

THE UNIVERSITY OF
ARIZONA
TUCSON ARIZONA

**ARCHITECTURE SUBSTATION
105A/107A FEEDER LOOP
MODIFICATIONS**

PRE-PURCHASE

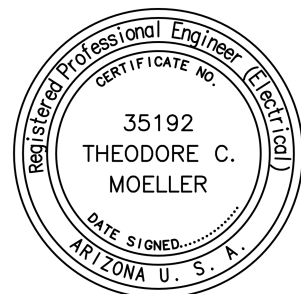
Section 263102 – Medium Voltage Pad Mounted Switchgear

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SECTION 263102 - MEDIUM VOLTAGE PAD-MOUNTED SWITCHGEAR

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section includes the furnishing and delivery of three (3) pad-mounted switchgear assemblies in accordance with this specification.

1.2 SUBMITTALS:

- A. Provide submittals in electronic format.

- B. Product Data:

- 1. Submit catalog cuts and descriptive literature for approval as specified herein.
 - 2. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
 - 3. The specific item(s) proposed shall be marked on the catalog cuts and shall be keyed to switch designations shown on plans.

- C. Shop drawings:

- 1. Submit plan drawings, front and rear elevation drawings, device summary, etc., necessary to fully evaluate compliance with the specifications.
 - 2. Shop drawings shall be at sufficient scale to show the details of construction, physical dimensions, and component locations relative to other parts of the structure. Any deviation of shop drawings from the specifications shall be called to the Architect/Engineer's attention in writing.
 - 3. Include dimensioned exterior and section views of the switchgear, floor plan of the switchgear, foundation plan of the switchgear, and provision and required locations for external wiring/bus entrances.

- D. Operation and Maintenance Manual:

- 1. Shall be a complete, detailed guide for maintenance and operation of the new equipment. Manual shall contain manufacturer's printed data and shall be sufficiently broad to serve operating staff as a permanent set of instruction which they can rely upon to understand the general theory and concept of the equipment and to assist them in making operating maintenance adjustments.
 - 2. The manual shall contain as a minimum: complete installation, operation and maintenance instruction books, complete parts lists, catalogs as well as detailed descriptions of special precautions, recommendations as to methods of adjustment of all parts requiring adjustment and a list of recommended spare parts. It shall also include complete interconnection diagrams that show all components of the switchgear lineup and complete diagrams of the internal wiring for each of the items of equipment. The diagrams shall identify the terminals to facilitate operation and maintenance.
 - 3. All final approved supplier-furnished drawings, submittals, and data shall be included and all shall be reduced to 11 inches high.
 - 4. The equipment designation and number shall be marked on each piece of literature and all non-relevant information shall be deleted.

1.3 QUALITY ASSURANCE:

A. Factory Testing:

1. Thoroughly test the switchgear at the factory. The factory tests shall be in accordance with the latest applicable standards of NEMA, ANSI, and IEEE.
2. Switch integrity shall be verified by measuring contact resistance between input and output terminals of all operational contacts with a low impedance ohm meter.

B. Factory Design Test Reports: Four copies of certified design test reports shall be submitted with equipment delivery. Reports shall include, but not be limited to, interrupting, short-time, momentary, BIL, high potential, fault close, and endurance performance.

1.4 APPLICABLE PUBLICATIONS: The following specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this specification to the extent indicated by the reference thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revision, supplements, and errata) on the date of Invitation for Bids shall be applicable. In text such specifications and standards are referred to by basic designation only.

