

**TECHNICAL SPECIFICATION FOR 11KV 350 MVA 1250AMP VCB SWITCHGEAR  
PANELS**

**1.0 SCOPE:**

- 1.1- The specification covers, the design, manufacture, testing and supply of 11KV, 3 phase, 50 c/s, air insulated metal clad indoor vacuum type switchgear unit with horizontal draw out circuit breaker as per ISS 2516 or latest amendment thereof.
- 1.2- All the equipments shall be suitable for satisfactory operation in tropical climates and dry dust laden atmosphere prevailing in UP. The equipment shall be able to with stand a wide range of temperature variation in Uttar Pradesh.
- 1.3- All the plant/apparatus/equipment supplied shall comply in all respect with the requirement of Indian Electricity Act 1910 and Indian Electricity Rule 1956/ISS and latest amendment thereof during the execution of contract wherever applicable.

**2.0 CONSTRUCTION**

- 2.1- The Switchgear shall be of sheet steel construction with M.S. sheet not less than 3 mm thick for load bearing section and not less than 2 mm thick for non-load bearing and shall be totally dust and vermin proof. All doors & removable covers shall be gasketed all around with neoprene/self adhesive gasket. The panels shall be rigid without using any external bracings. The switchboard panels should comply with relevant ISS/IEC and revision thereof and shall be designed for easy operation, maintenance and further extension. Bus bar, metering, circuit breaker chamber, cables and cable box chamber should have proper access for maintenance. Proper interlocks should be provided. All instruments shall be non-draw out type. Safe guards in every respect against damages shall be provided with mechanical indicator of connected and disconnected position of breaker. The switchgear shall be complete with all necessary wiring, fuses, auxiliary contacts terminal boards etc.
- 2.2- The components and bus bar should be rated for 350 MVA for 3 seconds. The bus bars shall be capable of connecting one switchgear panel to other through proper insulated arrangement, which does not decrease the insulation strength of the bus bar at the point of connection between two panels.
- 2.3- The breakers should be able to be drawn out in horizontal position at ground level (with vertical/horizontal isolation). When the breaker is drawn out, none of the live components inside the 11 KV switchgear panel should be accessible. The safety shutters shall be robust and shall automatically cover the components when the breaker is drawn out. The switchgear shall have complete interlocking arrangements at the fully inserted and fully drawn out position of breaker. Withdrawal of the breaker should not be possible while the circuit breaker is in service position.

**3.0- BUS BARS AND CONNECTORS**

- 3.1- Bus bars and all other electrical connection between various components shall be made of electrolytic copper of rectangular cross sections. The bus bars section shall be ample capacity to carry the rated current of 1250 Amp continuously without excessive heating and for adequately

meeting the thermal and dynamic stresses in the case of short circuit in the system up to full MVA rating specified in Para 2.2 above.

- 3.2- All bus bars connections shall be firmly and rigidly mounted on suitable insulators to withstand short circuit stresses and vibrations.
- 3.3- Adequate clearance between 11 kV point and earth and between phase shall be provided to ensure safety as per provision in Indian Electricity Rule 1956 and its amendment thereof and also in accordance with the relevant Indian standard specification and the same shall be capable of withstanding the specified high voltage tests as per ISS-2516.
- 3.4- Sharp edges and bends either in the bus bars or bus bar connections shall be avoided as far as possible. Where ever such bends or edges are un-avoidable, suitable compound or any other insulation shall be supplied to prevent local ionization and consequent flashover.

