

STANDARD TECHNICAL SPECIFICATION COVER SHEET

Specification No.: ENG-EHV-1011(R1)

Specification Name: Specification of 33KV Indoor Switchgear Panel

Annexure I (Additional for TP Odisha DISCOM Requirement)

1. Line Item:

- I. Incomer with Line PT (2000A/1250A) (DISCOM Specific Requirement)
- II. Incomer without Line PT (2000A/1250A) (DISCOM Specific Requirement)
- III. Bus-coupler (2000/1250A)
- IV. Bus PT
- V. Bus Riser cum Bus PT
- VI. Outgoing
- VII. Adopter
2. STC level: 25KA for 3 Sec or better
3. Internal arc: 25kA for 1 sec or better
4. Current Density of Busbar: as per manufacturer type tested design
5. **CT Ratio** (1600-1200/5-5-5 or 1-1-1, 1200-800/5-5-5 or 1-1-1, 800-400/5-5-5 or 1-1-1 for Incomer, 1600-1200/5-5 or 1-1, 1200-800/5-5 or 1-1 for bus coupler and 600-300/1-1 for O/G (Shall be confirmed during detailed engineering)
6. PS Class CT should be a separate one from Metering and Protection class.

(This is Optional and shall be confirmed by Concern TP Odisha DISCOM at the time of release of RO)

7. **Condition monitoring:** Space heater along with dehumidifier and hygro-thermostat (communicable type/SCADA compatible) to be considered for Cable chamber and suitable ratings of space heater with thermostat to be considered for all other busbar, breaker and control cubicle chamber.
8. Individual MCB with add-on contact to be considered

MCB nomenclature/nameplates inside the LT chamber shall be finalized and provided as follows:
 - a) (i) MAIN DC MCB (ii) TC1 (iii) TC2 (iv) Closing CKT (v) BCPU/86 Auxiliary DC (vi) Indication CKT (v) Isolator Status and Control (VIA AUX Relay) (vi) 87 T with AUX relay (vii) TMU (viii) MFM (viii) Independent DC MCB for the Indication Circuit and an independent DC circuit for the MFM shall be incorporated. (ix) Annunciation and hooter circuit (12 window annunciation for PTR control, 8 Window for rest)
 - b) Detailed MCB chart to be affixed in side LT chamber.
9. AC MCB Sequence (i) Main AC MCB (ii) Space Heater (iii) Spring charge MOTOR (iv) Socket(6/16A) and Illumination

10. Indications: Lamp Indication

- (a) Breaker in Service (RED) (b) Breaker in Test (GREEN)(c) BREAKER close (RED) (d) Breaker open (GREEN) (e) spring charge (BLUE) (f) TCS healthy 1 &2 (WHITE) (g) Auto trip (AMBER) Flash Cum Buzzer Preferable (h) DC fail (AMBER) (i) AC fail (AMBER) (j) R, Y, B phase indication for PT (k) BET in service (l) BPT in service/Test (j) In OG feeders Isolator ON/OFF & Earth switch ON/OFF.

And also, the following identification labels/stickers shall be provided:

- VCB internal equipment identification sticker
- Heater ammeter identification sticker
- MCB identification matrix sticker

- 11.** Schematic drawings shall include detailed cable schedules/details for all inter-panel cabling as per the approved GA drawing. The following cable details shall be clearly mentioned:

(i) DC Distribution Cables (ii) AC Distribution Cables (iii) CAT6 (RSTP Connection) Cables (iv) RS485 Communication Cables (v) Bus PT and Synch Check PT Cables (vi) Inter-tripping Cables (vii) Control Circuit Cables

- 12.** Cable tagging, core details, source-destination references, and termination details shall be properly indicated for all inter-panel connections.

- 13.** Transformer Trouble signals shall be considered as per the following logic, with latched type auxiliary contacts to ensure proper retention of status until manual reset.

For Trafo Trouble Trip, 4 Nos. of NO contacts shall be provided and allocated as follows:

(i) 86 Trip (ii) TMU (iii) 87T Input (iv) NIFPS

For Trafo Trouble Alarm, 3 Nos. of NO contacts shall be provided and allocated as follows:

(i) TMU (ii) 87T (iii) Common Buzzer

All auxiliary contacts shall be of latched type to ensure reliable indication and proper event recording until reset action is performed.

- 14.** Auto Reclose selector switch shall be incorporated for 11kV outgoing feeders to enable proper selection, control and isolation of the auto reclosing function. BO used with HMI/Remote closing shall be same for Reclosing. AR function enable /disable shall be integrated from Remote.

- 15.** Separate PT MCBs shall be provided for the following circuits/functions: (i) 4P PT MCB for Metering PT (ii) 4P PT MCB Protection PT (iii) Main Distribution PT (for Each BPT- applicable for BPT Panel) (iv) Synch Check 2P MCB (v) Power Pack -2P MCB

Appropriate ratings and segregation shall be ensured as per the application requirement.

- 16.** Two trip coils shall be incorporated for I/C and one coil for O/G Feeders

- 17.** Trip Coil Supervision Relay (TCS) shall be provided for supervision of both trip coils.

- 18.** IRF (Internal Relay Failure) / adjacent relay fail logic shall be considered by combining the

following signals:

- i. DC supervision relay contact, Relay watchdog contact, MCB auxiliary contact
- ii. Relay auxiliary supply MCB auxiliary contact status.
- iii. This composite supervision logic shall be extended in a cascading manner from panel to panel (left to right), with the last panel feeding back to the first panel to ensure complete chain monitoring.
- iv. A single binary input (BI) shall be utilized for all DC fail-related auxiliary contact signals to the adjacent panel relay, ensuring optimized wiring and consistent fail monitoring across panels.

19. Requirement in Incomer, Bus coupler: VPI shall be considered along with both hardwired and software-based interlocking for the incomer feeder in case Line PT is not included in the scope.

The VPI mounting location shall be selected to provide convenient viewing and safe accessibility for operating personnel during field activities.

20. Interlocking: CB closing Interlock:

- a) In Soft logic and hardwiring for closing I/L (i) Isolator close (ii) Earth switch open (iii) EM push button not operated (iv) Rear door close TC1 & TC2 healthy (In Series) (v) Master trip not operated (vi) Spring charging CB in Service Breaker off position (vii) 2 nos. of Future I/L Upstream breaker ON (for 11KV INCOMER) (viii) Synch Check BO if Synch check is enabled with Line PT and Bus PT input : For Incomer and Bus Coupler BET not inserted (for Adjacent Incomer and Bus coupler) BRPT rear DOOR not open (For Incomer 2 and Bus coupler) Isolator ON & Earth switch OFF .
- b) CB in Test Position Closing interlock from TNC and Relay HMI: CB in Test
- c) The TNC (Trip–Neutral–Close) switch shall be of unlockable type to ensure free operation during control actions. The Local/Remote (L/R) switch shall be of lockable type to prevent unauthorized or unintended mode changes, ensuring secure control of the breaker operation.
- d) An Emergency Trip Switch (ETS) shall be incorporated in the panel. The ETS shall provide immediate tripping of the circuit breaker under emergency conditions and shall be clearly accessible, properly labeled, and integrated into the trip circuit to ensure safe and reliable operation.
- e) 86 lockout relay electrical reset push button shall be incorporated in the panel. Master trip relay shall incorporate with pushbutton for hard reset. As well as Relay BO contact shall be incorporated for 86 lockout relay electrical reset. The reset push button shall be properly wired and designed to allow electrical reset of the 86 relay.
- f) Two binary outputs (BO contacts) shall be configured for the closing command:
BO XX: HMI Close Command, routed through an auxiliary relay.
BO XX: Remote Close Command, also routed through the same auxiliary relay
Both closing commands shall be governed by the Local/Remote selector status.
- g) All tripping and closing commands from the numerical relay shall be routed through

auxiliary relays before execution in the circuit breaker control circuit.

Isolator OPEN/CLOSE commands shall also be implemented through auxiliary relays to ensure proper interlocking, contact multiplication, and reliable operation.