A. National Fire Protection Association (NFPA) Publications:

70.....National Electrical Code (NEC)

B. National Electric Manufacturer's Association (NEMA) Publications:

SG6.....Power Switching Equipment

C. American National Standards Institute (ANSI)

C37.72..... Manually-operated, Dead-Front Padmounted Switchgear with Load Interrupting Switches and Separable Connectors for Alternating-Current Systems

C57.12.28..... Switchgear and Transformers – Padmounted Equipment – Enclosure Integrity

D. IEC Standard 60298, Annex AA

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements provide product and model by one of the following:

1. S & C, Vista.

2.2 GENERAL REQUIREMENTS

- A. Switchgear Item #1 shall consist of two (2) fault interrupters and (2) load interrupters.
 - 1. Quantity: 2.
- B. Switchgear Item #2 shall consist of two (4) fault interrupters and (2) load interrupters.
 - 1. Quantity: 1.
- C. The switchgear shall consist of a gas-tight tank containing SF6 gas, load-interrupter switches and resettable fault interrupters with visible open gaps and integral visible grounds, and a microprocessor-based overcurrent control. Load-interrupter switch terminals shall be equipped with bushings rated 600 amperes continuous, and fault-interrupter terminals shall be equipped with bushing wells rated 600 amperes continuous to provide for elbow connection. Manual operating mechanisms and viewing windows shall be located on the opposite side of the tank from the bushings and bushing wells, so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.

2.3 RATINGS

- A. The ratings for the integrated switchgear shall be:
 - 1. Frequency, Hz: 60
 - 2. Short-Circuit Current, Amperes, RMS, Symmetrical: 25,000
 - 3. Voltage Class, kV: 15.5
 - 4. BIL Voltage, kV: 95
 - 5. Main Bus Continuous Current, Amperes: 600
 - 6. Three-Pole Load-Interrupter Switches
 - a. Continuous Current, Amperes: 600
 - b. Load Dropping Current, Amperes: 600
 - c. Fault Closing Current, Duty-Cycle
 - d. Three-Time, Amperes, RMS, Symmetrical: 25,000
 - e. Three-Time, Amperes, Peak: 65,000
 - f. Ten-Time, Amperes, RMS, Symmetrical: 16,000
 - g. Ten-Time, Amperes, Peak: 41,600
 - 7. Fault Interrupters
 - a. Continuous Current, Amperes: 600
 - b. Load Dropping Current, Amperes: 600
 - 8. Fault Interrupting Current, Duty-Cycle
 - a. Three-Time, Amperes, RMS, Symmetrical: 25,000
 - b. Ten-Time, Amperes, RMS, Symmetrical: 25,000
 - 9. Fault Closing Current, Duty-Cycle
 - a. Three-Time, Amperes, RMS, Symmetrical: 25,000

- b. Three-Time, Amperes, Peak: 65,000
- c. Ten-Time, Amperes, RMS, Symmetrical: 16,000
- d. Ten-Time, Amperes, Peak: 41,600

2.4 CERTIFICATION OF RATINGS

- A. The manufacturer of the switchgear shall be completely and solely responsible for the performance of the load-interrupter switch and fault interrupter as well as the complete integrated assembly as rated.
- B. The manufacturer shall furnish certification of ratings of the load-interrupter switch, fault interrupter, and the integrated switchgear assembly consisting of switches and fault interrupters in combination with the gas-tight tank.

2.5 CONSTRUCTION

A. SF6-Gas Insulation

- 1. The SF6 gas shall conform to ASTM D2472.
- 2. The switchgear shall be filled with SF6 gas to a pressure of 7 psig at 68° F.
- 3. The gas-tight tank shall be evacuated prior to filling with SF6 gas to minimize moisture in the tank.
- 4. The switchgear shall withstand system voltage at a gas pressure of 0 psig at 68° F.
- 5. A gas-fill valve shall be provided.
- 6. A temperature-compensated pressure gauge shall be provided that is color coded to show the operating range. The gauge shall be mounted inside the gas-tight tank (visible through a large viewing window) to provide consistent pressure readings regardless of the temperature or altitude at the installation site.

B. Gas-Tight Tank

- 1. The tank shall be submersible and able to withstand up to 10 feet of water over the base.
- 2. The tank shall be of welded construction and shall be made of stainless steel.
- 3. A means of lifting the tank shall be provided.

