvanized steel, 6" and lower shall be 16 gauge, both with hinge or screw covers as noted on the plans.
- B. Wireways shall be coated with a corrosion inhibitor.
- C. Wireways shall be NEMA-1 (indoor) or NEMA-3R (outdoor) as noted on the plans. NEMA-3R wireways shall have a gasketed cover.
- D. All wireways excluding those in the sales area shall be primed and finished with dark gray enamel inside and out.

## 2.12 PANELBOARD CONTROLLERS / BREAKER INTERFACE

- A. Panelboard controllers shall be sized to control no fewer than 42 circuits per controller.
- B. Controller shall be integral to panel, with control wiring pre-wired by integrated panel manufacturer.
- C. Controller shall be fully compatible with Novar.
- D. Controllers shall be mounted in the panel sections so as not to interfere with feeders or branch circuit conductors.
- E. A service loop shall be provided for each controller for the communication link connection.

## 2.13 NAMEPLATES

- A. Nameplates shall be mounted on the face of the assembly, shall be provided for all main and feeder circuits as indicated on the drawings. Nameplates shall be printed in white characters on black background. Characters shall be 3/16" high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Provide master nameplate indicating switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

- B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc. shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

**PART 3 - EXECUTION****3.01 FACTORY TESTING**

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
- B. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard shall be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for (1) minute between live parts and ground.
- C. Proper communication and control shall be verified by the panel manufacturer to all smart breaker panels, smart breaker circuit breakers, smartbreaker controllers, and lighting contactors throughout the entire integrated panel assemblies.
- D. The manufacturer shall provide (3) certified copies of factory test reports.
- E. Factory tests as outlined above shall be witnessed by the owner's representative if requested.

**3.02 INSTALLATION**

- A. Contractor shall examine all terminations on switchgear upon installation and re-torque, as necessary, per the manufacturer's recommendations.
- B. Shop drawings shall indicate that all of the function requirements of the specifications have been met. In addition, the UL-approved RMS symmetrical interrupting capacity shall be indicated for each circuit breaker, and a certification that these are UL ratings shall be attached.
- C. Contractor shall provide 4' x 8' x ¾" wood backboards made of B-D INT-DFPA grade plywood, painted gray al sides, securely anchored to all walls of telephone and main electrical room as indicated on the plans. Backboards shall be continuous from floor to 8' high and wall to wall (excluding masonry openings).
- D. Contractor shall provide a 4" high reinforced concrete housekeeping pad under any floor mounted electrical equipment.

**3.03 STARTUP AND COMMISSIONING**

- A. Refer to Owner representative.

**END OF SECTION**