#### 4.0- **CIRCUIT BREAKER**

- 4.1 The circuit breakers shall have assembly of 3 vacuum interrupters complete with epoxy support insulators and self aligned finger type of contacts and shall be drawn out type suitable for insulation in the switchgear cubicles. The breakers shall comply with IS-2516 and latest amendment thereof. **The vacuum interrupters in VCBs shall be of original ABB, Areva, Siemens, Crompton Greaves, BEL (India), Megawin makes only with short circuit current 25 KA for 3 second , 2000 Amp and guaranteed for 50,000 mechanical and electrical operations at full rated current.** The contact in the interrupter shall be of oxygen free high conductivity copper. Construction of breaker shall be such that the point, which required frequent maintenance, shall be easily accessible.
- 4.3- The circuit breakers shall be motor operated /charged type LSG spring operated in addition to manually charged, manually released spring closing mechanism for 3 pole simultaneous operation. The speed of closing operation shall be independent of the speed of hand operating lever. The indication device shall show the OPEN and CLOSE position of breaker visible from the front of cubicle. The tenderer must be the manufacturer of the breaker.
- 4.4- The breakers shall be capable of making and breaking the short time current in accordance with the requirement of ISS: 2516 and latest amendment thereof and shall have three phase rupturing capacity of 350 MVA for 3 second at 11 kV. The continuous current rating of breaker shall not be less than 1250 Amp for all items. The total break/make time shall not be more than 4 cycle for break and 6 cycle for make time for all breakers.
- 4.5- The breakers shall ensure high speed extinction and adequate control of pressure during breaking of current and also designed to limit excessive over voltages.
- 4.6- Comprehensive interlocking system to prevent any dangerous or inadvertent operation shall be provided. Isolation of circuit breaker from bus bar or insertion into bus bar shall only be possible when the breaker is in the open position. Arrangements shall be there in both incoming and outgoing panels that in case of failure of shunt trip protection relay, the panels can be tripped through the shunt trip coils directly to provide protection against over current and earth fault, by passing the shunt trip relay. And also the scheme should facilitate in case of failure of shunt trip coils, the VCB shall be tripped through a separate shunt trip coil mounted in the circuit breaker.

- 4.7- Rated operating sequence of circuit breaker shall be 0.3sec-co-3min-co.
- 4.8- The circuit breaker shall be truck mounted designed with roll on floor type.
- 4.8- Vacuum interruptor must have been type tested along with the breaker, copy of such type test be enclosed with the tender offer.

#### 5.0- **PROTECTIVE RELAYS**

- 5.1 All the switchgears shall be provided with SCADA compatible Numerical Non Directional Over Current and Earth fault protection relays.
- 5.2 All the switchgears shall be provided with protective relays of AREVA /ASEA BROWN BOVERI, ASHIDA, VXL or EASUN REYROLE make designed to disconnect fault circuits with speed and discrimination and shall confirm to ISS - 3231 or latest revision thereof regarding accuracy and other feature.
- 5.3- The protective relays mounted on the panels shall be of the draw out type. The relay must be capable of resetting with out necessity of opening the case. The relays shall be provided with flag indicators. Each functional element of a relay shall be provided with its own flag indicator to enable the type of fault condition to be identified.
- 5.4- Each of the incomer switchgear units shall be provided with 3 elements of 5 Amp. Non-directional, 3 VA over current relays of the IDMTL type for shunt tripping with self/hand reset contacts with setting range of 50-200%. The definite minimum times shall be 3 second at 10 times plug setting.
- 5.5 Each of the out going feeder panels shall be provided with series tripping with hand reset contacts, two over current and one earth fault IDMTL 3 VA relays of 5 Amp. rating having ordinary inverse characteristic and with definite minimum time 3 second at 10 time plug setting element.  
  
The O/C element shall have setting of 50 to 200% in seven equal steps and E/F element shall have setting of 20 to 80% in seven equal steps. High set instantaneous element of low transient over reach not exceeding 5% should be incorporated in the O/C and Earth Fault relays for all the outgoing feeder panels capable of adjusting the setting from about 5 to 20 times normal rating in the O/C relays and 2 to 8 times in Earth Fault relays.
- 5.6 Each panel shall be provided with hand reset master trip relay for tripping commands for all protection.
- 5.7 The shunt trip relays should be suitable for operation at 24 V.D.C./ A.C. operated.
- 5.8- With CTs used as per Para 6.1 and taking into account the trip coil impedance of breaker with the plunger DOWN and with plunger UP position, the VA burden of relays offered etc. should be duly coordinated, so that the protection operates without errors at fault current corresponding to the fault MVA of 350 for all the tap position of the relays and the values of the impedance of the choke and resistance which may be required should also be determined and incorporated.