C. Viewing Windows

- 1. Each load-interrupter switch shall be provided with a large viewing window at least 6 inches by 12 inches to allow visual verification of the switch-blade position (closed, open, and grounded) while shining a flashlight on the blades.
- 2. Each fault interrupter shall be provided with a large viewing window at least 6 inches by 12 inches to allow visual verification of the disconnect-blade position (closed, open, and grounded) while shining a flashlight on the blades.
- 3. Viewing windows shall be located on the opposite side of the gear from the bushings and bushing wells so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.
- 4. A cover shall be provided for each viewing window to prevent operating personnel from viewing the flash which may occur during switching operations.

D. High-Voltage Bus

1. Bus material shall be copper.
2. Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the switchgear.
3. Before installation of copper bus, all electrical contact surfaces shall first be prepared by machine-abrading to remove any oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.

E. Provisions for Grounding

1. One ground-connection pad shall be provided per way.
2. The ground-connection pad shall be constructed of stainless steel and welded to the gas-tight tank, and shall have a short circuit rating equal to that of the switchgear.

F. Connections

1. Load-interrupter switches and fault interrupters shall be equipped with 600-ampere bushings and bushing wells.
2. Bushings and bushing wells shall be located on one side of the gear to reduce the required operating clearance.

G. Bushings and Bushing Wells

1. Bushings and bushing wells shall conform to ANSI/IEEE Standard 386.
2. Bushings and bushing wells shall include a semi-conductive coating.
3. Bushings and bushing wells shall be mounted in such a way that the semi-conductive coating is solidly grounded to the gas-tight tank.

PART 3 - BASIC COMPONENTS

3.1 LOAD-INTERRUPTER SWITCHES

- A. The three-phase, group-operated load-interrupter switches shall have a three-time and ten-time duty-cycle fault-closing rating as specified under "Ratings." This rating defines the ability to close the switch the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished upon request.
- B. The switch shall be provided with an integral ground position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to ground the equipment.
- C. The ground position shall have a three-time and ten-time duty-cycle fault-closing rating.
- D. The switch shall be provided with an open position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to establish a visible gap.

- E. The open gaps of the switch shall be sized to allow cable testing through a feed-thru bushing or the back of the elbow.
- F. Each load interrupter switch shall have 3 position (closed – open – grounded), operation selector to prevent inadvertent operation from “closed” position directly to “grounded” position and vice versa. The grounded position shall ground the line side of the interrupter.

3.2 FAULT INTERRUPTERS

- A. Fault interrupters shall have a three-time and ten-time duty-cycle fault-closing and fault interrupting rating as specified under "Ratings." This rating defines the fault interrupter's ability to close the designated number of times against a three-phase fault with asymmetrical (peak) current in at least one phase equal to the rated value and clear the resulting fault current, with the interrupter remaining operable and able to carry and interrupt rated current. Certified test abstracts establishing such ratings shall be furnished upon request.
- B. The fault interrupter shall be provided with a disconnect with an integral ground position that is readily visible through the viewing window to eliminate the need for cable handling and exposure to high voltage to ground the equipment.
- C. The ground position shall have a three-time and ten-time duty-cycle fault-closing rating.
- D. The disconnect shall be provided with an open position that is readily visible through the viewing window, eliminating the need for cable handling and exposure to high voltage to establish a visible gap.
- E. The fault interrupter, including its three-position disconnect, shall be a single integrated design so that operation between the closed and open positions or the open and grounded positions is accomplished with a single, intuitive movement. The grounded position shall ground the line side of the interrupter.
- F. The open gaps of the disconnect shall be sized to allow cable testing through a feed-thru bushing or the back of the elbow.
- G. An internal indicator shall be provided for each fault interrupter to show when it is in the tripped condition. The indicator shall be clearly visible through the viewing window.

3.3 OPERATING MECHANISMS

- A. Load-interrupter switches and fault interrupters shall be operated by means of a quick-make, quick-break mechanism.
- B. The manual handle shall charge the operating mechanism for closing, opening, and grounding of the switches and fault interrupters.
- C. A single, integrated operating mechanism shall fully operate each fault interrupter or load interrupter switch in a continuous movement, so that additional operations are not required to establish open or grounded positions.

