Functional Specification for 2.4kV to 17.5kV UG Distribution Medium Voltage Vacuum Fault Interrupters

1. Scope

1.1. This specification applies to three-phase, ***[indicate 50 Hz or 60 Hz]*** single-way vacuum fault interrupters with up to 17.5 kV, 95 kV-BIL.

1.2. This specification shall only cover the purchase and shipment of medium voltage vacuum fault interrupters. The purchaser and/or user shall be responsible for all site-work, electrical connections, and installation.

2. Applicable Standards

2.1. IEEE Std C37.74™ standard – Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear up to 39 kV

2.2. IEEE Std 386™ standard – Separable Insulated Connector Systems for Distribution Systems above 600 V

2.3. IEEE Std C37.04™ standard – Rating Structure for AC High-Voltage Circuit Breakers

2.4. IEEE Std C37.09™ standard – Test Procedure for AC High-Voltage Circuit Breakers

2.5. IEEE Std C57.12.40™ standard – Standard for Secondary Network Transformer

3. Ratings

3.1. This specification is for three-phase, ***[indicate 50 Hz or 60 Hz]*** MV submersible, vacuum fault interrupters rated as follows:

Nominal System Operating Voltage (kV)	_____	***[17.5 kV Maximum]***
Maximum System Operating Voltage (kV)	_____	***[17.5 kV Maximum]***
Basic Insulation Level (BIL)	_____	***[95 kV Maximum]***
Continuous Current Rating (A)	_____	***[900A Maximum]***
Mechanical Operations Endurance	_____	***[10,000]***
Three-phase Short Circuit Rating (kA)	_____	***[25kA or 40kA max]***
Line-to-ground Short Circuit Rating (kA)	_____	***[25kA or 40kA max]***
Momentary Withstand (asym)	_____	***[65kA or 104kA max]***
Altitude above Sea Level (m)	_____	
Minimum Ambient Temperature (°C)	_____	
Maximum Ambient Temperature (°C)	_____	***[HDPE 180F/82C max]***
Seismic Level per IEEE Std 693™ standard	_____	***[Low, Moderate, High]***

4. Features and Construction

4.1. The manufacturer of the MV three-phase vacuum fault interrupter shall also be the designer and manufacturer of the vacuum bottle and interrupting mechanism to ensure the highest quality and one-point of responsibility for the integration of the key components.

4.2. The submersible enclosure shall be a single-compartment, unpainted, all-welded or welded with bolted panel construction, self-supporting structure manufactured of:

Bi-Layer HDPE – High Density Polyethylene _____

304L stainless steel _____

316L stainless steel _____

The enclosure shall meet submersibility requirements of three (3) meters or 9.8 feet of water above top of the enclosure per IEEE Std C37.74™-2014 standard.

4.3. Stainless steel nameplate containing the following information:

- Manufacturer
- Weight
- Serial Number
- Date of Assembly
- Rated Maximum Operating Voltage
- Rated Frequency
- Rated Continuous Current Rating
- Rated max Interrupting Rating
- Rated Basic Insulation Level (BIL)

The metal corrosion-resistant nameplate shall be affixed by corrosion resistant screws to the vacuum interrupter enclosure.

4.4. A non-resettable operation counter shall be provided.

4.5. A mechanical indicator shall be provided that will indicate the OPEN and CLOSE positions of the vacuum interrupter. The mechanical indicator shall be easily read through the inspection window. When the vacuum interrupter is fully open, only the word OPEN shall be visible. When the vacuum interrupter is fully closed, only the word CLOSE shall be visible.