#### 6.0- **CURRENT TRANSFORMERS**

- 6.1- The requirement of ratio, VA capacity, class of accuracy, limit factor etc. for resin cast CTs

installed in different type of units are tabulated below:

Sl No.	Item	Core/CT	Ratio	VA Burden	Knee point voltage	ALF/ISF	Class of accuracy
1	2	3	4	5	6	7	8
1	Incoming Panel	Protection	600-300/5A	15	-	20	5P10
		Metering	600-300/5A	10	-	ISF<2.5	0.5
2.	Outgoing Panel	Protection	400-200/5A	15	-	20	5P10
		Metering	400-200/5A	10	-	ISF<2.5	0.5

- 6.2- Short time rating of CTs shall be 25 KA for 3 second. CTs shall be double core and dual ratio. Saturation factor for metering core shall not exceed 2.5
- 6.3- The designed accuracy should be available even at the lowest ratios and all CTs shall withstand fault current corresponding to 350 MV A for 3 sec.
- 6.4- The secondary terminal of the current transformers shall be such that effective and firm wire terminations are possible. Shorting links of adequate capacity shall be provided at the terminal blocks for shorting of the leads from secondary terminals of current transformers. The secondary terminal of the CTs shall be earthed at one point.
- 6.5- The secondary winding resistance of CTs shall be as low as possible but not greater than 0.2 Ohms per 100 turns.
- 6.6- CTs shall conform to ISS 2705 with latest amendment, if any in all respect and will be subjected to all routine and type test specified in the ISS.
- 6.7- Offered CTs must be self manufactured or of reputed make, having a successful past record of at least five years use in 11 KV switchgears.
- 6.7- Tenderers should have in-house testing facility for major bought out items viz. CT/PT's/Relays.

7.0- **CABLE GLANDS AND CLAMPING ARRANGMENT FOR HOUSING SUITABLE CABLE BOXES.**

- 7.1- Two nos, brass-wiping-glands for each incomer and one no. Brass wiping gland for each outgoing panel of adequate dimension for XLPE cable of 3 cores up 3×400 sq. mm. size shall be supplied along with panels. For Bus coupler no cable glands should be provided.
- 7.2- Suitable cable boxes as per requirement of cable shall be arranged by the purchaser at his end. The panel shall however provide a flat of size 50x6 mm with suitable clamp made of 50x6 mm flat along with Nut, Bolts and Washers for holding the cable boxes. The flat should be fitted at a suitable height with allotted arrangement for adjustment of height from 300 mm to 500 mm at Site. The clamp and flat shall have suitable stud type arrangement for earthing cable and cable box.

- 7.3- All control cable/wire entries shall be by means of suitable cable glands, such glands shall be of brass and tinned.

#### 8.0- **AUXILIARY/CONTROL WIRING**

All the secondary wiring in the panel shall have high quality PVC insulation and the same shall have conductor size of not less than 2.5 sq. mm. of copper. Colors of the secondary/auxiliary wiring should confirm to ISS 375/1963 and latest amendment thereof if any. All wiring shall be neatly run and group of wiring shall be securely fixed by clips so that wiring can be checked without necessity of removing the clamps. Wiring between fixed and moving portion of the panel shall be run in flexible tubes and the same shall be so mounted to avoid any damage to them due to mechanical movements. Ferrules with number shall be provided on both end of the wiring.

#### 9.0- **MARKING OF PARTS**

For facilitating the erection, the several parts of the plant and equipment shall be suitably marked.

#### 10.0- **NAME PLATE AND DIAGRAM PLATES**

All equipment viz. switchgear panel, CT's & PT's etc. shall have weather proof non detachable and non-corrosive brass or anodised aluminium plates fixed in suitable position with full particulars engraved thereon with white letters against black background.

The firm shall affix a nameplate on each Switchgear panel as well as on the breaker trolley having following information.

