

SECTION 26 13 30 – PAD MOUNTED SWITCHGEAR

[Standard TDCJ Specification]

PART 1 - GENERAL

1.1 SUMMARY

- A. Requirements for pad-mounted switchgear.

1.2 DEFINITIONS

- A. BIL: Basic Impulse Insulation Level.
- B. Bushing: An insulation structure including a central conductor, or providing a central passage for a conductor, with provision for mounting on a barrier, conduction or otherwise, for insulating the conductor from the barrier and conducting current from one side of the barrier to the other.
- C. Hotstick: An insulated stick, usually made of fiberglass that is used to work energized overhead conductors and operate electrical equipment that is overhead, underground, and compartmentalized.
- D. NETA ATE: Acceptance Testing Specification.
- E. SCADA: Supervisory control and data acquisition.
- F. Way: A three-phase or single-phase circuit connection to the bus that may contain combinations of switches and protective devices or may be a solid bus.

PART 2 - PRODUCTS, EQUIPMENT, MATERIALS AND/OR FIELD SERVICES

2.1 GENERAL REQUIREMENTS

- A. Brand or manufacturer's references are descriptive only, and indicate type and quality to be provided. All references to brand or manufacturer names shall be interpreted to include the language "or A/E approved equal". Any brand or manufacturer meeting specifications will be considered, irrespective of the language "or A/E approved equal" appearing in conjunction with the brand or manufacturer name.
- B. Pad-mounted Switchgear: A single self-supporting NEMA 3R enclosure, with one non fused service entrance interrupter switch, and 3 fused power interrupter switches with the necessary accessory components. Switches and components provided from the same manufacturer, factory installed in the enclosure, and operationally tested and warranted as a single unit.
- C. Additional Source and/or Manufacturer Qualifications: The manufacturer of the pad-mounted gear shall be completely and solely responsible for the performance of the basic switch and fuse components as well as the complete integrated assembly as rated.

2.2 PRODUCT, EQUIPMENT, MATERIAL AND/OR FIELD SERVICES REQUIREMENTS

A. GENERAL REQUIREMENTS

1. Product, Equipment, Material and/or Field Services provided under this Section shall comply with:
 - a. Applicable portions of ANSI C57.12.28, covering enclosure integrity for pad-mounted equipment.
 - b. Article 490.21(e) in the National Electrical Code, which specifies that the interrupter switches in combination with power fuses shall safely withstand the effects of closing, carrying, and interrupting all possible currents up to the assigned maximum short-circuit rating.
 - c. All portions of ANSI, IEEE, and NEMA standards applicable to the basic switch and fuse components.
 - d. Comply with IEEE C2.
 - e. Comply with IEEE C37.74.

B. System Requirements:

1. Manufactured Unit: PMH-12, Pad-mounted switchgear, designed for application in solidly grounded neutral underground and aerial distribution system.
2. Ratings: The short-circuit and three-time duty-cycle fault-closing ratings of switches, short-circuit rating of bus, interrupting ratings of fuses, and duty-cycle fault-closing capabilities of fuses with integral load interrupters shall equal or exceed the short-circuit ratings of the pad-mounted gear.
 - a. Nominal Voltage: 14.4 kV
 - b. Maximum Voltage: 17.0 kV
 - c. BIL Voltage: 95 kV
 - d. Short-Circuit
 - 1) Peak Withstand Current, Amperes, Peak: 36.4 kA
 - 2) One-Second Short-Time Withstand Current, Amps, RMS, Symmetrical: 14. kA
 - 3) MVA, Three-Phase Symmetrical, at Rated Nominal Voltage: 350 MVA
 - e. Main Bus
 - 1) Continuous Current, Amperes: 600 A
 - 2) Peak Withstand Current, Amperes, Peak: 36.4 kA
 - 3) One-Second Short-Time Withstand Current, Amps, RMS, Symmetrical: 14 kA
 - f. Three-Pole Interrupter Switches
 - 1) Continuous Current, Amperes: 600 A
 - 2) Load Dropping Current, Amperes: 600 A
 - 3) Peak Withstand Current, Amperes, Peak: 36.4 kA
 - 4) One-Second Short-Time Withstand Current, Amps, RMS, Symmetrical: 14.0 kA
 - 5) Three-Time Duty-Cycle Fault-Closing Current, Amps, RMS, Symmetrical: 14.0 kA
 - g. Fuses with Integral Load Interrupters
 - 1) Maximum Current, Amperes: 300E or 300K
 - 2) Load Dropping Current, Amperes: 300A
 - 3) Duty-Cycle Fault-Closing Current Capability, Amps, RMS, Symmetrical: 14.0 kA

