

Annexure- HT panel

General Technical Specification – Air Insulated Switchgear - 11kV

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1.0 Scope :

This specification covers the design, manufacturing, testing, packing and supply of Medium Voltage Indoor Air Insulated drawout type switchgear panels upto 12kV, with Vacuum Circuit Breaker.

The switchboard shall be totally enclosed, indoor, metal clad, single front, single busbar of fully compartmentalized construction comprising of a row of free standing, floor mounted panels. Each circuit shall have a separate vertical panel with distinct compartments for circuit breaker, main bus bars, cable compartment and low voltage compartment. Each compartment of the individual cubicles shall be segregated by metal partitions. Cubicles should be type tested for internal arc in all three HT compartments for 25KA for 1sec AFLR - as per IEC 62271-200

The Switchgear Panels, breaker, vacuum interrupter & relay shall be of same make only.

2.0 Codes and Standards :

The switchgear shall be manufactured and tested in line with the latest revisions of the following International Standards :

- 2.1 IEC 62271-100 :- High voltage alternating current Circuit Breakers.
- 2.2 IEC 62271-200 :- AC Metal enclosed Switchgear and Controlgear for rated voltages above 1kV and upto & including 52kV.
- 2.3 IEC 62271-1 :- International Standard :- Common specification for High Voltage Switchgear and Control gear standards.
- 2.4 IEC 60071-1 :- Insulation coordination for equipment in three phase systems above 1kV.
- 2.5 IEC 60529 : Degrees of protection provided by enclosures (IP Code)
- 2.6 IEC 61869 - 2 : Current Transformers.
- 2.7 IEC 61869 – 3 : Voltage Transformers.
- 2.8 IEC 62052 : Electrical indicating instruments.
- 2.9 IEC 60255-1 : Electrical Relays for power system protection.
- 2.10 IEC 60721-3 : Classification of environmental conditions.
- 2.11 IEC 61243-5 : Voltage detecting systems
- 2.12 IEC 62271-210 : Seismic Qualification
- 2.13 IEC 60099-6 : Surge Arrestors

3.0 Site Conditions :

The switchgear and control gear shall be suitable for continuous operation under the basic service conditions as indicated below :

Ambient Temperature : - 5 to + 50 Deg C

Altitude of installation : Up to 1000m

Relative Humidity : Up to 90%

Design Ambient Temperature : 40 Deg C

4.0 Enclosure and Mechanical Construction :

- 4.1 The switchgear shall be metal clad and shall be made of standard pre-fabricated cold rolled sheet steel units assembled (bolted) to form a rigid, free standing structure. The material used for sheet metal shall be CRCA – Grade D as per IS 513(From reputed manufacturers like Tata Steel, JSW, Essar Steel etc) with robust surface finish, having lower strain hardening coefficient and improved planar anisotropy(improved drawability). The switchgear structure having CRCA sheets shall be powder coated (inside and outside) providing optimal surface protection with long life properties enabling easy maintenance and cleaning. The sheet metal shall be pre-treated using 7-Tank process and then epoxy powder coated with paint shade of RAL 7035. Thickness of paint shall be at least 80 micron average. The minimum sheet metal thickness for different parts of the panel shall be as follows :

Frame - 2mm
High Voltage Door - 2.5mm
Low Voltage Door - 2mm
Pressure release flaps - 1mm
Partitions between compartments - 2mm
Partitions wall between panels - 2mm
Ground Plate - 2mm MS
Rear Side cover plates - 2mm
End wall - 2mm

In case of Internal Arc, gases shall always pass from the top of the panel.

Hence, the explosion flap located at the top of the switchgear should be designed using steel sheets of suitable thickness. This acts as a pressure relief system to allow safe and controlled passage of hot gases in the event of an internal arc in any chamber. Therefore, top sheets should preferably be 1 mm to allow the passage of gases easily.

Wherever single core cables are used, the detachable gland plates shall be made of Aluminium sheet.

- 4.2 Partitioning – The Switchgear shall be fully compartmentalized by metal partitions. Metal shutters and partitions between live parts and open compartment (Metal-enclosed condition maintained) shall comply to partition class PM.
- 4.3 Service continuity – Whenever an accessible compartment of the switchgear is opened, the incoming cable, the busbar and the adjacent switchgear panels shall remain in operation. The Switchgear shall comply to loss of service continuity category LSC-2B.

- 4.4 Degree of protection - The switchgear shall be totally enclosed and vermin proof. The switchgear panel shall have minimum degree of protection IP4X for complete enclosure. If necessary, openings for natural ventilation such as louvers and ventilation box shall be provided with a wire mesh(less than 1mm) on the inside.
- 4.5 Mimic - Mechanical Mimic shall be provided on the front of the circuit breaker door. Mimic shall be able to indicate the mechanical(Test/Service) position of the VCB by means of direct mechanical linkage of the true position with the inside mechanism. There should not be any use of electrical limit switches to achieve the same. Vertical position on the Mimic shall indicate VCB in service position and Horizontal position on the Mimic shall indicate VCB in test position. If Earth Switch is provided, Mimic shall be able to indicate Earth Switch ON/OFF position mechanically.
- 4.6 The switchgear shall be designed for single busbar system and fully inter-compartmentalized by means of metal sheets to sub-divide each panel as per below :
- Busbar Compartment
 - Low Voltage compartment
 - Circuit Breaker compartment
 - Potential Transformer Compartment (Withdrawable)
 - Cable Compartment
 - Pressure Relief Compartment (Only in case of Internal Arc 1 Sec)
 - Absorber assembly on selected panels (Only in case of Internal Arc 1 Sec)

All these compartments shall be segregated from each other by means of earthed metallic sheet without any perforations.