- D. Operating mechanisms shall be equipped with an operation selector to prevent inadvertent operation from the closed position directly to the grounded position, or from the grounded position directly to the closed position. The operation selector shall require physical movement to the proper position to permit the next operation.
- E. Operating shafts shall be padlockable in any position to prevent operation.
- F. The operation selector shall be padlockable to prevent operation to the grounded position.
- G. The operating mechanism shall indicate switch position which shall be clearly visible from the normal operating position.

3.4 OVERCURRENT CONTROL

- A. A microprocessor-based overcurrent control shall be provided to initiate fault interruption.
- B. The control shall be mounted in a watertight enclosure. The control shall be removable in the field without taking the gear out of service.
- C. Control settings shall be field-programmable using a personal computer connected via a data port to the control. The data port shall be accessible from the exterior of the enclosure. Neither external power nor energization of the gear shall be required to set or alter control settings. Necessary software shall be included.
- D. Power and sensing for the control shall be supplied by integral current transformers.
- E. The minimum total clearing time (from initiation of the fault to total clearing) for fault interruption shall be 40 milliseconds (2.4 cycles) at 60 hertz.
- F. The control shall feature time-current characteristic (TCC) curves including standard E speed, K-speed, coordinating-speed tap, coordinating-speed main, and relay curves per IEEE C37.112-1996. Coordinating-speed tap curves shall optimize coordination with load-side weak-link/backup current-limiting fuse combinations and coordinating-speed main curves shall optimize coordination with tap-interrupter curves and upstream feeder breakers.
- G. The standard E-speed curve shall have phase-overcurrent settings ranging from 25E through 400E. The standard K-speed curve shall have phase-overcurrent settings ranging from 25K through 200K. The coordinating-speed tap curve shall have phase-overcurrent and independent ground-overcurrent settings ranging from 50 amperes through 400 amperes. The coordinating-speed main curve shall have phase-overcurrent settings ranging from 100 amperes through 800 amperes and independent ground-overcurrent settings ranging from 100 amperes through 400 amperes.
- H. Time-current characteristic curves shall conform to the following IEEE C37.112-1996 IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays: U.S. Moderately Inverse Curve U1, U.S. Inverse Curve U2, U.S. Very Inverse Curve U3, U.S. Extremely Inverse Curve U4, U.S. Short-Time Inverse Curve U5, I.E.C. Class A Curve (Standard Inverse) C1, I.E.C. Class B Curve (Very Inverse) C2, I.E.C. Class C Curve (Extremely Inverse) C3, I.E.C. Long-Time Inverse Curve C4, and I.E.C. Short-Time Inverse Curve C5.

- I. The control shall have field-adjustable instantaneous-trip settings (0.2 kA through 6 kA) and definite-time delay settings (32 ms through 96 ms for coordinating-speed tap and 64 ms through 128 ms for coordinating-speed main), to allow tailoring of the coordinating-speed tap and coordinating-speed main curves to the application.
- J. Event records shall be easily extractable from the control using a personal computer connected to the data port.

3.5 VOLTAGE INDICATION

- A. Voltage indication with provisions for low-voltage phasing
 - 1. Voltage indication with provisions for low-voltage phasing shall be provided for each load-interrupter switch and fault interrupter by means of capacitive taps on the bushings, eliminating the need for cable handling and exposure to high voltage to test the cables for voltage and phasing. This feature shall include a flashing liquid-crystal display to indicate the presence of voltage for each phase, and a solar panel to supply power for testing of the complete voltage-indication circuit and phasing circuit.
 - 2. The voltage-indication feature shall be mounted on the covers for the viewing windows, on the opposite side of the gear from the bushings and bushing wells, so that operating personnel shall not be required to perform any routine operations in close proximity to high-voltage elbows and cables.