4.6. An external operating handle shall be provided. Provisions shall be made with a latch to prevent accidental movement and means to padlock the handle with an 11.1 mm (7/16 in) shackle padlock in each position: OPEN, AUTO, and CLOSE for manually operated vacuum interrupter; OPEN and AUTO for electrically operated interrupter. An electrically operated interrupter may have a NULL position for padlocking. This is the spring return position from the CLOSE position of the switch. The position of the operating handle shall be clearly indicated by nameplates visible from the front of the enclosure. [Indicate whether manual CLOSE is disabled or enabled; hookstick operated from above vault; right or left location]

4.7. Placing the handle in the OPEN position shall cause the vacuum interrupter to open and remain open.

4.8. Placing the handle in the AUTO position shall cause the vacuum interrupter to be controlled remotely via protection and control relaying, manual pendant or SCADA.

4.9. The enclosure shall each include a minimum of two steel lifting eyes with a minimum inside diameter of 25 mm (1.0 in) and shall be located on opposite sides of the unit, in a vertical plane approximately through the center of gravity.

4.10. Enclosure-grounding provisions shall consist of a copper-faced-steel or stainless-steel pad with two holes horizontally spaced on 44.5 mm (1-3/4 in) centers and drilled and tapped for 1/2-13 UNC thread (refer to ASME B1.1 [B3]). The ground pad shall be welded to the enclosure. The minimum thickness of the facing shall be 0.38 mm (0.015 in). The minimum threaded depth of holes shall be 12.7 mm (0.5 in). Thread protection for the ground pad shall be provided.

4.11. The top bushings of the vacuum interrupter shall be located on the [indicate front or rear side] of the vacuum interrupter and labeled as [indicate load or source].

[Select Optional Features: Submersible Enclosure Air Test Fitting]

4.12. Air test provisions shall be provided. This consists of a 1/2 inch National Pipe Thread (NPT) female fitting on the enclosure with a sampling device, made of corrosion resistant material, installed into the fitting using a suitable thread sealer.

4.13. The enclosure shall be pressurized up to a maximum of 2 psi with nitrogen to purge and remove any residual humidity or moisture in the enclosure which is then sealed for moisture free operation.

5. [Select Optional Features: Mounting]

5.1. [Select: Floor Mounting]

5.1.1 The enclosure shall be equipped with stainless steel mounting feet for floor mounting. Mounting holes shall be .562” in diameter for accepting ½” hardware.

5.2 [Select: Elevating Stand Mounting]

5.2.1 The enclosure shall be equipped with a stainless steel adjustable elevating structure. The elevating structure shall allow for elevating the enclosure a minimum of 12” to 18” maximum with 1” increments in between**.**

5.3 [Select: Wall Mounting]

5.3.1 The enclosure shall be equipped with stainless steel supporting brackets for wall mounting.

6. Three-Pole Isolation Switch

6.1 A three-pole, manually group-operated, non-load break, air insulated, isolation switch shall be included internal to the enclosure and will provide a visible disconnect between the load- and source-side bushings.

Two viewing windows installed on each side of the enclosure shall be provided to clearly show that the bus of all three phases have separated which will serve as a visible break. A mimic diagram physically linked to the operating mechanism with a viewing window shall also be provided that clearly shows the position of the isolation switch.

6.2 The isolation switch shall be mechanically interlocked internally with the vacuum interrupting load-break mechanism. The switch shall also have a back-up electrical interlock which causes the vacuum interrupter to OPEN should an attempt to manually OPEN the isolation switch first be performed.

6.3 The isolation switch shall be mechanically interlocked internally with the grounding switch to prevent the grounding switch from being operated while the isolation switch is in the CLOSED position.

6.4 The manually operating interface shall be located on the ***[indicate right or left side]*** of the enclosure.

7. Three Pole Grounding Switch

7.1 A three-pole grounding switch shall be provided for grounding the bus electrically tied to the top side bushings and shall be located internal to the switch enclosure.

7.2 A ground switch with a fully insulated manually operating handle shall be provided for safety and visual ground indication. Remote operation not permitted.

7.3 Two viewing windows installed on each side of the enclosure shall be provided to clearly show that the grounding bus has made contact with all three phases electrically tied to the top side bushings. A mimic diagram physically linked to the operating mechanism with a viewing window shall also be provided that clearly shows what position the grounding switch is in.