Rear covers, side covers shall be bolted to the frame and the front doors shall be hinged.

- 4.7 The complete switchgear shall be designed with full consideration for the safety of the operating person in the event of an internal arc. The panels shall be fully type tested for Internal Arc 25kA for 1 Sec IAC AFLR for all High Voltage compartments. In case of internal arc, the gases and pressure shall be released to the atmosphere through an arc absorber via pressure relief chamber. The design of the absorber shall be such that the gases are directed over and above the switchgear thus ensuring the safety of operators and equipment in the near vicinity of the switchgear. Switchgear design shall also ensure that there shall be minimal penetration of hot gases between the compartments within a panel to limit the damage and restoration time. Panels shall be suitable to withstand IAC of rating equal to full short circuit level of switchboard.
- 4.8 It shall be possible to extend the switchgear in either direction in the future date.
- 4.9 All hardware shall be of zinc passivated with EHS compliance (CR-VI free), high quality, high tensile steel (Grade 8.8).
- 4.10 Accessibility of Compartments :
- Busbar Compartment – Busbar compartment shall always be accessible from Top whenever maintenance is required. Access to busbar compartment shall always be tool based when busbar are dead.

Breaker Compartment – Access to the breaker compartment shall be controlled by integral design of the switchgear. Same shall be accessible only if all mechanical interlocks are complied.

Cable Compartment – Access to Cable compartment shall always be tool based. Solenoid based interlocking shall be provided which shall allow opening of rear cover only when main cables are dead and/or VCB is in test position. Alternatively, electrical interlock can be provided to ensure that breaker is tripped if the rear cover is opened when VCB is in Service position.

- 4.11 Viewing Inspection window shall be provided on front High voltage door to view the ON-OFF Indicator, Closing Spring charge Indicator, Operation counter. Also viewing inspection window shall be provided on rear cable compartment cover. Panel shall be fully type tested for IAC with Inspection window.
- 4.12 Lifting handle shall be inbuilt on rear cable compartment cover.
- 4.13 The panel shall be suitable for mounting directly on the finished/levelled floor.
- 4.14 High voltage door shall be provided with sliding handle arrangement for ease of opening of the door.

5.0 Main Busbar compartment, connections, supports and busbar design :

- 5.1 The switchgear shall comprise of 3 phase busbars, which shall extend through all the units of the switchgear line up. All phases of busbars shall be of uniform cross section throughout the switchgear and shall be sized to carry continuously the current specified in the Single Line Diagram with respect to site conditions.
- 5.2 Busbar shall be of flat profile. Shape of busbars shall be same for all ratings. Busbars shall not have any sharp edges. The Sharp edges of busbars shall be rounded. The busbars shall be joined between panels using bolted joint. High tensile M12 bolts and nuts of property class 8.8 to be used with Belleville(conical) washers.
- 5.3 The bus-bars shall be located in a separate metal clad chamber and shall be completely air insulated. Panels shall be completely type tested for full Basic Insulation level and rated current(Temperature Rise test) primarily with air insulation only. No other insulation like sleeving to be considered for type testing of panels.
- 5.4 Busbar shall be made of electrolytic Copper or Aluminium. If Copper, it should be of ETP grade, with full hard properties. The conductivity of the copper busbars at 20 DegC shall be 97-99%. If Aluminium, it should be of WP Range2. The conductivity of aluminium busbars at 20DegC shall be 55-57%.
- 5.5 For easy identification and handling of Busbars at site, loose busbars shall be dispatched mounted on side of the breaker compartment of individual panel. Separate box of loose busbars shall not be acceptable.
- 5.6 Phase identification in busbar compartment shall be done with polyester stickers pasted at suitable locations. Phase sequence shall be R-Y-B from left to right looking from front of the panel.

- 5.7 In case of higher busbar current ratings, ventilation boxes for cooling busbar system shall be provided. Panels shall be completely type tested for required degree of protection IP4X even with ventilation boxes.
- 5.8 The clearance between the live busbar and the nearest earth partition/ member shall be suitably arranged so as to withstand the 1 minute power frequency withstand voltage and impulse withstand voltage as specified in IEC-62271-1. However, switchgear shall be type tested for dielectric of 12kV/28kV/75kVp without any insulation on busbars.
- 5.9 Busbars shall not require any additional bus supporting insulators/bushings while passing between the panels.