21. Interlocking with Isolator:

- Isolator and earth switch status monitoring and control for outgoing feeders and 33kV incomers shall be implemented through CMR relay to ensure reliable operation, proper interlocking, and centralized control philosophy.
- The Isolator TNC switch shall be interlocked with the Field Local/Remote (L/R) switch.
- This interlock shall be incorporated to ensure that isolator operation is possible only under the permitted control mode, thereby preventing unsafe or unintended switching from field or remote commands.
- Isolator OPEN/CLOSE permissive logic shall be implemented using both hardware and software (soft logic) interlocks.
- The permissive conditions shall include the following:
 - Circuit Breaker (CB) shall be in OPEN condition, Earth switch shall be in OPEN condition. Local/Remote (LR) switch position as per outdoor reference
 - Isolator status confirmation through software (soft logic feedback). The isolator operation shall be enabled only when all the above permissive conditions are satisfied to ensure safe and reliable switching operations.

22. Relay Features:

- Relays shall support IEC 61850, Modbus, or DNP3 protocols for SCADA/EMS/DMS integration.
- Redundant communication ports (Ethernet/RS485) for reliability.
- Cybersecurity features: password protection, role-based access, secure firmware updates.
- Relay features shall be adhered as per Protection IED specifications.
- GOOSE messaging enabled for breaker failure (50BF) and inter-tripping schemes.
- Reverse blocking scheme shall be adopted.

23. Terminal Blocks:

- Terminal block covers shall be provided for all CT and PT terminal blocks. The TB covers shall ensure proper insulation, protection against accidental contact, and enhanced safety during operation and maintenance activities. Separator/suitable arrangement needs to be provided in between TBs used for AC and DC circuit.
- Insulated lugs shall be considered for all cable terminations. For CT and PT circuits, ring-type lugs shall be used to ensure secure and reliable connections. For control cables, pin-type or ring-type lugs shall be used as per the terminal requirement and field practice. Proper

crimping, insulation integrity and termination standards shall be strictly followed for all connections.

- All inter-panel wiring and cables routed inside the LT/HT chambers shall be properly insulated using spiral insulation to ensure mechanical protection and enhanced safety. All cable entry and routing holes shall be provided with suitable gasket-type sealing arrangements to prevent ingress of dust, moisture, and to ensure proper environmental protection of the panel internals.
- All inter-panel wiring details shall be clearly indicated at the end of the drawing set. The inter-panel wiring schedule shall include the following details for each connection: Terminal Block (TB) number: Panel number, Source and destination information. This shall be provided in a structured format to ensure clear traceability, ease of installation, and effective Cross ferruling shall be incorporated for all wiring, including proper identification of source, wire tag and termination details .A Cross Ferrule example page shall be included in the drawing set. This page shall clearly demonstrate the standard ferrule coding, marking methodology and identification practice to be followed for all wiring, ensuring uniformity across panels during installation, testing, and maintenance.

Other General Points:

- A caution label stating "Allowed in Test Position Only" shall be provided near the manual spring charging access hole.
- The nominal voltage shall be indicated on the Live Line Indicator (LLI).
- An IR inspection window shall be provided for the power cable compartment
- Indication lamps shall be arranged in a consistent sequence, preferably: VCB Status → Auto Trip → TCS → Phase Healthy → Heater Status, followed by other indications
- A bus bar mimic diagram shall be provided on the panel.
- Power pack battery capacity shall be 18 Ah instead of 7 Ah to cater for a minimum of 10 tripping operations with one-hour backup.
- Due to increased LT compartment height resulting from wiring requirements, the quantity of hinges and door locks shall be reviewed and increased as required.
- The following functions shall be incorporated and their functional testing shall be included in FAT/QAP: 1. O/G Feeders: Auto Recloser (79), Broken Conductor Protection (46BC) and Fault Locator (21FL).2. High Impedance fault detection for unbalance low current network (PHIZ or similar)
- I/C & B/C Feeders: Over Voltage (59), Under Voltage (27), Synchronism Check (25) and VT Fuse Failure Protection. During DC changeover, protection relays should not shut down (currently ~20 seconds including reboot time). High-speed heavy-duty relays shall be used instead of changeover contactors. (This issue is not observed in the power pack changeover circuit using PLA relays.)

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1. SCOPE

This specification covers the technical requirements of design, manufacture, testing at manufacturer's works, packing, forwarding, supply and unloading at site/store and performance of 33 kV Indoor switchgear complete with all accessories for trouble free and efficient performance. The equipment offered shall be complete in all respects. Any material or accessories, which may not have been specifically mentioned in the specifications but which are usually necessary for satisfactory, safe, trouble free, operation shall be provided without any extra charges. Vendor shall ensure the quality of workmanship for manufacture of equipment. The equipment shall be supplied as per the latest applicable standards and as stipulated in this specification.

Panel board requirement may be as an individual nomenclature:

- I. Incomer Panel with Line PT
- II. Incomer Panel without line PT
- III. Outgoing Panel
- IV. Bus coupler Panel with riser
- V. Bus riser panel with Bus PT
- VI. Bus PT Panel
- VII. Adopter Panel

2. APPLICABLE STANDARDS

The equipment covered by this specification shall unless otherwise stated, be designed, manufactured and tested in accordance with the latest editions of the following standards/IEC and shall conform to the regulations of local statutory authorities. For standards relevant to Automaton Philosophy & protection philosophy, kindly refer the TPCODL/TPNODL/TPSODL/TPWODL, "Automation specifications & Protection specification".

APPLICABLE STANDARDS		
a	IS 2705/IEC 60044-1	Current Transformers
b	IS 3156/IEC 60044-2	Voltage Transformers
c	IS 3427/IEC 62271-200	HV switchgear and control gear —AC Metal Enclosed switchgear and control gear for voltages above 1 kV and up to and including 52 kV

d	IS 694	PVC insulated cables for working voltage up to and including 1100V
e	IS 2629	Recommended practice for Hot Dip Galvanizing of Iron & Steel.
f	IS 2633	Tests for uniformity of zinc coating
g	IS 5578	Guide for marking of insulated conductors
h	IS 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals
i	IEC 60060	High-voltage test techniques
j	IEC 60255-3	Electrical relays-Single input energizing quantity measuring relays with dependent or independent time
k	IEC 60255-27	Measuring relays and protection equipment-Part-27 Product safety requirements
l	IEC 60265-1	High voltage switches-Part 1: Switches for rated voltages above 1 kV and less than 52 kV
m	IEC 60282-1	High voltage fuses
n	IEC 60529	Degrees of protection provided by enclosures (IP Code)
o	IEC 60694	Common specifications for high voltage switchgear and control gear standards
p	IEC 60947	Low voltage switchgear and control gear
q	IEC 61010-1	Safety requirement for electrical equipment for measurement and laboratory use
r	IEC 62052-11	Electricity metering equipment (a.c.)-General requirements, tests and test conditions
s	IEC 62053-22	Static meters for active energy (Class 0.2S and 0.5S)
t	IEC 62271-10	HV Switchgear and Control Gear- Alternating current disconnectors and earthing switches
u	IEC 62271-100	High Voltage alternating current circuit breaker

3. CLIMATIC CONDITIONS OF THE INSTALLATION:

1	Maximum ambient temperature	50 deg C
2	Max. Daily average ambient temp	35 deg C
3	Min Ambient Temperature	0 deg C

4	Maximum Humidity	95%
5	Average Annual Rainfall	150cm
6	Average No. of rainy days per annum	120
7	Altitude above MSL not exceeding	1000m
8	Wind Pressure	300 Km/hr
9	Earthquakes of an intensity in horizontal direction	Shall be suitable for Zone 4
10	Earthquakes of an intensity in vertical direction	Shall be suitable for Zone 4

TPCODL/TPNODL/TPSODL/TPWODL service area has heavy saline conditions along the coast and High cyclonic Intensity winds with speed upto 300 Kmph. The atmosphere is generally laden with mild acid and dust in suspension during the dry months and is subjected to fog in cold months.

