**Typical Specification**

**Three-Phase Solid Dielectric Front Access Multi-way Switch**

**Part 1-GENERAL**

* 1. **DESCRIPTION**

The switch shall consist of a solid dielectric insulated manually operated load break switches and resettable vacuum fault interrupter electronically controlled.

* 1. **QUALITY ASSURANCE**
1. Manufacturer Qualifications: The chosen manufacturer shall have at least 10 years experience in manufacturing solid dielectric insulated medium voltage switchgear. The manufacturer shall be completely and solely responsible for the performance of the fault interrupter as rated.
2. The manufacturer shall furnish certification of ratings of the switch upon request.
3. The switch shall comply with requirements of the latest revision of applicable industry standards, including:

IEEE C57.12.28, IEEE C37.74, IEEE C37.60, ANSI/IEEE 386, IEC60529, IEEE 592

1. The switch shall be tested to IEC 60529 for submersibilty. The switch shall be rated IP68 for 7 days with a 10 foot head of water.
2. The switch manufacturer shall be ISO 9001 and 14001 certified.
3. The switch shall be RUS approved
	1. **DELIVERY, STORAGE, AND HANDLING**
4. The switch shall be shipped preassembled at the factory. No field assembly shall be required.
5. The contractor, if applicable, shall handle, transfer and move the switches in accordance with manufacturer’s recommendations.

**PART 2-PRODUCTS**

**2.1 SWITCH CONFIGURATION**

1. Each switch shall be equipped with 3-phase Trident load break switch ways and 3-phase Trident fault interrupter ways, as indicated on the one-line diagram
2. The switch shall be designed for front access to cables and operators
	1. **SWITCH CONSTRUCTION**
3. The switch shall be a dead-front design. The operating mechanism housing shall be stainless steel with a viewing window for verification of vacuum interrupter contact position. The mechanism housing shall be painted ANSI 70 light gray using corrosion-resistant epoxy paint. Operating handles shall be padlockable and adaptable to keylock schemes. The operating shaft shall be stainless steel providing maximum corrosion resistance. A double "O" ring shaft seal shall be used for a leak resistant, long life seal.
4. The solid dielectric modules must be coated with a semi-conductive layer of epoxy, providing a completely dead front device. The semi-conductive layer must be tested to IEEE 592 to ensure it can carry fault current to ground so as to ensure operator safety.
5. The switch shall be designed for long term operation in the harshest environments. The interrupter design must be tested to IEC60529 and achieve a protection rating of IP68, subjected to a 10’ head of water pressure for 7 days.
6. The switch shall interrupt all load and fault currents within the vacuum bottle.
7. Each switch mechanism shall consist of three individual vacuum bottle assemblies mechanically linked to a single spring-assisted operating mechanism. Manual opening and closing of each way shall be via an operating handle.
8. The load break ways shall be G&W Trident 3-phase switch
9. The fault interrupter ways shall be G&W Trident for 3-phase trip and reset

**2.3 DESIGN RATINGS**

1. Switch Ratings

The switch shall be rated (*choose appropriate column*):

|  |  |
| --- | --- |
| **SELECTION OF RATINGS** | **IEEE/IEC** |
| Maximum Design Voltage, kV | 15.5 | 27 | 29.3 | 38 |
| Impulse Level (BIL) Voltage, kV | 110 | 125 | 125 | 150 |
| Continuous Current, Amperes | 630 | 630 | 630 | 630 |
| Load break Current, Amperes | 630 | 630 | 630 | 630 |
| One Minute Withstand (dry), AC kV | 35 | 50 | 50 | 70 |
| Production Test Rating | 34 | 40 | 40 | 50 |
| 15 Minute Withstand, DC kV | 53 | 78 | 78 | 103 |
| Momentary Current, kA asymmetrical | 20 | 20 | 20 | 20 |
| Fault Close Current, kA asymmetrical | 20 | 20 | 20 | 20 |
| Fault Interrupter rating, kA asymmetrical | 20 | 20 | 20 | 20 |
| Fault Interrupter rating, kA symmetrical | 12.5 | 12.5 | 12.5 | 12.5 |
| Mechanical Endurance, Operations | 2000 | 2000 | 2000 | 2000 |