C. System Elements

1. Insulators, High-Voltage Bus and Ground-Connection Pads
 - a. Insulators – interrupter-switch and fuse-mounting insulators shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:
 - 1) Operating experience of at least 25 years under similar conditions.
 - 2) Adequate leakage distance established by test per IEC Publication 507, "Artificial Pollution Test on High Voltage Insulators to be used on AC Systems."
 - 3) Adequate strength for short-circuit stress established by test.
 - 4) Conformance with applicable ANSI standards.
 - 5) Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs.
 - a) Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation.
 - b) Any surface damage to insulators during installation or maintenance of the pad-mounted gear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.
 - b. High-Voltage Bus
 - 1) Before installation of the bus, all electrical contact surfaces shall first be prepared by machine-abrading to remove any aluminum-oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.
 - 2) Bus and interconnections:
 - a) Aluminum bar of 56% IACS conductivity.
 - b) Withstand the stresses associated with short-circuit currents up through the maximum rating of the pad-mounted gear.
 - 3) Bolted aluminum-to-aluminum connections:
 - a) Suitable number of 1/2—13 galvanized steel bolts, with two Belleville spring washers per bolt, one under the bolt head and one under the nut.
 - b) Tightened to 50 foot-pounds torque.
 - c. Ground-Connection Pad in each compartment of the pad-mounted gear:
 - 1) Constructed of 3/16 in. thick steel,
 - 2) Nickel plated and welded to the enclosure, with a short-circuit rating equal to that of the pad-mounted gear.
 - 3) Coated with a uniform coating of an oxide inhibitor and sealant prior to shipment.
2. Enclosure, Doors and Finish
 - a. Enclosure:
 - 1) Pad-mounted gear constructed in accordance with the specifications of the fuse and/ or switch manufacturer for electrical clearances and space for fuse handling.
 - 2) Unitized monocoque (not structural-frame-and bolted- sheet) construction.
 - 3) 11-gauge hot-rolled, pickled and oiled steel sheet.
 - 4) All structural joints and butt joints: gas-metal-arc welded with external seams ground flush and smooth.
 - 5) All hardware (including door fittings, fasteners, operating mechanism parts, and other parts) subject to abrasive action from mechanical

- motion shall be of either nonferrous materials, or galvanized or zinc-nickel-plated ferrous materials.
- a) Cadmium-plated ferrous parts shall not be used.
 - b) No externally accessible hardware.
- 6) Base: Constructed for bolt connection to concrete pad with continuous 90-degree flanges, turned inward and welded at the corners.
 - 7) Enclosure top side edges: Overlap with roof side edges or other mechanism to allow ventilation of high-voltage compartments, minimize moisture infiltration, and inhibit tampering or insertion of foreign objects.
 - 8) Inside surface of roof: Heavy coat of insulating "no-drip" compound.
 - 9) Insulating barrier separating front compartments from rear compartments and to isolate tie bus (if applicable): NEMA GPO3-grade fiberglass-reinforced polyester.
 - a) Requirements include insulation for interphase and end barriers for each interrupter switch and each set of fuses where required to achieve BIL ratings.
 - 10) Side-by-side compartments: Separated by full-length steel barriers.
 - 11) Interrupter Switches and Fuses include Dual-Purpose Front Barriers (DPFB): DPFB:
 - a) In normal hanging positions: guard against inadvertent contact with live parts.
 - b) Possible to lift barriers out and insert into the open gap when the switch is open.
 - c) Comply with Section 381G of the National Electrical Safety Code (ANSI Standard C2).
 - 12) Miscellaneous:
 - a) Instruction manual holder.
 - b) Removable lifting tabs with blind-tapped sockets. A closed-cell resilient material placed between the lifting tabs and the enclosure.
 - 13) Doors:
 - 14) 11-gauge hot-rolled, pickled and oiled steel sheet.
 - 15) Doors and/or dividers: Polyurethane self-adhesive bumpers.
 - 16) Hinges: Minimum of two, extruded-aluminum with stainless-steel hinge pins, and interlocking extruded-aluminum hinge supports for the full length of the door.
 - a) Mounting hardware: Stainless steel or zinc nickel-plated steel, not be externally accessible.
 - 17) Door openings: 90-degree flanges, facing outward, with deep overlapping between doors and door openings.
 - 18) Door-edge flanges: Overlap with door-opening flanges formed to guard against water entry tampering or insertion of foreign objects, but shall allow ventilation.
 - 19) Equipped with an automatic three-point latching mechanism.
 - a) Spring-loaded to latch automatically when the door is closed.
 - b) All latch points latch at the same time.
 - c) Tamper-resistant: Specialized tool required to actuate the mechanism to unlatch the door and, in the same motion, recharge the spring for the next closing operation.
 - d) Provisions for padlocking that incorporates a means to protect the padlock shackle from tampering and coordinated with the latches such that:

- i. Not possible to unlatch the mechanism until the padlock is removed, and
 - ii. Not possible to insert the padlock until the mechanism is completely latched closed.
- 20) Doors providing access to solid-material power fuses:
 - a) Provisions to store spare fuse units or refill units.
 - b) Zinc-nickel-plated steel door holder located above the door opening, hidden from view when the door is closed, and not be possible for the holder to swing inside the enclosure.
- b. Finish:
 - 1) Process enclosures independently of components such as doors and roofs before assembly into unitized structures.
 - a) Exterior seams: filled and sanded smooth.
 - b) Resilient closed-cell material, such as PVC gasket, applied to underside of enclosure bottom flange.
 - c) Wax-based anticorrosion moisture barrier on welds along the enclosure bottom flange.
 - 2) Pretreatment process: Fully automated system of cleaning, rinsing, phosphatizing, sealing, drying, and cooling before any protective coatings are applied.
 - 3) Finishing system: Factory applied coating(s) meeting specifications as identified for requirements of Representative Test Specimens. Representative Test Specimens coated by the enclosure manufacturer's finishing system shall satisfactorily pass the following tests:
 - a) 4000 hours of exposure to salt-spray testing per ASTM B 117 with:
 - i. Under film corrosion not to extend more than 1/32 in. from the scribe, as evaluated per ASTM D 1645, Procedure A, Method 2 (scraping); and
 - ii. Loss of adhesion from bare metal not to extend more than 1/8 from the scribe.
 - b) 1000 hours of humidity testing per ASTM D 4585 using the Cleveland Condensing Type Humidity Cabinet, with no blistering as evaluated per ASTM D 714.
 - c) 500 hours of accelerated weathering testing per ASTM G 53 using lamp UVB-313, with no chalking as evaluated per ASTM D 659, and no more than 10% reduction of gloss as evaluated per ASTM D 523.
 - d) Crosshatch-adhesion testing per ASTM D 3359 Method B, with no loss of finish.
 - e) 160-inch-pound impact, followed by adhesion testing per ASTM D 2794, with no chipping or cracking.
 - f) 3000 cycles of abrasion testing per ASTM 4060, with no penetration to the substrate.
 - 4) Finish color: Olive green, Munsell 7GY3.29/1.5 green.
3. Basic Components
 - a. Interrupter Switches: Factory assembled and adjusted on a single rigid mounting frame.
 - 1) Frame: Welded steel construction such that the frame intercepts the leakage path which parallels the open gap of the interrupter switch to positively isolate the load circuit when the interrupter switch is in the open position.
 - 2) Interrupter: Positively and inherently sequenced with the blade