6.0 Breaker Compartment, Vacuum Circuit Breakers :

- 6.1 The offered switchgear panel shall be with horizontal isolation and horizontal drawout vacuum circuit breaker. The circuit breaker shall be of cassette type design. Minimum 2 no. circuit breaker transport trolleys per width(for interchangeability) required for movement of cassette breaker outside the compartment shall be provided for each switchboard. All the operations of the switching device shall be with front door closed only.
- 6.2 The breaker terminals shall be fitted with contact arms and movement between test/service position shall be behind closed doors using a hand crank. No open door operation shall be allowed. Breakers shall be provided with Tulip contacts which shall ensure solid engagement and less contact resistance.
- 6.3 The breaker shall have three distinct positions :

Service Position : Where both auxiliary and power circuit are connected.

Test Position : Where Auxiliary circuit is connected and Power circuit is disconnected.

Isolated Position : Where both auxiliary and power circuit are disconnected.
- 6.4 In test/disconnected position of the breaker, it shall be easy to isolate circuit breaker compartment from other compartments. The other compartments can remain live while maintenance or other kind of work can be carried out in circuit breaker compartment. The opening for isolating contacts shall be closed by means of positively driven metallic safety shutters. The movement of these shutters shall be interlocked mechanically with the movement of the withdrawable unit so that these will open only when the movement of the withdrawable unit is from test to service and shall close the respective opening when the movement of the withdrawable unit is from service to test position. These positively driven safety shutters shall be individual for cable and busbar openings. Both shutters shall be operable independently as well as shall be padlock able separately. It should not be possible to operate these shutters manually. Shutters shall be operable by breaker movement or with the help of dedicated tool. Suitable identification/caution labels shall be provided on these safety shutters.
- 6.5 In case of higher current ratings, ventilation boxes for cooling breaker contact system shall be provided. Also compartment door shall be provided with louvers. Panels shall be completely type tested for required degree of protection IP4X even with ventilation boxes and louvers.

- 6.6 Space heater shall be mounted as per design standards. Minimum rating of Space heaters shall be 100 watts. Protection cover shall be provided on space heater to avoid any accidental touch.
- 6.7 Each circuit breaker shall be provided with following accessories :
- a) Shunt trip coil suitable for operation between 70% - 110% of rated voltage. Approximate power consumption of trip coil shall vary between 140 Watts – 300 Watts. Tripping time shall be less than 75ms.
 - b) Closing coil suitable for operation between 85% - 110% of rated voltage. Approximate power consumption of closing coil shall vary between 140 Watts – 370 Watts. Closing time shall be less than 60 ms.
 - c) Spring charging motor suitable for operation between 90% - 110% of rated control voltage. Motor shall be a universal motor. Spring charging time shall be less than 15 Sec. Provision for manual Spring charging shall also be provided in test as well as service position. During manual spring charging operation, if electrical supply is restored, then spring charging handle shall be decoupled automatically ensuring operators safety.
 - d) Inbuilt Anti pumping device.
 - e) Mechanical ON/OFF Indicators for indicating status of breaker.
 - f) Mechanical ON/OFF push buttons with pad locking facility for manual operation of breaker.
 - g) Operation counter for counting the operations of the breaker.
 - h) Breaker status auxiliary Switch having 11 NO + 11 NC contacts.
 - i) Breaker position limit switch with 4NO at test position and 4NO at service position.
 - j) Mechanical Test/Service indicator on withdrawable unit for indicating position of breaker. Same shall be indicated through mechanical mimic provided on high voltage door.
- 6.8 Circuit breaker shall comply to Electrical Endurance – E2 class, Mechanical Operations - M2 class, Capacitive Switching duty - C2 class in conformance to IEC 62271-100.
- 6.9 Circuit breaker operating duty shall be 0 – 0.3Sec – CO – 3 min – CO.
- 6.10 DC component at rated short circuit breaking current for circuit breaker offered shall be 50% upto STC of 31.5kA.
- 6.11 Following minimum safety interlocks shall be provided so as to achieve maximum operating personnel safety :
- It shall not be possible to rack out the withdrawable Vacuum Circuit Breaker from Service to Test position when the breaker is in 'ON' condition. Similarly, it shall not be possible to rack in the breaker from Test to Service position, if the Vacuum Circuit Breaker is in 'ON' condition.
 - Any attempt to rack out Circuit Breaker from Service to Test position will not result in switching OFF of the Circuit Breaker instead the breaker Service position will be locked till VCB is 'ON'.
 - It will not be possible to rack in or rack out/operate Vacuum Circuit Breaker when the front high voltage door is open.

- High voltage door opening shall only be possible when breaker is locked in test position.
- Breaker can be switched ON or OFF only when the breaker is locked in either test or service position.
- Double bit key shall be removed only when breaker is locked in test or service position.
- High voltage door shall not be able to close unless low voltage control plug is connected.
- It will not be possible to rack in the Vacuum Circuit Breaker from test to service position when the low voltage control plug is not connected.
- When earthing trucks are provided for cable and bus earthing, same shall have necessary electrical interlocks during insertion inside panel. For eg, while inserting cable earthing truck inside incomer feeder, upstream breaker shall always be in 'Test' position. While inserting Bus earthing truck in BusPT panel, all incoming sources on that bus shall be in 'Test' position.