4. GENERAL TECHNICAL REQUIREMENTS

GENERAL TECHNICAL REQUIREMENTS		
S No	DESCRIPTION	Requirement
4.1	SWITCHGEAR PANEL	
4.1.1	Architecture	Metal Enclosed
4.1.2	No. of Phases	Three
4.1.3	Rated Capacity	1500 MVA
4.1.4	Rated Voltage	36 kV
4.1.5	Service Voltage	33 kV
4.1.6	Rated Frequency	50 Hz
4.1.7	Rated Lightning Impulse withstand voltage	170 kVP
4.1.8	Power Frequency Withstand voltage	70 kV rms
4.1.9	Rated short time withstand current	25 kA for 3 sec (minimum)
4.1.10	Peak withstand current rating	62.5 kA
4.1.11	Normal service condition	Indoor
4.1.12	Internal arc Protection	IAC-A FLR as per IEC 62271-200, Shall withstand 25 kA for 1 sec

4.1.13	Degree of Protection for enclosure/Partitions /For meters, relays and BCU	IP4X/IP4X/IP5X or equivalent to completely protect against dust ingress. Protected in such a way that meters/relay performance shall not be affected due to small dust also.
4.2	BUS BAR	
4.2.1	Type	Extensible on both sides
4.2.2	Bus bar continuous rated current	1250 A
4.2.3	Bus bar material	Copper with Silver Coated (On joint Areas) /As per Manufacturer Type Tested design
4.2.4	Rated short time withstand current	25 kA for 3 sec
4.2.5	Max current Density for Bus bar	As per Manufacturer Type Tested Design
4.2.6	Max. Permissible temp. rise at rated normal current	115 Degree Celsius
4.2.7	Minimum Clearance	Phase to phase-320 mm /Phase to earth-240 mm / To be provided by Bidder / As per Manufacturer Type Tested design
4.2.8	Material for Busbar Support: Bidder to Specify	To be provided by Bidder
4.2.9	Material for phase barriers	To be provided by Bidder
4.3	CIRCUIT BREAKER	
4.3.1	Application/Class	Indoor
4.3.2	Type of circuit	Vacuum, draw out type
4.3.3	No. of poles	3
4.3.4	Rated voltage	36 kV rms
4.3.5	Rated Insulation Level	
4.3.5.1	Lighting impulse	170 kV peak
4.3.5.2	One-minute power frequency withstand	70 kV rms
4.3.6	Rated Frequency	50 Hz
4.3.7	Rated normal current	1250 A
4.3.8	Rated operating sequence	O-t-CO-T-CO (t=0.3 sec , T=3 min)
4.3.9	Max. Spring Charging Time of Motor	10 sec
4.3.10.	Max. Power consumption of Trip &close coils	200 W

4.3.11	Rated load breaking current (sym)	25 kA rms		
4.3.12	Rated short circuit withstand current	25 kA (rms) for 3 sec		
4.3.13	Rated short circuit making current	62.5 kA		
4.3.14	Breaker Duty	M2,E2,C2		
4.4	OPERATING AUXILIARY VOLTAGES			
4.4.1	Trip Coil	48/24 V dc (TBD during detailed Engg.)		
4.4.2	Closing Coil	48/24 V dc (TBD during detailed Engg.)		
4.4.3	Spring Charging Motor (Universal Motor)	240 V AC		
4.4.4	No. of spare auxiliary contacts	6NO + 6NC		
4.5	VOLTAGE TRANSFORMER			
4.5.1	Location	Each bus-section		
4.5.2	Type	Draw Out		
4.5.3	Ratio	33/rt3 /110/rt3-110/rt3-110/rt3		
4.5.4	Core Details	Core-I	Core-II	Core-III
i)	Accuracy Class	3P	3P	0.2
ii)	Burden	50 VA	50 VA	30 VA
4.6	CURRENT TRANSFORMER	Note: CT Ratio subject to change during detailed Engineering		
4.6.1	Location	Line, B/C and Transformer		
4.6.2	Ratio	200-400-800/5-5-5 A or 100-200-400/5-5-5 A (TBD during detailed 'ENGG'.), Secondary Current /5 or /1 shall be decided during detailed engineering.		
4.6.3	Burden & Class (Metering and Protection)	PS Class CT shall be a separate one from Metering as well as 5P20 protection class CT.		
i)	Core-I	0.2S , 10VA; Isf<16		
ii)	Core-II	5P20 , 10VA for 1 A, (5 A CT , VA to be changed accordingly)		
ii)	Core-III	PS; Vkp>=250 at Centre Tap V; Im<=100mA at Vkp/2; Rct<6 ohm		
4.7	Additional points			
4.7.1	Busbar size	Cable Chamber	Busbar chamber	Dropper and Riser
Bidder to provide during detailed engineering				
4.7.2	Clearance In Cable Chamber			

(i)	Phase to Phase:			
(ii)	Phase to Earth			

5. GENERAL CONSTRUCTIONS

5.1.1. The switchgear Panel shall be of sheet steel construction and shall be dust and vermin proof. The panels shall be of Metal Clad compartmentalized design with all the High Voltage compartments viz. Circuit Breaker, Bus Bar, Current Transformers and Voltage transformers separated by metallic partitions. These compartments must have pressure relief flaps for the exit of gas due to internal bracing. The switchboard panels should comply with relevant IS/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, service, inspection and maintenance operations including visual checking of phase sequence, earthing of connected cables, locating of cable faults, voltage tests on connected cables can be carried out safely. The switchgear shall be complete with all necessary wiring fuses, auxiliary contacts terminal boards etc.

Panels shall have structural steel frame-work enclosed on all sides and top by CRCA /Aluzinc sheet steel of minimum thickness as specified below:

- Frame: 3 mm (Design shall be shared by OEM for Base frame fabrication work at site)
- Doors & Covers: 2 mm
- Removable gland plate: 3mm

5.1.2. Panels shall consist of a front portion with equipment mounted on it and wiring access from rear. All doors, cutouts and removable covers shall be gasketed all round by EPDM gaskets. Each panel section shall be provided with hygro-thermostat controlled space heater with ON/OFF switch and 15A single phase plug point with ON/OFF switch. LED lamp shall be provided with door switch for each panel for cubicle interior illumination. Suitable ratings of Space-heater shall be considered for each chamber i.e. Cable chamber, CB chamber, Busbar Chamber & Control Cubicle Chamber etc. Suitable ratings of Dehumidifier also to be considered Cable chamber.

5.1.3. Panels shall be mounted and bolted to a common base channel. The channel in turn shall be fixed to the foundation bolts at site. All foundation equipment, anchor bolts etc. including the supporting channel shall be furnished by successful bidder in advance for completion of Civil Works prior to dispatch of panels. The bottom plates of the panels shall be fitted with removable gland plates of not less than 3 mm in thickness, for fixing the cable glands, the size of which shall

suit the purchaser's external cables to the panels. Cable glands shall be Double Compression type and made of brass. (Cable glands are not in Panel supplier scope)

5.1.4. Indicating instruments and meters shall be at a suitable height so that the lettering on the dials can be easily read. Control switches/push buttons and relay resetting knobs shall be Conveniently located for ease of operation. Top lines of relays, meters shall be matched. Isolating switch fuse units shall be provided at the panel for incoming AC and DC supplies. Push buttons shall be made of non-hygroscopic material with shrouds. All other insulators shall also be made of non-hygroscopic material.

5.1.5. All components of the same rating and construction which may need to be replaced shall be interchangeable. If there are removable parts with different ratings and if parts are interchangeable within the assembly of metal enclosed switchgear and control gear, any possible combination of removable and fixed parts shall withstand the rated insulation level specified for fixed parts concerned.

5.1.6. Interlocks between different components shall be provided for safety and ease of operation. The withdrawal or engagement of a circuit breaker shall be impossible unless it is in open position. All instruments shall non-draw-out type and safeguarded in every respect from damages. The operation of a circuit breaker shall be impossible unless it is in service, disconnected and removed, test or earthing position. It shall be impossible to close the circuit breaker in service position unless it is connected to auxiliary circuit.