- position.
- a) Not possible for the blade and interrupter to become out of sequence.
 - b) Immediate operation contained within the interrupter, with no external arc or flame.
 - c) Exhaust vented in a controlled manner through a deionizing vent.
- 3) Operable by means of an externally accessible 3/4 in. hex switch-operating hub (Switch-operating hub) located within a recessed stainless-steel pocket (Switch-operating hub pocket) mounted on the side of the pad-mounted gear enclosure.
 - a) Switch-operating hub: Stops installed to prevent over travel resulting in damage to the interrupter switch quick-make quick-break mechanism.
 - b) Switch-operating hub pocket:
 - i. Sized to accommodate a provided 3/4 in. deep-socket wrench or a 3/4 in. shallow-socket wrench with extension.
 - ii. Pad lockable stainless-steel access cover that incorporates a hood to protect the padlock shackle from tampering.
 - iii. Labeled to indicate switch position.
 - 4) Folding switch-operating handle secured to the inside of the switch-operating-hub pocket by a brass chain and stored behind the closed switch-operating-hub access cover.
 - 5) Factory installed quick-make quick-break mechanism.
 - a) Integrally mounted on the switch frame,
 - b) Swiftly and positively open and close the interrupter switch independent of the switch-operating-hub speed.
 - 6) Readily visible open gap when in the open position.
 - 7) Single blade per phase for circuit closing, to include fault closing, continuous current carrying, and circuit interrupting.
 - a) Spring-loaded auxiliary blades not permitted.
 - b) Switch blade supports permanently molded in place in a unified insulated shaft constructed of the same cycloaliphatic epoxy resin as the insulators.
 - 8) Contacts: backed up by stainless-steel springs.
 - 9) Ground studs: Momentary rating equal to or greater than short-circuit rating of the pad-mounted gear.
 - a) At all switch terminals.
 - b) On ground pad in each interrupter switch compartment
 - c) On the terminals and ground pad in any bus compartment.
 - 10) Base-mounted distribution-class surge arresters, metal-oxide type rated (9 kV) shall be provided at all source switch terminals.
 - 11) Switch and bus-compartment terminals with adapters to accommodate two cables per phase.
 - 12) Cable guides at switch terminals and bus-compartment terminals.
- b. Fuses:
- 1) Solid-Material Power Fuses:
 - a) Refill-unit-and-holder or fuse-unit-and-end-fitting construction.
 - i. Readily replaceable.
 - ii. Fuse mountings: disconnect style.
 - iii. Fusible elements for refill unit or fuse unit:

- iv. Ratings at 10 amperes or larger applications: helically coiled.
 - (a) Non-aging and non-damageable.
 - (b) Continuous current applications: Supported in air.
 - (c) Single fusible element to eliminate the possibility of unequal current sharing in parallel current paths.
 - b) Melting time-current characteristics
 - i. Permanently accurate to within a maximum total tolerance of 10% in terms of current.
 - ii. Characteristics which permit coordination with source-side and load-side protective relays, automatic circuit reclosers, and other fuses.
 - c) Capable of detecting and interrupting all faults, whether large, medium, or small (down to minimum melting current); under all realistic conditions of circuitry; and with line-to-line or line-to-ground voltage across the fuse.
 - d) Capable of handling the full range of transient recovery voltage severity associated with these faults.
 - e) Blown-fuse indicator: Visible evidence of fuse operation while installed in the fuse mounting.
 - f) All arcing accompanying solid-material power fuse operation shall be contained within the fuse, and all arc products and gases involved shall be effectively contained within the exhaust control device during fuse operation.
- 2) Fuse-mounting jaw contacts: incorporate an integral load interrupter permitting live switching of fuses with a hotstick.
- a) The integral load interrupter housing: Thermoplastic material.
 - b) The integral load interrupter:
 - i. In the current path continuously. Auxiliary blades or linkages shall not be used.
 - ii. Hard pull to unlatch the fuse, reducing the possibility of an incomplete opening operation.
 - iii. Internal moving contacts: self-resetting after each opening operation that permits a closing operation to be performed immediately.
 - iv. Circuit interruption completely within, with no external arc or flame.
 - v. Separate fault-closing contacts and separate current-carrying contacts from fuse.
 - vi. Circuit-closing inrush currents and fault currents shall be picked up by the fault-closing contacts, not by the current-carrying contacts or interrupting contacts.
 - vii. Fuses:
 - (a) 14.4 kV rated pad-mounted gear shall have a three-time duty-cycle fault-closing capability equal to the interrupting rating of the fuse.
 - (b) 25 kV rated pad-mounted gear shall have a two-time duty-cycle fault-closing capability equal to the interrupting rating of the fuse.
 - c) Live switching: Hotstick with no other load-interrupting tool required.
- 3) Fuse terminal pads: two-position adapter, for accommodation of a