 IEEE C37.60 Fault Interrupting Duty for 12.5kA rated switches

|  |  |  |
| --- | --- | --- |
| **Percent of Maximum Interrupting Rating** | **Approximate Interrupting: Current, Amps** | **No. of Fault: Interruptions** |
| 15-20% | 2000 | 44 |
| 45-55% | 6000 | 56 |
| 90-100% | 12500 | 16 |
| Total Number of Fault Interruptions: 116 |

**2.4 CABLE ENTRANCES**

1. Load Break Switches

Cable entrances shall be tested to IEEE 386 and be, as indicated on the switch drawing:

\_\_\_\_15.5KV 110KV BIL 600A Dead break Apparatus Bushings per IEEE 386 Figure 11

 \_\_\_\_15.5KV 110KV BIL 200A Bushing Well per IEEE 386 Figure 3

\_\_\_\_27KV 125KV BIL 600A Dead break Apparatus Bushings per IEEE 386 Figure 11

 \_\_\_\_27KV 125KV BIL 200A Bushing Well per IEEE 386 Figure 3

\_\_\_\_38KV 150KV BIL 600A Dead break Apparatus Bushings per IEEE 386 Figure 13

 \_\_\_\_38KV 150KV BIL 200A Bushing Well per IEEE 386 Figure 3

1. Fault interrupters

Cable entrances shall be tested to IEEE 386 and be, as indicated on the switch drawing:

\_\_\_\_15.5KV 110KV BIL 600A Dead break Apparatus Bushings per IEEE 386 Figure 11

 \_\_\_\_15.5KV 110KV BIL 200A Bushing Well per IEEE 386 Figure 3

\_\_\_\_27KV 125KV BIL 600A Dead break Apparatus Bushings per IEEE 386 Figure 11

 \_\_\_\_27KV 125KV BIL 200A Bushing Well per IEEE 386 Figure 3

\_\_\_\_38KV 150KV BIL 600A Dead break Apparatus Bushings per IEEE 386 Figure 13

 \_\_\_\_38KV 150KV BIL 200A Bushing Well per IEEE 386 Figure 3

**2.5 VACUUM INTERRUPTER CONTROL**

An electronic control shall be provided to monitor load and fault current on all three phases of the interrupter. The current transformers encapsulated within the solid dielectric modules provide control power and current sensing. No external power source shall be required for overcurrent protection. Operational temperature range of the control shall be -40°C to +65°C. Maximum time for power up and ready to trip when closing on a circuit shall be ten percent of the trip time or 1/2 cycle, whichever is greater. Trip selection may be made with the interrupter energized. The range of Phase Overcurrent minimum trip settings shall be 15-300A (500:1 CT) or 30-600A (1000:1 CT) (the specifier must choose one)

*Select one of the following controls:*

Type 2

The control shall include 30 Time Current Characteristic (TCC) curves, which shall be field selectable using dip switches. The control shall be equipped with multiple TCC curve modification options, including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. All settings shall be inputted via selector knobs located on the faceplate of the control. The control shall include a last cause of trip indicator. Trip modules shall not require a computer or other external device for inputting trip settings or other operational parameters.

Type 3 EZSet

The control shall include 30 Time Current Characteristic (TCC) curves. All settings shall be inputted via the control’s Vacuum Fluorescent Display or via a computer. The control shall allow for multiple TCC curve modification options, including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. The control shall allow for the selection of independent TCC curves for Phase Overcurrent and Phase Imbalance (Ground Fault) protection. The control shall include a Sequence of Events Recorder (SER) which shall record the last 16 causes of trip. The control programming software shall include password protection, the ability to download the SER, and the ability to save and print setting files.