5.1.7. All the HV design shall ensure conformity to IES-62271-200 Appendix 'A' and must be Type tested for Internal Arc Test. It shall withstand 25 kA for 1 sec. The suppliers shall submit Type Test report from CPRI/ERDA/PHELA/Any Reputed International Lab to prove the above.

5.1.8. Auxiliary and control equipment installed on the panel shall be suitably protected against disruptive discharge from main circuit. Buses shall be insulated with heat shrinkable insulating sleeves, wherever bare conductor is employed.

5.1.9. Degree of Protection for the enclosure and the partitions shall be IP4X. The covers and doors should only be opened when the part of main circuit contained in the compartment being made accessible is dead. Partitions of metal-clad switchgear and control gear shall be metallic and earthed. All the meters, detachable units of relays, relays and BCU shall be minimum IP5X or with an equivalent provision to completely protect it against dust ingress. Meters/ relay shall be

protected in such a way that the performance does not get affected due to small dust also. Provision of louvers for air circulation shall be provided.

5.1.10.All indicating lamps shall be provided with suitable series resistors and bulbs shall be replaceable from the front of the panel. Lamps shall be of LED type and suitable for continuous operation at 85% to 110% of their rated voltage. The following indicating lamps with color shall be mounted over switchgear to indicate important status/alarm of breaker:

Breaker close	Red
Breaker open	Green
DC Healthy	Amber
Space Heater not healthy	Blue
Spring Charge	Blue
Trip coil 1 & 2 healthy	White
Auto trip	Amber
Breaker In Service	RED
Breaker in Test	Green
AC fail	Amber
R,Y,B Phase indications for PT	
BET in Service	
BPT in Service /Test	
In O/G Feeder isolator ON/OFF & E/S ON/OFF	

All color caps shall be similar and interchangeable and all LEDs shall be of same type and ratings. The LED lamps shall be furnished 20% in excess of actual numbers required and color caps shall be furnished 10% in excess of actual numbers used for each color.

5.1.11. DC fail supervision relay (80) shall be provided on all control and relay panels. DC fail annunciation shall be provided on each panel and loss of DC & trip circuit fail alarm will be suitably annunciated at the panel as well as at the SCADA. All the relays and auxiliaries shall have DC auxiliary supply. Identification of components shall agree with the indication on the winding diagrams and drawings. If a component is of the plug-in type, an identification mark should be placed in trunking and it should be suitable to accommodate 20% wiring for future modifications.

5.1.12. AC and DC supervision relays shall be provided.

The same shall be integrated with the respective AC Fail and DC Fail relay DI circuits for continuous supply health monitoring.

5.1.13. Control supply in individual bay have to be distributed through MCBs of suitable rating for individual control function like:

- Main DC MCB
- Trip Coil -1 circuit
- Trip Coil -2 circuit
- Closing Circuit
- BCPU /86 Aux DC
- Indication Circuit
- Isolator status and Control (Via Aux Relay)
- 87T with Aux Relay
- TMU
- MFM
- Spring charging Circuit
- Heating and Lighting Circuit

5.1.14.(Independent DC MCB of suitable ratings shall be provided with add-on Contacts and Detail MCB description /chart to be affixed inside LT Chamber)

5.1.15.MCB shall be rated for 10kA short circuit rating. It shall be quick make, quick break, and independent manual type with trip free feature. The DC MCBs and AC MCBs ratings shall be separately mentioned and the panel having AC MCB of higher in lieu of DC MCB shall not be accepted.

5.1.16.MCB shall have the following:

- Over current protection
- ON/OFF Trip position indicators
- Auxiliary contact block (wherever required)

5.1.17.Wherever CB contacts are to be multiplied, latch type relay shall be used for contact multiplication. Auxiliary contact multiplier relays shall be reputed make and selected on the basis of continuous current carrying capacity and rated voltage. The fluctuation in voltage level shall be

accounted for (+/-) 10% continuously.

5.1.18.Fuse failure relay and trip circuit supervision relay shall be suitably selected, considering burden and auxiliary voltage. External circuitry like compensating resistances will not be accepted.

5.1.19.Relays shall support IEC 61850, Modbus, or DNP3 protocols for SCADA/EMS/DMS integration.

5.1.20.Redundant communication ports (Ethernet/RS485) for reliability.

5.1.21.Cybersecurity features: password protection, role-based access, secure firmware updates.

5.1.22.Relay features shall be adhered as per Protection IED specifications.

5.1.23.Capacitor bank switching device shall be provided with suitable gate interlock mechanism with castle key along with timer to ensure safety.

5.1.24.Each switchgear panel shall have 20% spare terminals. All equipment mounted on front side of panel shall have individual nameplates with equipment designation engraved. Alarms for Trip & non-trip should be separate. The termination links for cables shall be segregated in vertical plane. The bidder shall deliver to site completely assembled, wired, tested panels and only the interconnecting cables shall be connected at site.

5.1.25.The bidder shall deliver to site completely assembled, wired, tested panels and only the interconnecting cables shall be connected at site. The bidder shall further refer to ENG-Automation specifications & protection specifications for constructional and other requirements.

5.1.26. Transformer (Trafo) Trouble signals shall be considered as per the following logic, with latched type auxiliary contacts to ensure proper retention of status until manual reset.

I. For Trafo Trouble Trip, 4 Nos. of NO contacts shall be provided and allocated as follows:

- 86 Trip
- TMU
- 87T Input
- NIFPS

II. For Trafo Trouble Alarm, 3 Nos. of NO contacts shall be provided and allocated as follows:

- TMU
- 87T
- Common Buzzer

5.1.27.All auxiliary contacts shall be of latched type to ensure reliable indication and proper event recording until reset action is performed

5.1.28.Closing, Tripping, and Interlocking Logic of Isolator:

a) Isolator OPEN/CLOSE permissive logic shall be implemented using both hardware and

software (soft logic) interlocks.

- b) The permissive conditions shall include the following:
- Circuit Breaker (CB) shall be in OPEN condition
 - Earth switch shall be in OPEN condition
 - Local/Remote (LR) switch position as per outdoor reference
 - Isolator status confirmation through software (soft logic feedback)
- c) The isolator operation shall be enabled only when all the above permissive conditions are satisfied to ensure safe and reliable switching operations.
- d) Isolator OPEN/CLOSE commands shall also be implemented through auxiliary relays to ensure proper interlocking, contact multiplication, and reliable operation.
- e) The Isolator TNC switch shall be interlocked with the Field Local/Remote (L/R) switch.
- f) This interlock shall be incorporated to ensure that isolator operation is possible only under the permitted control mode, thereby preventing unsafe or unintended switching from field or remote commands.
- g) Isolator and earth switch status monitoring and control for outgoing feeders and 33kV incomers shall be implemented through CMR relay to ensure reliable operation, proper interlocking, and centralized control philosophy.
- h) Two independent control CB close Command shall be considered for both Local and Remote operation through the Local/Remote (L/R) switch via Control Relay.
- i) The control scheme shall ensure proper segregation of Local and Remote commands.
- j) All tripping and closing commands from the numerical relay shall be routed through auxiliary relays before execution in the circuit breaker control circuit.
- k) **CB closing Interlock:** In Soft logic and hardwiring for closing Interlock:
- Isolator close
 - Earth switch open
 - EM push button not operated
 - Rear door closed
 - TC1 & TC2 healthy (In Series)

- Master trip not operated
 - Spring charging
 - CB in Service
 - Breaker off position.
 - 2 nos. of Future I/L
 - Upstream breaker ON (for 11KV INCOMER)
 - Synch Check BO if Synch check is enabled with Line PT and Bus PT input: For Incomer and Bus Coupler
 - BET not inserted (for Adjacent Incomer and Bus coupler)
 - BRPT rear DOOR not open (For Incomer 2 and Bus coupler)
 - Isolator ON & Earth switch OFF
 - CB in Test Position Closing interlock from TNC and Relay HMI
 - CB in Test
 - The TNC (Trip–Neutral–Close) switch shall be of unlockable type to ensure free operation during control actions.
- l) The Local/Remote (L/R) switch shall be of lockable type to prevent unauthorized or unintended mode changes, ensuring secure control of the breaker operation.
- m) An Emergency Trip Switch (ETS) shall be incorporated in the panel.
- n) The ETS shall provide immediate tripping of the circuit breaker under emergency conditions and shall be clearly accessible, properly labeled, and integrated into the trip circuit to ensure safe and reliable operation.
- o) 86 lockout relay electrical reset push button shall be incorporated in the panel. Master trip relay shall be incorporated with pushbutton for hard reset.
- p) As well as Relay BO contact shall be incorporated for 86 lockout relay electrical reset.
- q) The reset push button shall be properly wired and designed to allow electrical reset of the 86 relays.