7.0 Cable compartment, connections :

- 7.1 The Cable compartment shall accommodate following equipments :
- a) Bushings with mating contacts for lower contact arms of withdrawable part.
 - b) Current Transformers
 - c) Cable Termination bars
 - d) Inter-panel Main earth busbar
 - e) Space heater
 - f) Cable supports
- 7.2 The current transformers shall be mounted in compartment in the upside-down position using CT mounting fixture.
- 7.3 Phase identification labels shall be placed on cable termination bars for easy identification.
- 7.4 Space heater shall be mounted as per design standards. Minimum rating of Space heaters shall be 100 watts. Protection cover shall be provided on space heater to avoid any accidental touch.
- 7.5 Ample space / termination height shall be provided in the cable chamber so as to terminate 3 core/ 1 core cables as specified in the Single Line Diagram. Cable termination height from gland plate to cable terminations shall be minimum 580mm suitable for mounting 11kV(UE) cables comfortably without any cable pan.
- 7.6 Earth busbar extension shall be provided for direct continuous earth throughout the switchboard.
- 7.7 Wherever applicable, cable compartment shall be suitable for mounting the Surge arrestors, Core balance current transformers, Capacitive Voltage detection.

- 7.8 The incomer as well as outgoing power connections shall be through XLPE cables and shall be accessible from rear bottom. The power as well as control cable shall enter the switchgear panel from the bottom.
- 7.9 Split type detachable undrilled gland plates of minimum 2mm Mild steel shall be provided for cables at bottom of the panel. In case of single core cables, the gland plate shall be of non magnetic material.
- 7.10 There shall be an inspection window at the rear back cover enabling operator to have visual inspection of power cable connections without opening rear cover in live condition. Viewing window at the rear side shall have internal arc withstand capability.
- 7.11 Maximum 3 runs x 3 core x 400sqmm cable arrangement shall be possible in standard panel depth.

8.0 Instrument Transformers :

The Instrument transformers shall be used for measurement of electrical quantities like voltage, current, power, used with protection relays for protection of power system. Instrument transformer shall be of two types :

- 1. Current Transformer
- 2. Potential Transformer

8.1 Current Transformer –

- a) Current transformer shall be epoxy cast resin insulated.
- b) Current transformer shall conform to IEC 61869-2
- c) Insulation class for current transformer shall be class E or better.
- d) Current transformer shall be multi core used for metering and protection respectively.
- e) Current transformer shall have minimum burden of 5VA for both the cores.
- f) Current transformer secondary current shall be 1A/5A.
- g) Primary rating of current transformer shall be as per attached SLD.
- h) Accuracy class for metering core shall be class 1.0 and for protection core shall be 5P10.
- i) Current transformer shall be rated for full short circuit current for 3 Sec. For Primary rating below 100A, current transformer shall be rated for full short circuit current for 1 Sec.

8.2 Potential Transformer –

- a) Potential transformer shall be epoxy cast resin insulated.
- b) Potential transformer shall conform to IEC 61869-3
- c) Insulation class for potential transformer shall be class E or better.
- d) Potential transformer shall be dual core. Core 1 for metering and protection, Core 2 for Open Delta connection which damps the ferro resonance effect.
- e) Potential transformer shall have minimum burden of 50VA for both the cores.
- f) Potential transformer secondary voltage shall be 110V/rt3 for Core 1 and shall be 110V/3 for Core 2.
- g) Primary rating of potential transformer shall be as per attached SLD.

- h) Minimum accuracy class for core 1 shall be 1.0/3P and core 2 shall be 3P(Open Delta).
- i) The bus as well as line voltage transformer shall be in single pole version. 3 no.s single phase PT shall be used along with suitable primary fuse.
- j) Both Line PT and Bus PT shall be drawout type.
- k) Line Potential transformer : Line PT shall be provided in separate compartment below breaker compartment. Same shall be drawout from front. Withdrawable PTs shall be provided with shutters and bushing to cables. PT movement shall be completely independent of breaker movement to ensure PT maintenance without disturbing the breaker. Top mounted PTs shall not be acceptable.
- l) For ratings where front drawout PTs are not possible, rear drawout / fixed PTs shall be acceptable.
- m) Bus potential transformer : Bus PT shall be provided in separate BusPT panel or adaptor panel(If buscoupler is considered). Same shall be drawout from front.
- n) Rated voltage factor for potential transformer shall be 1.2 continuous & 1.9 for 30 seconds.

9.0 Low Voltage Compartment

9.1 The Low voltage compartment shall house following equipments :

- a) Flush Mounted Equipments on Low voltage door - Numerical relays, Metering devices, Switches, Indication lamps, Push buttons.
- b) Equipment mounted inside Low voltage compartment – Auxiliary contactor, MCBs, Fuses, terminal blocks, Metrosils, Damping resistors.
- c) Control and auxiliary wiring

9.2 The low voltage compartment height shall vary depending upon the number of equipments to be mounted and wired. Height of the low voltage compartment shall be uniform for complete switchgear.