1. Manufacturer's name and trade mark.
2. Unique No./Sr. No.
3. Type of Panel.
4. CT Ratio.
5. Rated Voltage
6. Rated Insulation Level
7. Rated Frequency
8. Rated Normal Current
9. Rated Short Circuit Breaking Current
10. Weight
11. Specification No.
12. Order No. and Date
13. Month & Year of supply
14. Property of PVVNL, Uttar Pradesh.

#### 11.0- **PAINTING**

All metallic surface except enameled and bright parts exposed to weather shall be given suitable primer coat and two coats of first quality paint of Siemens Grey colour. The supplier shall also supply adequate quantities of paints, Varnish etc. for use of finished cost and for use of patching up any scratches received during, transport, handling, erection testing and commissioning.

Instead of above proper powder coating after proper pre treatment is acceptable and in that case earlier condition will not applicable.

#### 12.0- **DETAILED FITINGS AND MOUNTINGS**

Detailed fittings and mountings of equipments in various switchgear panel shall be as follows:

12.1 Item No. 1- Incoming Panels Rating: 1250 Amp With CTs Of Ratio 600-300/5-5 A On All Panels.

Each unit shall have the fittings and equipments as follows:

- 1 No All steel totally enclosed, fully interlocked, indoor industrial pattern, metal clad, horizontal draw out, vertical horizontal isolation floor mounting switch unit complete with transportation truck having integral mechanism and all necessary supports each equipped as under.
  - 1 No. Fabricated sheet steel housing
  - 1 No. Complete set of mechanical interlocks
  - 1 No. Set of isolating plugs and sockets 6 nos. rated for 1250AMP. with automatic safety shutters and pad-locking arrangements. Facilities shall be provided for proper opening of the safety shutter for cleaning, inspection and testing.
  - 1 No. 1250AMP triple pole VCB fitted with isolating sockets, spring, operated, manually charged, manually released spring closing mechanism with mechanical ON/OFF indicators suitable for a rupturing capacity of not less than 350MVA at 11 kv for 3 seconds and fitted with one set of direct acting trip coils suitable for operation with AC series trip relays.
  - 1 No. Auxiliary switch with minimum four normally closed and four normally opened contacts. The contact terminals shall be brought out and terminated at Terminal Board irrespective of whether terminals are used or not.
- 3 Nos. 600-300/5-5 A ratio double core resin cast current transformer of required Accuracy, for protection and metering as per Para 6.1 of specification.
- 1 No. 96 mm dial flush pattern moving iron spring controlled ammeter suitably scaled to suit CT ratio.
- 1 No. 3 way ON and OFF ammeter selector switch for reading the current in any phase on the above ammeter.
- 1 No. 3-phase resin cast, draw out type bus bar connected potential transformers of Ratio 11000/110 volts class 0.5 accuracy having minimum 50 VA output per phase to Operate the AC. static H.T. Trivector meter, voltmeter etc. and complete with H.T. & LT. fuse.
- 1 No. 96 mm dial round flush pattern moving iron spring controlled voltmeter suitably scaled to suit the PT ratio
- 1 No. 3 way and off voltmeter selector switch for reading the voltage between any two phase on the voltmeter.
- 1 No. M/S Secure Meter or L&T make A.C. fully static DLMS compliant category-A (AMR Compatible) TRI-VECTOR Energy Meters as per data exchange for electricity meter as per guideline specification for R-APDRP (issued by CPRI), 3 elements suitable for three phase, 4 wire un-balanced load and CT/ PT ratio mentioned in Para 6.1, 0.5S accuracy class with load, survey and T.O.D. /Tariff, and M.R. facility. Meter shall be capable of displaying above parameters in the following sequence within specified limits of errors for balanced or unbalanced load at all P.F. as mentioned hereinafter:
  - (1) Real time clock – Date and Time
  - (2) Current – IR
  - (3) Current – IY
  - (4) Current – IB
  - (5) Voltage – VRN