- r) Two binary outputs (BO contacts) shall be configured for the closing command:
- s) BO XX: HMI Close Command, routed through an auxiliary relay
- t) BO XX: Remote Close Command, also routed through the same auxiliary relay
- u) Both closing commands shall be governed by the Local/Remote selector status.
- v) Incomer close interlock logic shall be implemented as follows when Line PT is available:
 - a. Line PT healthy AND Bus condition is DEAD
 - b. Line PT healthy AND Bus PT healthy AND Synch Check permissive available
- w) The breaker closing command shall be enabled only when the above defined permissive conditions are satisfied to ensure safe and reliable operation.
- x) The Local/Remote (L/R) interlock shall not be applicable for tripping commands in both Local and Remote modes, including TNC, Local Trip, and Remote Trip operations.
- y) Tripping and closing commands shall be implemented through auxiliary contactors, with auxiliary DC supply fed from the BCPU DC circuit to ensure reliable operation and proper circuit isolation.

5.1.29. Multi-function meter to be considered of suitable class in section excluding bus coupler.

5.2 Circuit Breaker

5.2.1 The Circuit breakers shall be Vacuum, draw out type in horizontal position. The circuit breaker chamber shall have metallic safety shutters, which will close in the event of breaker withdrawal and ensure that no live components inside the switchgear panels are accessible. Withdrawal of the breaker shall not be possible in ON position. CB shall have TEST & SERVICE positions. It shall be possible to test the circuit breaker in "TEST" position inside the panel with all the auxiliary and control circuit connected and Power contacts isolated. Comprehensive interlocking system to prevent any dangerous or inadvertent operation shall be provided. Isolation of CB from bus bar or insertion into bus bar shall only be possible when the breaker is in the open position. Control switch for circuit breaker shall be of spring return to normal type with pistol grip handle. The CB chamber & other live parts accessible from a distance are to be provided with suitable locking arrangement. The circuit breakers compartment is to be provided with hinged doors and proper access to be provided for racking mechanism without opening the CB compartment door. The spare contact of breakers, Test/ service switches to be wired up to terminals.

5.2.2 The CB shall be spring operated, motor charged and manually released spring closing mechanism with three pole simultaneous operations. The speed of closing operation shall be independent of the hand-operating lever. The indicating device shall show the OPEN and CLOSE position of breaker visible from front of the cubicle. The spring charging time of the motor shall not exceed 10 sec in case of Vacuum Circuit Breaker. The "TRIP" and "CLOSE" coils shall be of reliable design and low consumption preferably less than 200W. Anti-pumping relays & T-N-C switch shall be provided for each panel.

5.2.3 The Breakers shall be capable of Making & Breaking the short time current in accordance with the requirement of IEC 62271-100 and latest amendment thereof and shall have 3 phase short circuit current capacity of 1500 MVA. The continuous current rating of breaker shall not be less than 1250A. For each switchboard one no. 1250 A CB handling trolley shall be supplied.

5.2.4 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.

5.2.5 Vacuum Interrupter, Breaker and Switchboard should be of same make.

5.3 BUS BARS AND CONNECTORS

5.3.1 Bus bars and all other electrical connections between various components shall be made of copper of rectangular cross-section. The bus bars shall be insulated with heat shrinkable insulating sleeves, except at the points of connections. The bus bars shall be of ample capacity to carry the rated current of 1250A 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. All bus bars shall be rigidly and firmly mounted and shall be capable of withstanding short circuit stresses and vibrations. Bidder should specify current density for Cu bus bars provided in the switchgear. The bus bars shall be extensible on both sides.

5.3.2 Adequate clearance between phases and between phase & earth 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 latest Indian standard specification. The same shall be capable of withstanding the specified High Voltage tests as per IEC-62271/60060 and the amendments thereof.

5.3.3 The interlocking facility should be provided between incomers and Bus couplers. However, Scheme will be finalized during detail engineering. The insulators shall be made of non-hygroscopic material.

5.3.4 All bus bar joints and all tap-off connections from the main horizontal bus bars shall be provided with removable FRP shrouds.

5.3.5 Bus bars shall be prominently marked with Red, Yellow and Blue color rings for easy phase identification at regular interval and at every power tap off point.

5.3.6 Only zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers shall be used for all bus bar joints and supports.

5.4 Current Transformer

The Current Transformers shall be of Epoxy Cast Resin Type with Window type construction and rated for 1500 MVA and be of the single-phase type , with separate core for metering, protection and differential . For CT/PT circuits, drop type links to be provided and lugs shall be ring type. The control wiring shall be of 4 sq. mm multi stranded copper with 1.1 kV insulation grade. The physical location of CT core for differential protection shall be near BUS to have overlapping protection different zone. The additional auxiliary CTs and related wiring work required to match existing Trf. Differential Protection shall be part of this tender specification. All current transformers shall be designed to carry continuously a current of 120% of the rated current.

5.5 Voltage Transformers

The Voltage Transformer shall be of epoxy cast resin type and mounted horizontally on a draw-out type trolley and protected by HRC fuses on both primary and secondary sides.

BUS PT:

Bus VTs shall be provided in each bus section. The VT shall have Metallic safety shutters, which will close in the event of VT withdrawal and ensure that no live components inside the 33 kV switchgear panels are accessible. The VT shall be of the single-phase type with separate core for metering and separate core for protection.

Line PT:

For Line PT Rear Side Access and BPT will be Front side access

The control wiring shall be of 4 sqmm multi stranded copper with 1.1 kV grade insulation.

All voltage transformers shall be designed to carry continuously 1.2 times the normally rated voltage and 1.9 times the normally rated voltage for continuous operation upto 30 sec.

5.6 Relays

- a) The switchgear shall have numerical communicable relays designed to disconnect fault circuits with speed and discrimination and shall confirm to IEC 60255-3/IS 3231 or latest revision thereof regarding accuracy and other features.
- b) The relay resetting should be such that resetting of the main protection relay should reset all the other auxiliary relays. All the relays shall be communicable with suitable protocol so as to provide all the I/O signals required by the Purchaser
- c) Relays shall support purchaser's protection philosophy. However, the substation operation shall comply to the integrated automation requirements with the MASTER SCADA.
- d) BCPU Relay should have at least 24BI and 14BO and Transformer protection relay have 20BI and 10 BO at least.
- e) Two Trip Coils along with Two Trip Coil Supervision relay to be considered for each Panel.
- f) All plugs in heavy current modules that carry CT circuits shall be equipped with CT shorting features when the module is withdrawn. Suitable facilities shall be provided on each measuring relay to disconnect trip outputs and disconnect the CT circuits.

The bidder shall further refer to Protection specifications & Automation specifications.

5.7 DC SELECTION SWITCH

There shall be three position DC selector switch i.e neutral, DC1 & DC2. In normal supply condition the left side panel & bus section is fed by DC1 Source and right-side panel is fed from DC2 Source. In case of failure of DC2 source, all panels will be fed by DC1 source. Similarly, in case of failure of DC1 source, all panels will be fed by DC2 source. Cabling required from DCDB to DC selector switch is included in vendor scope. DC MCB OF 25 A rating with 'C/K' characteristics shall be preferred.