- variety of cable-terminating devices.
- 4) Ground studs at all fuse terminals:
 - a) One ground stud on the ground pad in each fuse compartment.
 - i. Momentary rating of the ground studs: equal or exceed the short-circuit rating of the pad-mounted gear.
- 5) Bus and switch terminals, fuse connector adapters, and bus terminals: Copper.
- 6) Each terminal and ground pad in the fuse compartment(s), switch and bus compartment(s): Copper ground stud.

4. Labeling

a. Hazard-Alerting Signs

- 1) All external doors providing access to high voltage signage: "Warning—Keep Out—Hazardous Voltage Inside Can Shock, Burn, or Cause Death".
- 2) Inside of each door providing access to high voltage signage: "Danger—Hazardous Voltage—Failure to Follow These Instructions Will Likely Cause Shock, Burns, or Death".
 - a) Further signage: Require operating personnel to know and obey the employer's work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment.
- 3) Interrupter switch compartments signage: "Danger", "Switches May Be Energized by Back feed."
- 4) Fuse compartments signage: "Danger", "Fuses May Be Energized by Back feed."
- 5) Barriers used to prevent access to energized live parts signage: "Danger—Keep Away—Hazardous Voltage—Will Shock, Burn, or Cause Death".

b. Nameplates, Ratings Labels, and Connection Diagrams

- 1) The outside of each set of double doors providing access to high voltage: Nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture, and serial number
- 2) On inside of each set of double doors: Ratings label indicating the following:
 - a) Overall pad-mounted gear ratings: nominal voltage, kV; maximum voltage, kV; BIL voltage, kV; power frequency, Hz; short-circuit peak withstand current, amperes, peak; short-circuit one-second short-time withstand current, amperes, RMS, symmetrical; and short-circuit MVA, three-phase symmetrical, at rated nominal voltage.
 - b) Main bus ratings: continuous current, amperes; peak withstand current, amperes, peak; and one-second short-time withstand current, amperes, RMS symmetrical.
 - c) Switch ratings: continuous current, amperes; load splitting current, amperes; load dropping current, amperes; peak withstand current, amperes, peak; one-second short-time withstand current, amperes, RMS, symmetrical; and three-time duty-cycle fault-closing current, amperes, RMS symmetrical.
 - d) Fuse type and integral load interrupter ratings and capabilities: maximum current, amperes; load splitting current, amperes; load dropping current, amperes; and duty-

cycle fault-closing current, amperes, RMS symmetrical or asymmetrical.

- 3) On the inside of each door (or set of double doors), and on the inside of each switch-operating-hub access cover: Three-line connection diagram showing interrupter switches, fuses with integral load interrupters, and bus, along with the manufacturer's model number.

D. Manufacturers:

1. S&C Electric Company.

2.3 REQUIRED FIELD SERVICES

- A. No additional requirements.

2.4 PRODUCT, EQUIPMENT, MATERIAL AND/OR FIELD SERVICES WARRANTY REQUIREMENTS

- A. No additional requirements.

2.5 PRODUCT, EQUIPMENT, MATERIAL AND/OR FIELD SERVICES SUBMITTALS

- A. Manufacturer Certification of ratings of the basic switch and fuse components and/or the integrated pad-mounted gear assembly with the switch and fuse components in combination with the enclosure.

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EQUIPMENT SCHEDULE

Replacement pad mount switchgear shall have termination points positioned for connection to existing incoming and outgoing cables, dimensions suitable for mounting on existing pad, meet requirements of project specifications and shall be S&C Cat#5511 (PHM-5, olive green outdoor finish mild steel enclosure - KK interlock – 6” base – UL listing) with SMU-20 fusing rated for 24.4 KV nom, one 600A incoming way, one outgoing fuse way and 12,500A rms sym SC. Fuses shall be a 50E standard speed fuse. The standard speed should allow coordination with a slow or very slow fuse at the supply pole.

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