- (6) Voltage – VYN
- (7) Voltage – VBN
- (8) Voltage – VRV
- (9) Voltage – VBY
- (10) Signed Power Factor – R Phase
- (11) Signed Power Factor – Y Phase
- (12) Signed Power Factor – B Phase
- (13) Three Phase Power Factor – PF
- (14) Frequency
- (15) Apparent Power – KVA
- (16) Signed Active Power – kW (+ Forward; - Reverse)
- (17) Signed Reactive Power – kvar (+ Lag; - Lead)
- (18) Cumulative Energy – kWh
- (19) Cumulative Energy – kvarh – Lag
- (20) Cumulative Energy – kvarh – Lead
- (21) Cumulative Energy – kVAh
- (22) Cumulative Power failure duration.
- (23) Cumulative Tamper Count.
- (24) Cumulative MD reset count.
- (25) Cumulative Programming Count.
- (26) Date & time of last MD reset.
- (27) Maximum Demand – kW
- (28) Maximum Demand – kVA

The meter shall have 7 digits (with  $\pm$  indication), parameter identifier, backlit Liquid Crystal Display (LCD) of minimum 10 mm height, wide viewing angle. Auto display cycling push button required with persistence time of 10 Seconds. LCD shall be suitable for temperature withstand of 70 deg C; Sequence of display of various instantaneous electrical parameters shall be as desired by Purchaser at the time of order.

The data stored in the meters shall not be lost in the event of power failure. The meter shall have Non Volatile Memory (NVM), which does not need any battery backup. The NVM shall have a minimum retention period of 10 years.

Meter shall have feature of connection check i.e. PT missing, CT reversal on meter display itself. PT missing & CT reversal shall be checked from looking on meter display.

Meter shall have the facility to lock any parameter on display screen i.e. Scroll lock facility.

Rating of meter should be as follows:

Ib-5A

IMx.- 1.2 Ib

In case of fault capable to bear 20Ib for 0.5 sec.

- 1 No. set Non-directional, adjustable IDMTL series trip O/C relay with definite minimum 3 seconds at 10 times plug setting. The relay shall be arranged for over current protection with setting from 50 to 200% of 5A on all three over current elements mounted in draw out case tropicalised with flag indicator.
- 1 No. Set of indicating pigmy lamps operating at 230V.A.C. single phase one colored RED and other GREEN to show the closed or open position of circuit breaker.
- 1 No. 80 watts [Continuously rated tubular/strip type] heater with manual ON/OFF switch working on 230 V AC single phase supply.
- 1 No. Set of copper bus bars of not less than 1250AMP. Continuous rating.

- 1 No. Multiway plug box for secondary wiring between the fix and moving protection.
- 1 No. Set of independently operated automatic shutters for bus bar cable and voltage transformers orifices which shall be clearly leveled and individually pad-locked
- 2 Nos. Brass-wiping glands shall be provided (Refer clause 8 above).
- 1 No. Sheet instruments panel mounted on the front of the unit with hinged access doors and totally enclosed wiring terminals mounted there.
- 1 No. Complete set of self-contained inter connectors foundation bolts, fine wiring, wiring terminals board, sundries to complete the unit.

#### 12.1.1 CLARIFICATION

The total requirement of CTs for incomer of ratio 600-300/5A is as follows:

- 3 CTs one for each phase of ratio 600-300/5A to connect to 3 nos. O/C relays.
- 3 nos. CT one of ratio 600-300/5 A for metering.

It is not necessary that all the above CTs have separate entity; the contractor can commingle two cores in one phase. This arrangement will be acceptable so long as the requisites of individual cores are met.

#### 12.2 ITEM NO. 2- OUTGOING FEEDER PANEL WITH CT RATIO 400-200/5A

The fittings and mountings shall be similar to item no. 1 above except-the following:

- The CT ratio will be 400-200/5 A.
- One no. brass wiping glands shall be supplied [refer clause8].
- The voltage transformers, voltmeter and volt meter selector switch shall be deleted.
- 3nos. CT operated overload releases are to be provided.
- 1 no. non directional triple pole adjustable IDMTL combined O/C and E/F [2 no. O/C and 1 no. E/F] A C. series trip relay with instantaneous high set trip, feature of low transient over reach not exceeding 5% with definite minimum 3 seconds at 10 times plug setting. The relay shall be arranged for over current protection with setting 50-200%/ of 5Amp. And for earth fault protection with setting 20-80%, mounted on a draw out case tropicalised with flag indicators. High set element of O/C shall have setting range of 5 to 20 times the rated current and the E/F elements shall be 2 to 8 times of rated current.