5.8 TERMINAL BLOCKS

5.8.1 The terminal blocks shall be 1100 V grade, 10A rated, one piece moulded, complete with insulated barriers, stud type terminals, washers, nuts.

and identification strips. The terminal blocks for CT shall be of disconnecting type. Markings on the terminal strips shall correspond to wire numbers on the wiring diagrams. The terminal blocks shall be fully enclosed with easily removable covers and made of moulded non-inflammable plastic material,

5.8.2 A minimum clearance of 250 mm between the first row of terminal blocks and the associated cable and plate shall be ensured. Also, the minimum clearance between two rows of terminal blocks shall be 150 mm.

5.8.3 All spare contacts and terminals of the panel mounted of the panel mounted equipment and devices shall be wired to terminal blocks. All the TB's shall be of single Decker type The bidder shall further refer to Protection specifications & Automation specifications.

5.9 SPACE HEATERS:

Strip type space heaters of adequate capacity shall be provided inside each panel to prevent moisture condensation on the wiring and panel mounted equipment. Space heaters shall be rated for 240 V, 1 phase, 50 Hz supply. Heaters inside the panels shall not be mounted close to the winding or any panel mounted equipment. Heaters shall be complete with either Miniature circuit breakers or with isolating switches, HRC fuse on phase and link on the neutral of the heater supply.

An adjustable type thermostat shall be provided in the heater control circuit with temperature range of 0-90 deg t h e indication shall be provided for monitoring the healthiness of Space heater.

5.10 INTERIOR LIGHTING AND RECEPTACLES

Each panel shall be provided with a compact fluorescent lighting fixture rated for 240 V, 1 phase, 50 Hz supply for the interior illumination of the panel during maintenance, The fitting shall be complete with switch-fuse unit and the switching of the fitting shall be controlled by the respective panel door switch.

Each panel shall be provided with a 240 V, 1 phase, 50 Hz, 15 A, 5 pin receptacle with switch. The receptacle with switch shall be mounted inside the panel at a convenient location.

5.11 POWER AND CONTROL SUPPLIES

- a) Each control panel shall be provided with necessary arrangement for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling and space heater circuits. The incoming and sub-circuits shall be separately provided with MCBs. Supply monitoring arrangement shall be provided. Selection of the MCB ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall also be protected by MCBs.
- b) Concern DISCOM to arrange AC Supply (230V) and DC Supply (24V/48V) at site. Necessary suitable ratings of Incomer MCB shall be provided by Bidder in Panel Board.

- c) All fuses shall be HRC cartridge type conforming to relevant standards, mounted on plug-in type fuse bases and Siemens type of bases and cover with locking arrangement for fuse link. All accessible live connection to fuse bases shall be adequately shrouded. Fuse carrier base shall have imprints of the fuse rating and voltage.

5.12 PANEL WIRING

- a) Panels shall be supplied completely wired internally to equipment and terminal blocks and ready for the purchaser's external cable connections at the terminal blocks. Panel wiring shall be securely supported, neatly arranged by lacing and tying, readily accessible and connected to equipment terminals and terminal blocks. Flame retardant, plastic wiring channels / troughs with strap on plastic covers shall be used for this purpose. When panels are arranged to be mounted adjacent to each other all inter-panel wiring and connections between panels shall be provided by the Bidder.
- b) All wiring shall be carried out with 1100 V grade, single core stranded copper conductor wires with FRLSH Type insulation. Extra flexible wires shall be used for wiring of devices mounted on moving parts such as swinging panels and doors. The minimum size of the stranded copper conductor used for panel wiring shall be as follows:
- a. All circuits except CT & PT circuits: 1.5 Sqmm per lead
 - b. CT circuits: 4 Sqmm per lead
 - c. PT circuits: 4 Sqmm per lead
- c) Longitudinal troughs extending throughout the full length of the panels shall be provided for Inter panel winding, for AC and DC supplies, PT circuits, annunciator circuits and other common services. Interconnections to adjacent panels shall be brought out to a separate set of terminal blocks located near the slots or holes meant for taking the interconnecting wires. Arrangements shall permit easy inter-connections to adjacent panels at site and wires for this purpose shall be provided by the bidder looped and bunched properly inside the panels.
- d) If accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker or positive and negative wires, these wires shall not be terminated on adjacent terminal blocks. The unused instrument space on the front or rear of the panels shall be kept clear of wiring, to facilitate addition of devices without rewiring associated portion of the panels.
- e) Wire terminations shall be made with soldieries crimping type of (ring type lugs for all CT & PT circuits and pin type lugs for other circuits) tinned copper lugs which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules, marked to correspond with panel wiring diagram

shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is disconnected. Lock in type ferrule shall be provided.

f) Bidder shall be solely responsible for looping all protection relays up to the BCU/BCPU or DC as per the requirement. Network cable required to communicate BCU/BCPUs with DC shall be under bidder's scope. Looping and networking cable shall be CAT-6 type. The Bidder shall be solely responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment. In case the cables are to be routed through trenches, necessary metal clad conduits shall be used.

g) Internal wiring to be connected to external equipment shall terminate on terminal blocks. The terminal blocks for CTs and PTs shall be provided with test links and isolating facilities. The CT terminal blocks shall be provided with short circuiting and earthing facilities. Change of CT cores should be possible by linking & delinking of terminals. Switchgear shall have 20% terminals as spare terminals in each panel & should be uniformly distributed in all the terminal blocks. (Shall be decided during detailed engineering)

5.13 CABLE TERMINATION

ACCESSORIES

- a) The purchaser's external cable connections will be terminated on the terminal blocks provided in the control panel. All necessary cable terminating accessories such as gland plates, cable glands and crimp type tinned copper lugs, supporting clamps and brackets wiring troughs, etc. for cables shall be included in the bidder's scope of supply.
- b) For CTs: Ring Type Interface lugs required.
- c) All color caps shall be similar and interchangeable and all lamps be of same type and ratings lamps shall be furnished 20% in excess of actual numbers required and color caps shall be furnished 10% in excess of actual numbers used for each color.

5.14 LABELS

- a) All equipment mounted on front and rear side as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation engraved. Also, on the top of each panel on front as well as rear side, large and bold nameplates shall be provided for circuit/feeder designation. The labels shall be mounted directly below the respective equipment.
- b) All front mounted equipment shall be provided with individual labels at the rear also with

equipment designation engraved with tag numbers corresponding to the ones shown in the panel internal wiring to facilitate easy tracing of the wiring.

- c) Bay Name signage shall be provided on both front and rear sides of the panel along with clear mimic indication for easy identifications.
- d) Phase marking along with phase separators shall be provided as per standard practice to ensure proper insulation clearance and safe segregation between phases inside the panels.
- e) Cross ferruling is required i.e. source /designation/Destination
- f) An instruction sheet including clear DO's and DON'Ts for circuit breaker operation and BET/CET shall be provided and permanently affixed on the panel.
- g) Permanent fixing of instruction and rating plates shall be ensured.

(All instruction sheets, equipment rating plates shall be securely and permanently fixed on the panel using suitable fasteners/Adhesives to prevent detachment during operation, maintenance or, maintenance)

- h) Each IED and meter shall be prominently marked. All relays and other devices shall be clearly marked with manufacturer's name, type, serial number and electrical rating data.
- i) Labels both external & internal shall be made on non-rusting metal preferably Al anodized one. Labels shall have white letters on black background. The lettering size shall be subject to Purchaser's approval.
- j) Each switch shall bear clear inscription identifying its function e.g. 'BREAKER' 52A' etc. Similar inscription shall also be provided on each device whose function is not defined. If any switch device doesn't bear this inscription for each position indication e.g. 'Trip-Neutral-Close', 'ON-OFF', 'R-Y-B-OFF' etc.