Type 4 EZSet

The control shall include 30 Time Current Characteristic (TCC) curve. All settings shall be inputted via a computer. The control shall allow for multiple TCC curve modification options, including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. The control shall allow for the selection of independent TCC curves for Phase Overcurrent and Phase Imbalance (Ground Fault). The control shall include a Sequence of Events Recorder (SER) which shall record the last 16 causes of trip. The control programming software shall include password protection, the ability to download the SER, and the ability to save and print setting files.

Type 7 EZSet

 (Note to specifier: Type 7 EZSet or Plus are highly recommended for subsurface applications)

The control shall include 30 Time Current Characteristic (TCC) curves. All setting options shall be inputted via a computer. The control shall allow for multiple TCC curve modification options, including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. The control shall allow for the selection of independent TCC curves for Phase Overcurrent and Phase Imbalance (Ground Fault). The control shall include a Sequence of Events Recorder (SER) which shall record the last 16 causes of trip. The control programming software shall include password protection, the ability to download the SER, and the ability to save and print setting files. Switches equipped with a Type 7 control shall include a 6’ programming cable that is submersible, and suitable for permanent attachment to the interrupter while in service. The programming cable shall allow the user to stand up to 6’ away from the device during programming.

Type 3 Plus

The control shall include 60 pre-loaded and 5 user created time current characteristic (TCC). All setting options shall be accomplished using the Vacuum Fluorescent Display or a computer. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. The control shall allow for multiple curve modification options for each minimum trip setting (phase and ground) including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. The control shall allow for two settings groups (protection and alternate). The control shall allow for two TCC curves for each protection settings group (one for phase and the other for phase imbalance (ground fault)). The control shall include an option for single or three phase trip (Phase Imbalance/ Ground Fault shall not be available when the control is set for single phase trip). The control shall include a Sequence of Events Recorder (SER) which shall include the last 16 causes of trip. The control programming software shall include password protection, the ability to download the SER, and the ability to save and print setting files.

Type 4 Plus

The control shall include 60 pre-loaded and 5 user created time current characteristic (TCC). All setting options shall be accomplished using a computer. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. The control shall allow for multiple curve modification options for each minimum trip setting (phase and ground) including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. The control shall allow for two settings groups (protection and alternate). The control shall allow for two TCC curves for each protection settings group (one for phase and the other for phase imbalance (ground fault)). The control shall include an option for single or three phase trip (Phase Imbalance/ Ground Fault shall not be available when the control is set for single phase trip). The control shall include a Sequence of Events Recorder (SER) which shall include the last 16 causes of trip. The control programming software shall include password protection, the ability to download the SER, and the ability to save and print setting files.

Type 7 Plus

(Note to specifier: Type 7 EZSet or Plus are highly recommended for subsurface applications)

The control shall include 60 pre-loaded and 5 user created time current characteristic (TCC). All setting options shall be accomplished using a computer. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. The control shall allow for multiple curve modification options for each minimum trip setting (phase and ground) including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. The control shall allow for two settings groups (protection and alternate). The control shall allow for two TCC curves for each protection settings group (one for phase and the other for phase imbalance (ground fault)). The control shall include an option for single or three phase trip (Phase Imbalance/ Ground Fault shall not be available when the control is set for single phase trip). The control shall include a Sequence of Events Recorder (SER) which shall include the last 16 causes of trip. The control programming software shall include password protection, the ability to download the SER, and the ability to save and print setting files. Switches equipped with a Type 7 control shall include a 6’ long programming cable extension that is submersible and capable of permanent attachment to the device while in service.