9.3 Wiring - Inside the cubicles, the wiring for control, signalling, protection and instrument circuits shall be done with flexible PVC insulated conductors of insulation grade 1100V. Minimum wire sizes with colour indication shall be as follows :

Current Transformer – 2.5sqmm , Respective phase colour
 Potential Transformer – 1.5sqmm, Respective phase colour
 Control and Protection – 1.5sqmm, Grey
 Control Plug – 1sqmm, Grey
 Bus Wires - DC – 2.5sqmm, Grey
 AC Circuit – 2.5sqmm, Red and Black
 Earth – 2.5sqmm, Green-Yellow or Green
 Rs 485 Looping – 1.5sqmm, 3 core insulated shielded cable

9.4 Tubular type white coloured printed ferrules with black lettering as per local dependent end marking shall be provided on both end of the wiring.

9.5 More than two wires shall not be terminated onto a single terminal.

9.6 All wires travelling from High Voltage compartment devices to Low Voltage compartments shall be enclosed in an earthed metal enclosed flexible conduit or earthed metal duct.

9.7 Wiring to Low Voltage compartments of neighboring panels shall be tied in a common loop

utilizing cable ties and shall run at upper part of Low Voltage compartment, travelling between compartments in purpose built cut-outs in sidewalls, fitted with edge protection as they pass through sidewalls.

- 9.8 All inter-panel control wiring including wiring within the same shipping section shall be done by the manufacturer. For different shipping sections, wires in rolls of the required length shall be provided.

- 9.9 Terminals – Following type of terminals shall be provided for connection of different circuits. Terminals shall be polyamide type

Current Transformer – Disconnecting Shorting type – Screw/Stud type – with Ring lug

Potential Transformer, Control and protection, Control Plug, AC circuit – Through type – Screw/Push type – With Pin lug

Buswires, Earth – Through type – Screw/Push type – With Pin/Ring lug

- 9.10 External Labels to identify equipment or devices shall be manufactured from two ply laminate with black letters engraved on white background. They shall be fitted to door using rivets.

- 9.11 Devices mounted inside LV compartment shall be identified by their function number with self adhesive yellow labels with black lettering affixed to fixed part of enclosure.

- 9.12 Devices mounted on LV compartment door shall be identified from inside by their function number with self adhesive yellow labels with black lettering fixed to door immediately near device. Function number marking shall be done on equipment as well.

- 9.13 Connection of Low Voltage compartment to earth shall be made by frame of the panel. No separate wire shall be installed to make this connection. A terminal strip shall be installed within LV compartment to make a common connection of earth to frame. Where devices are mounted on door and electrical connections are made to these devices then door shall be bonded to frame using a 6 sqmm wire conductor. Earth connections to individual earth points on relays and meters etc shall be made from this point via 2.5sqmm green/yellow cables.

- 9.14 Panel rating nameplate shall be provided inside Low voltage compartment.

- 9.15 Indicating Instruments -

a) All indicating meters shall be digital, flush mounted on panel front. The instruments shall be of at least 96 mm square size, and shall have an accuracy class of 1.0 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

b) Multifunction meter shall be Microprocessor based communicable composite meters with RS485 port & Modbus protocol for downloading on serial communication to PC/HMI (Currents, Voltages, frequency, power factor, kWH, kVARH, kVAH) and conform to accuracy class as per SLD. Meters shall be suitable for PT secondary of 110V (line) and CT secondary of 1A.

9.16 Control switches :

- a) Breaker Control Switch – TNC Switch – Switch shall be 4 ways, Spring return type, with pistol grip handle, having three position with inscription TRIP-NORMAL-CLOSE in clockwise sequence. Switch shall have 2 NO contacts in close and 2 NO contacts in trip. Switch shall be non-lockable and flush mounted.
- b) Local/Remote Switch – Switch shall be rotary type, open execution flush back of panel, having two positions Local and Remote. Switch shall have 2 poles. Switch shall be lockable and flush mounted.

9.17 Push Buttons :

Push-buttons shall be of spring return, push to actuate type. All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise.

9.18 Indicating Lamps :

Indicating lamps shall be of the panel mounting LED type.
Lamps shall have translucent lamp-covers. Lamps shall be easily replaceable from the front of the cubicle. Indicating lamps shall have colour coding as per below :

Breaker ON – Red
Breaker OFF – Green
Master Trip Operated – Amber
Trip Circuit Healthy – White
Spring Charged - Blue

9.19 Illumination Lamp :

240V AC LED Lamp with minimum 3W rating shall be provided with mounting provision.

9.20 Plug and Socket :

6/16A plug and socket suitable for 240V AC, 4 in 1 with inbuilt MCB shall be provided.

10.0 Relays and Protection :

Relays shall be provided in each feeder as per protections mentioned in SLD.

10.1 Numerical Relay :

Following features shall be included in numerical relay :

- **Construction:** The relay shall be draw out type and shall ensure that CT circuits remain short circuited when relay is withdrawn. The rear terminal blocks shall comprise M4 female terminals for ring crimp wire connections, to provide a secure and reliable termination.
- **LEDs:** Relay shall have 9 user programmable TRI color self / hand reset LEDs allowing for clear indication of associated functions state and shall have label insert for user defined text labelling.
- **Auxiliary Power Supply :** Relay shall be suitable for universal aux supply from 24 VDC to 250 VDC / 100-230 VAC.

