UTILITIES & ENERGY SERVICES
TEXAS A&M UNIVERSITY

Design Standard

15kv Switches – Underground

Detailed specifications follow.

PART 1 - GENERAL

1.01 SUMMARY

A. This section specifies the furnishing of submersible load interrupter switchgear utilizing solid dielectric insulation. SF6 or oil Insulated switches are not acceptable.

1.02 REFERENCE STANDARDS

A. IEEE Std. C37.74 -2014 – Standard Requirements for Pad Mounted Load Interrupter Switchgear.

B. IEEE Std. C37.60 2012 – Standard Requirements for Fault Interrupters.

1.03 SUBMITTALS MUST PROVIDE THE FOLLOWING MINIMUM INFORMATION:

A. Manufacturer

B. One line diagram, three-line diagram, control diagrams.

C. Dimensional drawings, showing:
1. Outline dimensions.
2. Top and bottom views showing entry and exit space for conduits.
3. Front and side elevations showing arrangement of all devices.

D. Total weight of unit.

E. Installation procedures.

F. Operation and maintenance manuals.

G. Instrument transformer data.

H. Cut sheets/information on all devices used in switch.

PART 2 - PRODUCTS

2.01 TYPE

A. Provide solid dielectric vacuum load break switches and vacuum fault interrupters (VFI) 15.5KV, 600 Ampere rated dead-front switchgear assembly with the necessary accessory components, all completely factory-assembled and

operationally checked. Switch ways must be capable of both full fault interruption and fault closing at 20 kA symmetrical.

B. Switch shall have four ways, with all ways rated for 600A. Way shall be defined as a three-phase circuit consisting of three bushings and one vacuum fault interrupter (VFI), connected to a common bus.

C. The VFI Trip or VFI Protected Way shall be a solid dielectric insulated, three-phase fault interrupter mechanism with vacuum fault interrupter contacts capable of interrupting both 600 amperes of load current and rated fault current. The VFI-Trip Way shall include the VFI-Trip mechanism, trip circuitry, and current transformers mounted internally in the switch tank on the bushings. The VFI-Trip mechanism shall have three positions, Open, Closed and Tripped.

D. Switch shall have a Visible Open Isolation Point Switch (VOIP) which is a three-phase isolation point switch in series electrically with the vacuum contacts, integral to the VFI-Switch and VFI-Trip mechanism.

E. Switch shall be design and construction so that it is capable of being lowered through a standard 42-inch manhole opening, without removal of components.

2.02 RATINGS

A. Component ratings shall be as follows, and also as shown on the drawings:
1. System Voltage: 12.47KV, 3 Phase.
2. Maximum Voltage: 15.5 KV.
3. BIL Voltage: 95 KV.
4. Main Bus Continuous Amperes: 600A.
5. Short Circuit Amperes, Symmetrical: 20,000.
6. Short Circuit Amperes, Asymmetrical: 32,000.
7. Fault Closing, Amperes, Symmetrical: 20,000.
8. Fault Closing, Amperes, Asymmetrical: 32,000.
9. Peak Current (per IEEE C37.60): 52,000 amps.
10. Frequency: 60 Hertz.
11. Momentary withstand, Amperes, Symmetrical: 20,000.
12. Momentary withstand, Amperes, Asymmetrical: 32,000.
13. Short-Time withstand, Symmetrical: 20,000.

2.03 BASIC COMPONENTS

A. Solid dielectric insulation.
1. Mechanisms and bus work shall be solidly dielectrically insulated.
2. No liquid insulation allowed.
3. No SF6 gas insulation allowed.

B. Vacuum Fault Interrupters Ways (VFI-Trip).

1. Each mechanism shall have vacuum fault interrupter contacts rated for both load-break and fault interruption.
2. VFI-Trip Protected Ways shall include internally mounted current transformers, trip circuity, and a connection for an over-current relay.

C. Overcurrent relays shall be Square D P116 and shall be:
1. Powered by current transformers mounted internally in the switch tank on the bushings. Provide twelve, 600: 5CTs, and four CT shorting plugs.
2. Relay shall be powered and programmed in the field by a USB to mini USB connection.
   a. No external power other than a laptop shall be required for programming or downloading setting or events. No special manufacturer's cable or connections for the relay will be allowed.
   b. Relay shall also have ability to be programmed remotely.
3. Provide two relays.