5.15 EARTHING

a) All panels shall be equipped with a separate earth bus securely fixed along with the inside base of panels. When several panels are mounted adjoining each other, the earth bus shall be made continuous. Provision shall be made for future extension of the earth bus. Provision shall be made on the earth bus bars of the end panels for connecting the same to the earthing grid.

b) An earthing conductor/Bus of suitable rating of Cu shall be provided extending the whole length of switchgear and control gear to sustain the Rated short time withstand current. Each equipment mounted in the panel shall be directly earthed to this earth bus

by distinct connections. Bidder shall provide separate electronic earthing for all LED's. Separate earth bus bar to be run along switchgear for protecting earthing of relays and communication equipment and LEDs and shall be insulated from the frame.

c) Earthing trolley shall be provided separately to earth the bus bar and cables adequate interlocking facilities such that earthing trolley can't be 'ON' when bus bar/cable is energized and it should have only mechanical closing facility. The offered trolley shall be of sufficient capacity to carry the peak fault current. One bus bar earthing truck & one cable earthing truck shall be supplied per switchboard. In case the sizes are different for Incoming and outgoing separate earthing trucks shall be provided.

d) All metallic cases of relays, instruments and other panel mounted equipment shall be connected to the earth bus by independent copper wires of size not less than 2.5 Sq mm for VT and CT secondary neutral or common lead shall be earthed at one place, preferably at the terminal blocks where they enter the panel. The color coding for earthing wires shall be given. Bidder shall provide separate electronic earthing for all IEDs.

e) Looping of earth connections, which would result in loss of earth connection to the other devices when the loop is broken shall not be permitted. However, looping of earth connections between equipment to provide alternative paths to earth connections between equipment to provide alternative paths to earth bus shall be provided.

5.16 PAINTING

The Paint Shade shall be RAL 7032 (Pebble Grey). Paint Thickness shall be in the range of 70 Micron ensuring adequate Corrosion Protection.

All painting works shall be carried out in accordance with our standard painting procedure which includes proper surface preparation, primer application and final finish.

5.17 GALVANIZING

All galvanizing shall be carried out by the hot dip process, in accordance with IS 2629/ ISO 1460 amended to date. Nut, bolts, washer made of stainless steel of grade: 304. However, high tensile steel nuts, bolts and spring washers shall be hot dip galvanized to service condition four. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing.

1. There shall be no impurities in the zinc or additives to the galvanic bath, which could

have a detrimental effect on the durability of the zinc coating.

2. After galvanizing no drilling or welding shall be performed on the galvanized parts of the equipment except that nut may be threaded after galvanizing.

3. To avoid the formation of white rust, galvanized material shall be stacked during transport and stored in such a manner as to permit adequate ventilation. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization. The galvanized steel shall be subjected to tests as per IS-2633/ BS 729 amended to date.

4. The zinc deposition should not be less than 705 grams / meter square of the galvanized surface area / 100 microns / 6 dips.

5.18 SYSTEM ARCHITECTURE AND COMMUNICATION

The bidder shall refer to Automation specifications for System architecture and communication requirements.

5.19 DATA CONCENTRATOR (Optional Requirement)

The bidder shall refer Automation specifications for Data concentrator requirements

Armored CAT-6 cable around 60 meters to be provided along with Managed Ethernet Switch (16 Ports).

5.20 CONTROL, METERING AND PROTECTION

Incomer switchgears should be provided with separate protection unit and separate metering & control unit. Outgoing feeder switchgears (including switchgears for capacitor & local transformer) should be provided with combined protection, metering & Control unit. All these units shall be communicable with Purchaser's SCADA on IEC-61850 protocol without any change & modification of hardware.

Purchaser's SCADA on IEC-61850 protocol without any change & modification of hardware.

The bidder shall further refer to Automation specifications for Control, metering and protection requirements

5.21 TRANSFORMER MONITORING UNIT (Optional requirement)

Please Refer Automation specifications

5.22 REMOTE MONITORING AND MAINTENANCE STATION (Optional Requirement)

Please Refer Automation specifications

5.23 CONTROL PHILOSOPHY

The bidder shall refer to Automation specifications for Control philosophy requirement.

5.24 OPERATIONAL PHILOSOPHY

The bidder shall refer Automation specifications for Control philosophy requirement.

5.25 PROTECTION PHILOSOPHY

The bidder shall refer to Please Refer Protection specifications for protection philosophy requirement.

5.26 PQM Meter (Optional Requirement)

PQM meters shall be provided by bidders in Transformer outgoing panel. Separate droppable links shall be provided in Metering circuit and space on front door to be provided. Power Quality Meter make are A-Eberle, METRUM, UNIPOWER, Elspec. Communication Port as per the BCPUs communication port. The PQM meter needs to be connected in switch network so that data can be transferred to the central system

5.27 Asset monitoring system: (Optional Requirement)

The Asset Monitoring System shall be as per the requirement of the tender. If this system is required a separate line item shall be added in the BoQ, else this system shall not be required. Asset Monitoring System is for Condition Based Predictive Maintenance for the Switchgear Panels. It should have interoperability with other make panels & relays, cyber security, user licenses etc.

Sensor Based Remote Maintenance Care system shall have following sensors:

Sensor Type	Sensor Location
Temperature Sensor	Bus Bar Compartment, Breaker Compartment (Upper Arm and Lower Arm), Cable Compartment
Partial Discharge Sensor	Cable Compartment
Humidity Sensor	Cable Compartment
Arc Sensor	Arc Chamber
Room Temperature and Humidity Sensor	Outside the Panel Board inside the Switchgear room
Pollution or Dust Sensor	Outside the Panel Board inside the Switchgear room

Online condition monitoring, asset health monitoring, data storage, reporting and maintenance support, health prediction of electrical distribution network assets, allow engineers/ managers to gather data and insight that allows them to make more informed decisions about asset health. It should have Circuit Breaker Parameter Monitoring (Input through protection relay), Substation Monitoring Device/Data Concentrator Unit, Data usage & Analytics with inbuilt algorithm.

All the accessories required for successful operation of this system shall be in the bidder's scope. Bidder has to submit BoQ for this system along with tender bid. The license of this system shall be provided for at least 5 years to minimum 10 persons. The complete architecture shall be as per the requirement of DISCOM.

6. MARKING

All the components and operating devices of the switch gear shall be provided with durable and legible nameplates containing all technical parameters. Name plate shall be embossed with "PO no. with date"," PROPERTY OF TPCODL/TPNODL/TPSODL/TPWODL" along with the following information

- a) Manufacturer's Name
- b) Serial Number
- c) Type designation or serial number
- d) Applicable rated values
- e) No. of the relevant standard
- f) Warrantee/guarantee clause

The name plate of each functional unit shall be legible during normal service. The removable parts, if any shall have a separate nameplate with the data relating to the functional units they belong to, but this nameplate need only be legible when the removable part is in removed position.

7. TESTS

All the Routine and acceptance tests shall be carried out in accordance with the relevant IEC standards. All routine/acceptance tests shall be witnessed by the Purchaser/his authorized representative. All the components should also be type tested as per the relevant standards. All meters and metering elements in KU shall also be routine and type tested as per the relevant standards and shall further be tested at site by the successful bidder. For Type test of Numerical relays, control, and communication equipment and Factory acceptance test, Hardware Intelligence test and Integration System tests kindly refer Automation specifications & Protection specifications For type tests of meters, relevant IS has to be followed

Following tests shall be necessarily conducted on the switchgear in addition to the others specified in IS/IEC:

Routine Test:

1. Dielectric Test on main and control circuits.
2. Dimensional and visual checks
3. Mechanical Operation tests
4. Tests of auxiliary electrical devices
5. Verification of correct wiring
6. Measurement of resistance of main circuit
7. Partial Discharge Measurement
8. Tests after erection on site

Type Tests:

1. Tests to verify the insulation level of the equipment including tests at power frequency test voltages on auxiliary circuits (Dielectric Tests)
2. Tests to prove the temperature rise of any part of the equipment and measurement of resistance of the main circuit
3. Tests to prove the capability of the main and earthing circuits to be subjected to the rated peak and the rated short-time withstand currents
4. Tests to prove the making and breaking capacity of the included switching devices
5. Tests to prove the satisfactory operation of the included switching devices and removable parts (Mechanical Operation tests)
6. Tests to verify the protection of persons against approach to live parts and contact with moving parts
7. Tests to verify the protection of persons against dangerous electrical effects
8. Electromagnetic Compatibility — Emission and Immunity tests (for secondary system)

Type Tests for Numerical Relays/ Devices:

- | | |
|---|---------------------------|
| 1. Dielectric Withstand Test | IEC60255-5 |
| 2. High Voltage Impulse Test, | class III IEC 60255-5 |
| 3. DC Supply Interruption | IEC 60255-11 |
| 4. AC Ripple on DC Supply | IEC 60255-11 |
| 5. Voltage Dips and Short Interruptions | IEC 61000-4-11 |
| 6. High Frequency Disturbance | IEC 60255-22-1, Class III |
| 7. Fast Transient Disturbance | IEC 60255-22-4 Class IV |

8. Surge Withstand Capability

IEEE/ANSI C 37.90.1(1989)

Special Test

- 1) Tests to verify protection of the equipment against external effects due to weather.
- 2) Tests to verify the protection of the equipment against mechanical damage
- 3) Tests to assess the effects of arcing due to an internal fault. It shall withstand fault current of 25 kA for 1 sec.
- 4) Tests to detect certain defects in the solid insulation of the equipment by the measurement of partial discharges.