- **Current Inputs:** relay shall have site selectable 1A/5A current inputs. Relay shall have optional Sensitive current input for sensitive E/F protection. i.e 4CT configured as 3PF + EF or 3PF + SEF/REF.
- **Voltage Inputs :** Relay shall have voltage inputs for measurement of PT voltage. Shall have phase to phase & Phase to neutral voltage measurement.(Applicable for Incomer & Buscoupler feeder only)
- **Binary Inputs :** Relay shall have up to 6 binary inputs with individual pick up and drop out times. It shall be possible to invert BI for user specific application.
- **Binary Outputs:** relay shall have up to 8 binary outputs which shall be configured as self reset / pulsed output or latched output.
- **Communication Interfaces:** The relay shall offer a USB serial port as standard on the front of all units. All of the relays functions can be set on a PC using suitable software via the USB port. The connection is made with a USB cable and operates with a 'plug and play' connection, so no pre-setting of the relay is required. The relay shall support user selectable communications protocols DNP3.0, MODBUS-RTU, IEC60870-5-103 with RS485 connection possibility and shall also support IEC61850 protocol with either electrical or optical redundant ports. Relay with IEC61850 ports shall support PRP (parallel Redundancy Protocol).
- **Operating and evaluation software :** it shall be possible to do settings, interrogate settings, retrieve events and disturbance waveforms, view measurements using windows based software tool. The parameterization tool shall provide functions for simple and fast commissioning, e.g. for the testing of binary inputs and outputs or of the communication interface. Furthermore, it shall be possible to initiate test fault records for commissioning purposes.
- **Password Protection:** Relay shall have 2 level Password Protection: One for setting and other for control.

Monitoring Functions :

- **Sequence of event records :** Up to 1000 events shall be stored and time tagged to 1ms resolution.
- **Fault Records :** The last 100 fault records shall be displayed on the relay fascia and shall also available through the communication interface, with time and date of trip, measured quantities and type of fault.
- **Waveform recorder :** The waveform recorder shall store analogue data for all poles and the states of protection functions, binary inputs, LEDs and binary outputs with user settable pre & post trigger data. A record can be triggered from protection function, binary input or via data communications. 10 records of 1 second duration shall be stored.
- **Demand Metering :** A rolling record of demand over the last 24h shall be stored. The demand shall be averaged over a user selectable period of time. A rolling record of such demand averages is stored and provides the demand history. A typical application is to record 15min averages for the last 7 days.
- **Programmable Logic:** It shall be possible to map binary inputs, protection elements, LEDs and binary outputs together in a logical scheme using standard logic functions e.g. Timers, AND/OR gates, Inverters and Counters to provide the user required functionality. Each logic output can be used for alarm & indication and/or tripping.

Protection features for Outgoing Feeder :

- 37 Undercurrent Protection
- 50 / 51 Overcurrent protection
- 50N / 51N / Non Directional Earth Fault protection
- 50SEF / 51SEF / Non Directional Earth Fault protection

- 51C Cold Load Current Protection
- 46BC Phase Unbalance/Broken Conductor
- 46NPS Negative Phase Sequence Overcurrent
- 49 Thermal Overload
- 50BF Circuit Breaker
- 64H High Impedance Restricted Earth Fault
- 81HBL2 Inrush Restraint
- 50AFD Arc flash detection
- 50 SOTF

Protection features for Incomer & Buscoupler Feeder :

In addition to outgoing feeder protection, incomer & Buscoupler feeder should have following protection functions.

- 67 Directional Overcurrent protection
- 51V Voltage controlled Overcurrent protection
- 67N Directional Earth Fault protection
- 67SEF Directional Earth Fault protection
- 27/59 Under/Over Voltage protection
- 47 Negative Phase Sequence Voltage
- 59N Neutral Overvoltage Protection
- 81 Under / Over Frequency protection
- 32 Directional Power Protection
- 32S Directional Sensitive Power Protection
- 55 Power Factor

10.2 Master Trip Relay :

Single pole high speed tripping relay, flush mounted, Non Drawout shall be provided suitable for 110V DC. Burden of the relay shall be high. Contact combination for trip relay shall be 3NO + 1NC with hand reset provision. Relay shall be provided with flag.

11.0 Auxiliary Supply :

- 11.1 110V DC auxiliary supply shall be considered for operation of closing and tripping coil of breaker. DC supply shall be arranged at site through external battery source.
- 11.2 240V AC auxiliary supply shall be considered for operation of spring charging motor, space heaters, illumination lamp, Plug and socket. AC supply shall be arranged at site.

12.0 Earthing and earthing trucks :

- 12.1 All cubicles shall be connected to an earth busbar running throughout the length of the switchboard. Earth busbar shall run through cable chamber.
- 12.2 Size of the earth busbar shall be suitable for rated short circuit current.
- 12.3 All non-current carrying metallic parts shall be earthed to the earth busbar effectively through structure.