7.4 The manually operating interface shall be located on the ***[indicate right or left side, same side as isolation operating interface]*** of the enclosure.

7.5 The grounding switch shall be equipped with mechanical interlocks located internal to the enclosure to prevent operation of the grounding switch while the visible isolation switch is in the CLOSED position.

7.6 The grounding switch shall be rated as follows:

5s withstand in ground position (kA) _____ ***[15kA Maximum]***

0.2 withstand in ground position (kA) _____ ***[45kA Maximum]***

8. Low Voltage Wiring

8.1 The low-voltage control wiring shall be completely self-contained within the enclosure unless otherwise noted in this specification.

8.2 All external control power will be provided by the end user; the MV Vacuum interrupter shall be rated for

[Select Control Operating Voltage: Vdc – 24, 48, 110 or 125; VAC – 120, 220 or 240]

8.3 [Select Optional Features:]

8.3.1 **[Submersible Plug]** All control wiring such as CLOSE, TRIP, AUX, Control Power, and other miscellaneous control functionality shall be wired to an 8- to 12-pin female plug connector located **[Indicate desired location of plug].**

8.3.2 **[Submersible Bulkhead]** All control wiring such as, CLOSE, TRIP, AUX, Control Power, and other miscellaneous control functionality shall be wired to an external bulkhead that is connected via a water-tight connection to the enclosure. All control wiring for status and control shall be wired to the necessary number of 8-point terminal blocks located inside the submersible bulkhead. The bulkhead shall be located **[Indicate desired location of bulkhead].**

8.3.3 **[Submersible Bulkhead]** The bulkhead shall be equipped with one (or two as required) 8-pin submersible female Fischer Plug connector.

8.4 [Select Optional Features:]

8.4.1 **[Select Optional Features: Submersible Cable]** The switch shall be equipped with one (or two as required) 8- to 12-pin submersible cables. The length of each cable shall be **[Indicate desired cable length].**

8.4.2 **[Select Optional Features: Control Pendant with Cable]** The control pendant shall be equipped two pushbuttons for remote OPEN and remote CLOSE of the vacuum interrupter. It shall also include indicating lights to indicate the status of the vacuum interrupter as well as the position of the isolation and ground rods.

8.4.3 The control pendant shall be equipped with one submersible cable. The length of the cable shall be **[Indicate desired cable length].**

9. Protection and Control

9.1. [Select Optional Features: Digitrip 1150 V] The primary vacuum interrupter shall be equipped with a Digitrip 1150 V controller capable of providing over-current protection, metering and communications functionality. The Digitrip shall be mounted internally to the enclosure located behind a water-tight access panel.

9.2. [Select Optional Features: Current Sensors] Current sensors shall be provided and mounted internal to the enclosure. The current sensor secondaries shall be wired internally and rated accordingly to match the rating of the vacuum interrupter and coordinate with the controller.

9.3. [Select Optional Features: Communication Module] A communication module shall be provided to interface with the Digitrip 1150 V allowing for seamless integration with upstream communication devices. The communication module will allow the user through a secure interface to view and change Digitrip settings via a personal laptop.

9.4. [Select Optional Features: Other] Alternate application requirements; i.e. based on the utility's specific relay protection and control standards.

10. Testing

10.1. The manufacturer shall test all wiring for grounds, opens and proper continuity, and for proper operation of all controls, contacts, switches, mechanisms and interlocks.

10.2. Type test reports shall be available upon request by the end user.

11. Quality Assurance

11.1. The manufacturer shall be a company specializing in submersible switching equipment.

11.2. Equipment shall be built in accordance with the industry standards for medium voltage equipment.

11.3. The manufacturer shall be registered and certified as ISO 9001 compliant by a recognized international and independent body.

11.4. Manufacturer warranty should include a minimum of 12 months from date of energization, not to exceed 18 months from ship date.

12. Approved Manufacturers

Eaton