D. Switch Tank.
1. Switch tank shall be constructed of 304 stainless steel.
2. Switchgear shall be 600 amp rated and shall be maintenance-free, fully-sealed, and dead-front design with solid dielectric insulation for the mechanisms and bus work.
3. The switch tank filled with approximately 3 to 5 pounds of dry air pressure to maintain the tank structure at sea level.

E. High Voltage Enclosures.
1. 304 stainless steel construction.
2. Double-Sided Access Enclosures:
   a. Cable terminations and operating handles are located on both sides.
   b. Phase sequence must follow existing equipment and cable phasing ABC-CBA.

F. Electrical Components.
1. The VFI-Switch device shall be a three-phase, gang-operated mechanism having a quick-make, quick-break design operating independently of the speed in which the external operating handle is opened or closed. The VFI-Switch mechanism shall have a two-position latch for open and closed positions. When the operating handle is pulled to the open position the vacuum contacts shall de-energize the circuit and the VOIP switch shall rotate to isolate the circuit creating a safe to work environment. The VOIP contacts shall be visible through the viewing windows on the surface of the switch tank.

2. The VFI-Trip device shall be a three-phase, gang-operated mechanism having a quick make, quick break design operating independently of the

speed in which the external operating handle is opened or closed. The vacuum fault interrupter mechanism shall have a three-position latch for open, closed and tripped positions. When the operating handle is pulled to the open position the vacuum contacts shall de-energize the circuit and the VOIP switch shall rotate to isolate the circuit creating a safe to work environment. The VOIP contacts shall be visibly through the viewing windows on the surface of the switch tank.

3. The internal copper bus shall be silver plated. The bus shall be insulated with solid dielectric material to maintain the BIL rating between phases and to ground.
4. The internal wiring for the current transformers, control trip circuitry, and mechanism status shall be made to connectors located on the switch tank surface. Cabling shall be supplied with appropriate connectors to plug into each connection and to the corresponding connection to the low voltage component or on the low voltage control cabinet.

G. Connectors.
1. Submersible-rated, stainless steel connector(s) shall be installed on the switch tank for the following optional features and equipment installed: mechanism status, VFI trip circuitry, internal current transformers, and internal voltage sensors.

H. Current Transformers.
1. Internally mounted 600:5 ratio current transformers shall be installed on all four 600 amp VFI trip bushings.
2. The current transformers will be terminated to a connector on the switch tank.
3. Provide four CT shorting plugs.

I. Ground Bus.
1. Provisions for mounting external ground bus bar or ground rod with short-circuit rating equal to that of the switchgear assembly shall be provided on tank surface.

J. Switch Tank.
1. The high voltage switch tank shall be constructed of type 304 stainless steel.
2. Enclosures and shall be welded using 308 type filler material to maintain the corrosion resistant properties of the stainless steel.
3. Switch tank is submersible-rated, fully-sealed, and not subject to moisture intrusion, even when submerged in 10 feet of water.
4. Bushing terminations shall be welded in place.
5. Provisions for lifting the switchgear shall be provided.

6. Each switch tank shall have ground nuts welded to the switch tank for customer installation for grounding equipment.

K. Operating Handles and Position Indication.
   1. A single external operating handle shall open the vacuum contacts and rotate the visible open isolation point device in one motion.
      a. Designs with two operating handles will not be considered.
   2. Each way shall have a vacuum contact position indicator located on the switch handle housing to indicate the Open and Closed positions of the vacuum contacts.
   3. **Open position** - a reflective nameplate with silver letters stating “Open” on reflective green background will be seen on the handle housing.
      a. When the operating handle is positioned up and away from the switch tank and the vacuum contact position indicator indicates “Open”, both the vacuum contacts and the visible open isolation point contacts will be in their open positions.
   4. **Closed position** - a reflective nameplate with silver letters stating “Closed” on reflective red background will be seen on the handle housing.
      a. When the operating handle is positioned down and flat against the switch tank and the vacuum contact position indicator indicates “Closed”, both the vacuum contacts and the visible open isolation point contacts will also be in their closed positions.
   5. **Tripped Position**.
      a. When the overcurrent relay identifies an over load or fault current, a signal from the overcurrent relay will be sent to the VFI-Trip mechanism solenoid to trip open the vacuum contacts.
      b. The vacuum contact position indicator will show “Open”, indicating that the vacuum contacts have been “tripped” open.
      c. The external operating handle will remain in the closed position until the operating handle is pulled to the full open position.
      d. When the external operating handle is pulled to the full open position, the VFI-Trip mechanism will be re-set and the visible open isolation point device will rotate to its open and isolated position.