- 12.4 Provision for connecting earth busbar to earthing grid shall be provided in cable chamber of every 5th panel of switchgear.
- 12.5 Cable earthing truck and Bus earthing truck shall be provided for cable earthing and bus earthing respectively. Earthing trucks shall be provided with necessary safety interlocking fitted with solenoids.

13.0 Name plates :

- 13.1 All panels shall be provided with prominent identification plates for board and feeders at front and rear of panels. Feeder Nameplate shall include feeder number, feeder rating, feeder type and feeder description.
- 13.2 All name plates shall be two ply laminate with black letters engraved on white background.
- 13.3 Specific Danger symbols shall be applied to explosion ventilation points, removable covers providing access to live parts. These shall be with black symbols on yellow background and shall be stickers.
- 13.4 Sticker type Name plate shall be provided on top of explosion vents with label "DO NOT STEP".

14.0 Painting :

- 14.1 All Panels sheet-metal shall be powder coated (inside and outside) providing optimal surface protection with long life properties enabling easy maintenance and cleaning.
- 14.2 Following Specification of Powder Coating required :
 - a) Colour – RAL 7035
 - b) Powder type – Epoxy – Polyester Resin based
 - c) Thickness – Minimum 80 Micron average

15.0 Packing :

- 15.1 Packing of panels shall be done using Tri wall packing. Same shall be Sea worthy packing.
- 15.2 Packing shall be suitable for indoor conditions and shall ensure protection against moisture, rain, dust, prevention from rusting/corrosion of components. Packing shall be rigid enough to withstand the anticipated transportation strains, stacking pressures, acceleration strains and vibrations.
- 15.3 Packing shall be recyclable type.
- 15.4 All sharp edges shall be covered properly to avoid tearing off of the inside polyethylene bag.
- 15.5 Proper dunnage shall be provided on the front of the Low voltage chamber to avoid any damage to equipment mounted on the door as well as the sides of the panel to avoid any transit damage.

16.0 Dimensions :

- 16.1 Standard Depth of the panel shall be limited to 1350mm for Short time current upto 31.5kA
- 16.2 In case a rear extension box is required for mounting additional current transformer, accommodating more no :of cables, the same shall be of equivalent height of the HV compartment of the panel.

17.0 ROUTINE TESTS :

Routine tests shall be carried out in accordance with IEC 62271-200, IEC 62271-100 standards.

These tests shall ensure the reliability of cubicle.

Below listed test shall be performed as final acceptance tests at manufacturer's works before the delivery of switchgear :

- i) Power Frequency voltage test on the Main Circuit (HV Test)
- ii) Circuit Breaker Test : Measurement of breaker Operation times at minimum and maximum control voltage, Measurement of Contact Resistance.
- iii) Functional test : Mechanical Operation Test, operation of functional locks, electrical and mechanical interlocks, signalling devices and auxiliary devices
- iv) Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism
- v) Verification of wiring
- vi) Visual inspection
- vii) CT/PT routine tests to be carried out at Sub Suppliers works and necessary test certificates shall be submitted. Current Injection test shall be performed at manufacturers end.

18.0 TYPE TESTS

The manufacturer shall submit following Type test reports to prove the capability and suitability of his offered switchgear. The design of circuit breaker shall be proven through all the type tests in accordance with IEC 62271-200, IEC 62271-100 and any amendment thereof. Type test report earlier than 10 years from the date of tender opening shall not be acceptable. The switchgear should have been subjected to all type tests at an internationally recognized testing station, like PEHLA, KEMA or NABL/STL accredited laboratory like ERDA/CPRI.

Type tests certificates / reports shall be considered acceptable if they are in compliance with the latest applicable relevant IEC Standards

The following tests shall be carried out as a minimum requirement :

- i) Short Time Current Test (Rated for 3 Sec)
- ii) Short Circuit Test duties on Circuit Breaker (Rated for 3 Sec)
- iii) Impulse voltage withstand Test. (Without Insulation)

- iv) Power Frequency voltage withstand test (Without Insulation)
- v) Temperature rise test, measurement of resistance of main circuit.
- vi) Internal Arc Test – AFLR – 25kA for 1 Sec – For all HT Compartment
- vii) Mechanical Endurance test on Circuit Breaker – M2 Class
- viii) Test to prove Degree of Protection of enclosure – IP4X
- ix) Electrical Endurance test – E2 Class
- x) Capacitive Current Switching test – C2 Class

19.0 Technical Particulars

1	Nominal System voltage	11 kV
2	Highest System voltage	12 kV
3	Rated Frequency	50 Hz
4	Number of phases/ poles	Three
5	System neutral earthing	Solidly grounded
6	Power frequency withstand voltage	28kV
7	Impulse withstand voltage	75kVp
8	Short time rating	25kA for 3 sec
9	Dynamic withstand rating	62.5 kA (peak)
10	IAC A FLR Rating	25kA for 1 sec
11	Control supply voltage:	
a)	Aux control voltage – DC	110V DC
b)	Aux control voltage – AC	240V AC
12	Design ambient temperature	40 deg. C
13	Degree of Protection for Enclosure	IP4X
14	Paint Shade	RAL 7035