#### 12.3 ITEM NO.3 BUS COUPLER PANEL:

Each unit shall have the fittings and equipment as follows:

- 1 No. All steel totally enclosed fully interlocked indoor industrial pattern metal clad horizontal draw out, horizontal/ vertical isolation, floor mounting switch unit complete with transportation truck having integral circuit breaker mechanism and all necessary supports each equipped as under.
- 1 No. Fabricated sheet steel mounting.
- 1 No. Complete set of mechanical interlocks.
- 1 No. Set of isolating plug and sockets [6 nos. Rated for 1250AMP.] With automatic safety shutters and pad locking arrangement. Facilities shall be provided for proper opening of the safety shutter for cleaning, inspection and testing.
- 1 No. 1250AMP. Triple pole VCR fitted with isolating sockets, spring operated manually charged, manually released spring closing mechanism with mechanical ON/OFF indicators suitable for a rupturing capacity of not less than 350MVA at 11 kv for 3 second.



- 1 No. A set of Red and Green pigmy lamps for indicating opened and closed position of breaker.
- 1 No. 3 way auxiliary witch with 4 normally closed and eight normally open contacts.
- 1 No. 80 Watt. 230 V AC heater with 6 Amp. rotary cam switch.
- 1 No. Bus bar chamber with 1250 A rated copper Bus Bars.
- 1 No. A set of self aligning horizontal vertical isolation type auxiliary plug and sockets.
- 1 No. Sheet steel instrument panel mounted on the front of the unit with hinged across doors and totally enclosed wiring terminals mounted there.
- The panel shall be without any metering protection CTs, cable box, series trip coils, and relays.

The HT chambers (adopter chamber) will be gasketed to make it vermin proof.

NOTE :-

Separate spring charging and operating handle shall be provided and supplied with each item.

### 13.0- **TESTS**

The design of circuit breaker shall be proven through all the routine and type tests in accordance with IEC 62271-100/200, IS 13118; 1991/ IEC-56 and any amendment thereof:

- i) Basic short circuit duties T100s, T100a & Single Phase short Circuit.
- ii) Basic short circuit duties T60, T30 & T10.
- iii) Short Time Withstand & Peak withstand current test.
- iv) No-load operation test.
- v) Lightning Impulse voltage withstand test.
- vi) Power frequency voltage withstand test (Dry).
- vii) Mili volt drop test & temperature rise test.
- viii) IP 4X test.
- ix) Internal Arc fault current test on bus bar chamber, breaker and cable chamber.
- x) Single phase breaking current test.
- xi) Mechanical endurance operation test considering to M-2 class.

**ROUTINE /ACCEPTANCE TEST**

Following Routine / Acceptance tests shall be carried out as per relevant standard shown in clause '2' of Technical specification.

**1. BREAKER:**

1. Power frequency voltage withstand dry test on main circuit.
2. Voltage withstand test on control and Auxiliary circuit.
3. Measurement of the resistance of the main circuit.
4. Mechanical operation test.
5. Design & visual checks.

**2. CURRENT TRANSFORMERS**

1. Verification of terminal marking and polarity.
2. Power frequency dry withstand test on primary winding.
3. Power frequency dry withstand test on secondary winding.
4. Over voltage inter turn test.
5. Partial discharge test in accordance with IS: 11322/1985 and latest amendment thereof.
6. Determination of errors or other characteristic according to the requirement of the appropriate designation or accuracy class.

**3. VOLTAGE TRANSFORMER**

1. Verification of terminal marking and polarity.
2. Power frequency dry withstand test on primary winding.
3. Power frequency dry withstand test on secondary winding.
4. Partial discharge test in accordance with IS: 11322/1985 and latest amendment thereof.
5. Determination of errors or other characteristics according to the requirement of the appropriate designation or accuracy class.