L. Bushings.
   1. 600-amp bushings for all ways, rated 20KA.

M. Nameplates.
   1. Nameplates shall be 304 stainless steel with photo-engraved etched letters, schematics, and numbers.
   2. Ratings, schematic diagram, way, termination, and serial number designation nameplates.
      a. The ratings nameplate shall have:

1) Name of manufacturer.
2) Month and year of manufacture.
3) Catalog number.

b. The schematic diagram nameplate shall have:
1) Diagram of internal bus.
2) Weight.

c. Each way nameplate shall be numbered and welded to each switch handle housing.

d. The termination nameplates shall include the way and phase designation and will be located on the switch tank near their respective termination.

N. Overcurrent Protection Relays.

1. If specified in part number, CT powered relays shall be provided on VFI-Trip ways.
2. Overcurrent protection relays shall be microprocessor based, substation quality, programmable overcurrent relays, Schneider P116.
3. The overcurrent relays shall be installed in a submersible rated enclosure with hinged door and water tight gasket seal. Enclosure shall be designed so that the relay can be drawing out for testing.
4. The CT connections must short automatically when the relay is drawn-out of its case.

O. Motor Operator Mounting.

1. Provisions for mounting a motor operator on each of the switch handle housings shall be provided.

P. Motor operators (optional).

1. Motor operators are 24-volt, DC powered, and constructed of 304 stainless steel. Motor operators are sealed and submersible rated. The motor operator bolts directly to the operating handle housing for ease of field installation and future upgradability. Each motor comes with mounting hardware, connector pins and adjustable linkages to connect the motor operator to the operating handle. The quick-disconnect linkage allows for field testing and operation of the motor operator without interrupting service to the customer.
2. The motor operators must mount directly to the switch tank without requiring a special stand.
3. The motor operator must open both the vacuum contacts and the visible open isolation point device to de-energize and isolate the circuit in one operation from outside the vault.
4. 24v DC motor operators must be able to be installed on all ways.

5. When installed on a switch way, the motor operator will open and close both the vacuum contacts and the visible open isolation point contacts.
6. When installed on a VFI protected way, the motor operator will open and close both the vacuum contacts and the visible open isolation point contacts and also re-set the VFI mechanism and open the visible open isolation point after a trip command has been issued by the over-current relay.

Q. Future Automation.
1. Each enclosure must include provisions for installing a Future Automation Control on enclosure. Controls must be capable on all ways and by any individual configuration of one or more way.
2. Provisions for mounting and connecting future motor operators shall require the witch tank to be opened.

2.04 ACCEPTABLE MANUFACTURERS.

A. Innovative switchgear Model. No with S40406666-303-A09.

PART 3 - EXECUTION: BY INSTALLER OF SWITCH.

3.01 INSTALLATION.

A. Secure the Mounting Stand to the concrete pad as recommended by the manufacturer.

B. Secure the switch to the Mounting Stand as described by the manufacturer.

3.02 EQUIPMENT ADJUSTMENT.

A. Settings
1. Properly set relay current and time settings. Trip settings shall be set in accordance with the recommendations of the study performed under specification Section 26 05 73, Protective Relay and Device Coordination Study.

B. Inspection.
1. Thoroughly inspect switch for items such as loose connections and presence of foreign material, and remedy prior to energizing.

3.03 Field TESTING.

A. Relays.
1. Test by a relay manufacturer’s certified technician. After installation and before acceptance by the Owner, the Contractor shall provide the services of an independent testing organization to performance test all protective relays. This test shall involve passing a primary current through the current sensor with a suitable, low-voltage test set and timer, which shall allow

verification that the protective relays track their published curves and that they actually trip the devices on which they are applied. Refer to Protective Relay and Device Coordination Study, Section 26 05 73. This test shall also include the polarity of the current sensors and give an indication of satisfactory operation.

B. Controls.

1. All control devices and the corresponding operating sequences must be tested to verify operability.