20.0 1.0 Pre-qualification criteria for Air Insulated Switchgear manufacturer

- 1 Manufacturer shall have established manufacturing facility of 11KV, Single Bus switchboards with Vacuum circuit breakers and shall have proven track record of at least 20 years within India.
- 2 Manufacturer shall have minimum yearly average turnover of 500 crores in the last three financial year in medium voltage switchgear business.
- 3 Manufacturer shall have facilities for design, research and development, engineering, manufacturing for switchgear panel, circuit breaker, vacuum interrupter. Same make panel, breaker, vacuum interrupter shall be used in the project.
- 4 Manufacturer shall have designed, engineered, manufactured, tested and supplied, in the last 10 years reckoned from the bid opening date, at least five sets of 11KV Air Insulated Indoor

Switchboards with vacuum circuit breaker for different customers in India & comprising not less than 30 panels each and same must have completed two years of operation as on bid due date.

5 Manufacturer shall have necessary infrastructure/ established AIS facility/ works in India with respect to availability of spares, personnel, equipment etc. to provide support for installation, testing & commissioning, post order support services including supply of spares and for repair & maintenance of up to 11KV Air Insulated Indoor switchgears. Manufacturer shall have carried out site service activity from its Indian establishment for at least five sets of 11kV Air Insulated Indoor switchgears installed in India comprising of 10 panels each. Necessary purchase order copy to be submitted.

WARRANTY / SERVICES:

Warranty on Complete HT VCB Panel - 30 months from date of supply and 24 month from date of installation whichever is earlier.

TEST REPORTS: Agree to provide all relevant documents Test Report / supporting document /reports etc. (from authorized government designated agency) to the buyer at the time of bidding or on demand

DOCUMENTATION:

Detailed technical manuals, handbooks, warranty card and factory quality assurance checklist, test results and any other certifications, if any, shall be supplied along with the consignment.

Supplied manuals/handbooks must cover detailed technical specifications and installation, operation, maintenance and system safety procedures.

The receipts for taxes paid, if any, for the supplied equipment should also be submitted.

Any other relevant documents, instruction manual, specifications or data necessary for satisfactory installation, operation and maintenance to be submitted as & when required.

DRAWINGS :

General Arrangement Drawing, Foundation Drawing, Structural Drawing or any other required drawing (if any) must be got approved by Sr. DEE/G/ASN or AEE/G/ASN before inspection & supply of items. These Drawings should have proper spaces for signature of checking authority & approval authority.

INSPECTION:

1. Supply items (likes P&M items, Luminaries and any special items included in LOA having bid value more than Rs. 5,00,000/- should be inspected / tested by RITES (as per Railway Board's Circular) with firm cost at manufacturer's premises / site as decided by Railway.
2. Material supplied should be as per the description, scope and specification in the tender document. Contractor will intimate in advance for readiness of materials for inspection.
3. Manufacturers test certificates for the different test carried out should be submitted by the tenderer.

The decision of Railway Administration for inspection of supply items by RITES / Consignee by firm own cost over the matter will be final.

The description of scheduled item is indicative. Entire Electrical Work is to be done in line of relevant RDSO's specification & Guideline or IS/IEC or PCEE/ER's specification & design, Electrical General Service Manual ,Volume-I (Power Supply) & latest or OEM Standardisation or equivalent international standard for detail technical specification and all other clauses, terms & conditions for design, manufacture, testing, supply, installation and commissioning

followed by statutory rules and common prudence and shall confirm to the rules & regulations of Railways. **The decision of Railway Administration over the standardisation & make for execution of the work will be final.**

The eligible contractor must furnish the detail of material which is proposed to be supplied or used inevitably got approved from Sr.DEE(G)/ASN or Sr.SE/Elect/G- the Supervision-in-charge of the work or authorized representative of Sr. SE/Elect/G before commencement of work. Decision of Railway administration over the standardisation& make of all the material for the items of work schedule will be final.

PUBLIC PROCUREMENT POLICY (MAKE IN INDIA): Bidder must follow Public Procurement Policy (Make in India) Order 2017, dated 15/06/2017, issued by Department of Industrial Promotion and Policy, Ministry of Commerce, circulated vide Railway Board letter no. 2015/RS(G)/779/5 dated 03/08/2017 and 27/12/2017. The definition and calculation of local content in accordance with the Make in India policy as approved by PCEE/ER is 50% of Minimum Local Content (MLC).

NOTE:-

These technical details / general specifications are indicative only. In case of any ambiguity in the General specification or Technical Details it may be collected from Sr. DEE (G)/Asansol's office if required. All items pertaining to Electrical should confirm to relevant IS or equivalent international standard. Any deviation must be got approved by Sr.DEE/G/ASN.

Any typographical error shall not be construed to be benefit of the Contractor; In all cases the interpretation and decision of Sr.DEE/G/ASN shall be final and binding upon the contractor.

The issues not covered under these tender documents shall be governed by General Conditions of Contract April-2022 or its time to time latest amendments if any.

**Sr. Divl. Electrical Engineer (Genl.)
Eastern Railway, Asansol**