3.6 PAD-MOUNTED STYLE ENCLOSURE

- A. The switchgear shall be provided with a pad-mounted enclosure suitable for installation of the gear on a concrete pad.
- B. The pad-mounted enclosure shall be separable from the switchgear to allow clear access to the bushings and bushing wells for cable termination.
- C. The basic material shall be 14-gauge hot-rolled, pickled and oiled steel sheet.
- D. The enclosure shall be provided with removable front and back panels, and hinged lift-up roof sections for access to the operating and termination compartments. Each roof section shall have a retainer to hold it in the open position.
- E. Lift-up roof sections shall overlap the panels and shall have provisions for pad-locking that incorporate a means to protect the padlock shackle from tampering.
- F. The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.
- G. Panel openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between panels and panel openings to guard against water entry.
- H. For bushings rated 600 amperes continuous, the termination compartment shall be of an adequate depth to accommodate encapsulated surge arresters mounted on 600-ampere elbows having 200 ampere interfaces.

- I. An instruction manual holder shall be provided.
- J. Non-removable lifting tabs shall be provided.
 - 1. Enclosure Finish
 - a. All exterior welded seams shall be filled and sanded smooth for neat appearance.
 - b. To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, all surfaces shall undergo a thorough pretreatment process comprised of cleaning, rinsing, phosphatizing, sealing, drying and cooling, before any protective coatings are applied. The enclosure shall receive a highly consistent thorough treatment.
 - c. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the steel enclosure. To establish the capability to resist corrosion and protect the enclosure, representative test specimens coated by the manufacture's finishing system shall satisfactorily pass the following tests:
 - 1) 4000 hours of exposure to salt-spray testing per ASTM B 117 with:
 - a) Underfilm corrosion not to extend more than 1/32 inch from the scribe, as evaluated per ASTM D 1645, Procedure A, Method 2 (scraping) and
 - b) Loss of adhesion from bare metal not to extend more than 1/8 inch from the scribe.
 - 2) 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.
 - 3) 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.
 - 4) Crosshatch-adhesion testing per ASTM D 3359 Method B, with no loss of finish.
 - 5) 160-inch-pound impact, followed by adhesion testing per ASTM D 2794, with no chipping or cracking.
 - 6) 3000 cycles of abrasion testing per ASTM 4060, with no penetration to the substrate. Certified test abstracts substantiating the above capabilities shall be furnished upon request.
 - d. The finish shall be inspected for scuff and scratches. Blemishes shall be touched up by hand to restore the protective integrity of the finish.
 - e. The finish shall be Sage Green Fed Std. 595b Color 14449.

PART 4 - LABELING

4.1 HAZARD-ALERTING SIGNS

- A. The exterior of the pad-mounted enclosure shall be provided with "Warning-Keep Out-Hazardous Voltage Inside-Can Shock, Burn, or Cause Death" signs. Provide warning labels in Spanish and English.

- B. All warnings shall be bilingual, in English and Spanish.

4.2 NAMEPLATES, RATINGS LABELS, AND CONNECTION DIAGRAMS

- A. Each unit of switchgear shall be provided with a nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture, and serial number.
- B. Each unit of switchgear shall be provided with a ratings label indicating the following: voltage rating; main bus continuous current rating; short-circuit rating; fault-interrupter ratings including interrupting and duty-cycle fault-closing; and load-interrupter switch ratings including duty-cycle fault-closing and short-time.
- C. A one-line connection diagram showing load interrupters, fault interrupters and bus along with the manufacturer's model number shall be provided on the enclosure.
- D. Provide an engraved phenolic nameplate on each compartment, 1" lettering on black background, indicated switch designation and load served as specified by the University. Attach nameplates with #6 stainless steel screws. Provide "names" as directed by University of Arizona.

PART 5 - ACCESSORIES

5.1 USB CABLE KIT

- A. USB cable kit shall be provided for connecting an overcurrent control to a user-furnished personal computer. Provide one cable for each switch purchased.

PART 6 –GUARANTEE

- 6.1 All equipment furnished under this section of the specifications shall be guaranteed by the supplier against defective workmanship and material for a period of two (2) years from date of final acceptance of the complete operational unit. Guarantee shall include labor and material. All requests for service by the University under the guarantee provisions must be responded to within 24 hours.

PART 7 –DELIVERY

- 7.1 Deliver to University of Arizona and unload at the location on campus to be determined.

END OF SECTION 263102