***Options for Vacuum Interrupter Controls***

(Choose as required for the application)

* The control cable shall be connectorized, allowing the electronic control to be removed from the interrupter for repair or replacement while the interrupter is energized. The interrupter shall include protection circuitry to allow this while preventing any damage to the current transformers. (applicable to Type 2, 3, and 4 only)
* The control shall include an option to allow it to be powered via a (select one: 24VDC, 48VDC, 120VAC, 220VAC) source. The control shall include an option to accept a dry contact input that will cause it to initiate a trip signal to the interrupter.
* For Dry Applications: Control mounted in a NEMA4X rated fiberglass enclosure (applicable to Type 2, 3, and 4 only)
* For Wet/ Damp Applications: Control to be epoxy coated and achieve a protection rating of IP68, subjected to a 20’ head of water pressure for 20 days. (applicable to Type 4 only)

**2.6 PAD MOUNT ENCLOSURE**

(Note to specifier: for pad mount applications only

The enclosure shall be fabricated of 12 gauge galvanized steel and manufactured to ANSI C37.72 and C57.12.28 standards. The enclosure shall be tamper resistant incorporating hinged access doors with pentahead locking bolts and provisions for padlocking. The enclosure shall be provided with lifting provisions and painted with a Munsell 7.0GY3.29/1.5 green finish.

**2.7 FACTORY PRODUCTION TESTS**

Each interrupter shall undergo the following production testing. Test reports must be available upon request

* A mechanical operation check
* AC hi-pot tested one minute phase-to-phase, phase-to-ground and across the open contacts
* Circuit resistance shall be checked.
* Each solid dielectric module shall undergo an X-ray inspection and a partial discharge test to ensure void-free construction.
* Leak test to insure the integrity of all seals and gaskets
* Primary current injection test to test CTs, trip mechanism, and electronic control

**2.8 STANDARD COMPONENTS**

The following shall be included as standard:

* Welded stainless steel mechanism housing painted light gray with stainless steel and brass fasteners.
* Lifting provisions
* ½”-13 nuts to provide sufficient grounding provisions for interrupter and all cable entrances.
* Stainless steel three line diagram and corrosion-resistant nameplates.
* Switch operating handle with padlock provision.
* Removable parking stands
* Mounting bracket
* Operating handle

**2.9 OPTIONS**

(Choose as necessary for the application)

The following options shall be supplied:

* Mounting frame to bolt switch to the floor (specify galvanized or stainless steel construction. Specify height of lowest bushing)
* 4/0 brass ground lugs
* Provisions to mount a key interlock after installation
* Key lock installed at the factory, to lock in open position
* Two (2) Form C contacts for remote monitoring of the position of the vacuum bottle contacts.
* Junction box for wiring Form C contacts or external power source for Electronic Control (specify NEMA 4X for dry applications or NEMA6P for wet/damp applications)
* 12-gauge stainless steel enclosure manufactured to ANSI C37.72 and C57.12.29 standards. The enclosure shall be tamper resistant incorporating hinged access doors with penta head locking bolts and provisions for padlocking. The enclosure shall be provided with lifting provisions and painted with a Munsell 7.0GY3.29/1.5 green finish.

**2.10 LABELING**

A. Hazard Alerting Signs

The exterior of the pad mount enclosure (if furnished) shall be provided with “Warning--Keep Out--Hazardous Voltage Inside--Can Shock, Burn, or Cause Death” signs. Each unit of switchgear shall be provided with a “Danger--Hazardous Voltage--Failure to Follow These Instructions Will Likely Cause Shock, Burn, or Death” sign. The text shall further indicate that operating personnel must know and obey the employer’s work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment. Each unit of switchgear shall be provided with a “Danger--Keep Away--Hazardous Voltage--Will Shock, Burn, or Cause Death” sign.

B. Nameplates, Ratings Labels, and Connection Diagrams

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. Each unit of switchgear shall be provided with a ratings label indicating the following: voltage rating; main bus continuous rating; short-circuit rating; fault interrupter ratings including interrupting and duty-cycle fault-closing; and fault interrupter switch ratings including duty-cycle fault-closing and short-time.