However, in case any type test is not carried out/ carried out at In-house laboratories, the same shall be decided for acceptance as per the mutual agreement between the Purchaser and Bidder.

8. TYPE TEST CERTIFICATES

The bidder shall furnish the type test certificates for the tests as mentioned above as per the corresponding standards. All the tests shall be conducted at CPRI/ERDA/PHELA/ International Lab as per the relevant standards. Type test should have been conducted in certified Test Laboratories during the period not exceeding 10 years from the date of opening the bid. In the event of any discrepancy in the test reports i.e. any test report not acceptable or any/all type tests (including additional type tests, if any) not carried out, same shall be carried out without any cost implication to TPCODL/TPNODL/TPSODL/TPWODL.

Note:

Type test validity shall comply with the latest CEA guidelines. However, type test certificates older than the prescribed validity period may be considered acceptable, subject to confirmation that there has been no change in the design of the panel board.

9. PRE-DISPATCH INSPECTION

Equipment shall be subject to inspection by a duly authorized representative of the Purchaser. Inspection may be made at any stage of manufacture at the option of the purchaser and the equipment if found unsatisfactory as to workmanship or material is liable to rejection. The bidder shall grant free access to the places of manufacture to the Purchaser's representatives at all times when the work is in progress. Inspection by the Purchaser or its authorized representatives shall not relieve the bidder of his obligation of furnishing equipment in accordance with the specifications. Material shall be dispatched after specific MDCC (Material

Dispatch Clearance Certificate) is issued by the Purchaser.

Following documents shall be sent along with material

- a) Test reports
- b) MDCC issued by TPCODL/TPNODL/TPSODL/TPWODL
- c) Invoice in duplicate
- d) Packing list
- e) Drawings & catalogue
- f) Guarantee / Warrantee card
- g) Delivery Challan
- h) Other Documents (as applicable)

10. INSPECTION AFTER RECEIPT AT STORES

The material received at the Purchaser's store will be inspected for acceptance and shall be liable for rejection, if found different from the reports of the pre-dispatch inspection and one copy of the report shall be sent to Project Engineering department.

11. GUARANTEE

Bidder shall stand guarantee towards design, materials, workmanship & quality of process / manufacturing of items under this contract for due and intended performance of the same, as an integrated product delivered under this contract. In the event any defect is found by the Purchaser up to a period of at least 54 months from the date of commissioning or 60 months from the date of last supplies made under the contract whichever is later, Bidder shall be liable to undertake to replace/rectify such defects at its own costs, within mutually agreed time frame, and to the entire satisfaction of the Purchaser, failing which the Purchaser will be at liberty to get it replaced/rectified at Bidder's risks and costs and recover all such expenses plus the Purchaser's own charges (@ 20% of expenses incurred) , from the Bidder or from the "Security cum Performance Deposit" as the case may be.

Also refer Please Refer Automation specifications & Protection specifications.

12. PACKING

Bidder shall ensure that all equipment covered under this specification shall be prepared for rail/road transport (local equipment) and be packed in such a manner as to protect it from damage in transit,

13. TENDER SAMPLE: NA

14. QUALITY CONTROL

The bidder shall submit with the offer, Quality assurance plan indicating the various stages of inspection, the tests and checks which will be carried out on the material of construction, components during manufacture and bought out items and fully assembled component and equipment after finishing. As part of the plan, a schedule for stage and final inspection within the parameters of the delivery schedule shall be furnished. The Purchaser's engineer or its nominated representatives shall have free access to the manufacturer/sub-supplier's works to carry out inspections.

15. MINIMUM TESTING FACILITIES

Bidder shall have adequate in-house testing facilities for carrying out all routine tests & acceptance tests as per relevant International / Indian Standards.

16. MANUFACTURING ACTIVITIES

The successful bidder will have to submit the bar chart for various manufacturing activities clearly elaborating each stage, with quantity.

This bar chart should be in line with the Quality assurance plan submitted with the offer. This bar chart will have to be submitted within 15 days from the release of the order.

17. SPARES, ACCESSORIES AND TOOLS

17.1 Spares:

Bidder should quote unit rates for following mandatory spares along with the bid. However, the exact quantity of these shall be as per the BOQ attached with the tender.

- a) Trip Coil
- b) Closing Coil
- c) Spring charging motor
- d) T-N-C Switch
- e) Local remote selector switch
- f) Tulip/Finger contact
- g) Indication lamps
- h) Auxiliary switches
- i) LED for cable charge indication
- j) Relay (Feeder Protection)

k) Relay (Transformer protection)

In addition to above, bidder shall submit recommended list of spares for 3 years of operation, if any with unit prices and recommended quantity.

For other requirements of Training, Support, Services, Maintenance and Spares, bidder shall refer Automation specifications.

17.2 SPECIAL TOOLS & GAUGES:

A list of complete set of special tools and gauges required for erection & maintenance and installation procedure should be submitted.

The Bidder shall give an assurance that special maintenance tools & tackles and spares will continue to be available through the life of the equipment, which shall be 25 years minimum.

However, the supplier shall give a minimum of 12 month notice in the event of plan to discontinue manufacture of any component used in this equipment. Any special maintenance tools & tackles apparatus, parts or tools shall be subject to the same specifications, tests and conditions as similar material supplied under the Contract. They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the plant and must be suitably marked and numbered for identification. Spanners and other maintenance equipment provided under this contract shall not be used for the purpose of erection.

18. DRAWINGS AND DOCUMENTS

Following drawings & documents shall be prepared based on TPDDL specifications and statutory requirements and shall be submitted with the bid:

- a) Completely filled-in Technical Parameters
- b) General description of the equipment and all components including brochures
- c) General arrangement drawings
- d) Single Line Diagram
- e) Bill of material
- f) Type Test Certificates
- g) Experience List
- h) Foundation fixing drawings.
- i) Drawings/documents to be submitted after the award of the contract, please refer below table

The bidder shall further refer Automation specifications & Protection specification for providing

documents after award of contract.

Instruction Manuals: Supplier shall furnish two softcopies (CD) and four (4) hard copies of nicely bound manuals (in English language) covering erection and maintenance instructions

And all relevant information and drawings pertaining to the main equipment as well as auxiliary devices. Bidder shall also submit one no. soft copy of as-built drawings in pdf. Format

Sr. No.	Description	For Approval	For Review Information	Final Submission
1	Technical Parameters	✓		✓
2	General Arrangement drawings	✓		✓
3	Single Line Diagram	✓		✓
4	Typical Mimic diagram	✓		✓
5	Schematic/Inter logic diagrams	✓		✓
6	Bill of Material	✓		✓
7	Foundation Plan & loading details	✓		✓
8	Manual/Catalogues/drawings for DC, BCU meters, relays , switches , lamps etc.		✓	✓
9	Control and Operational Philosophy of Automation		✓	✓
10	Input/output List		✓	✓
11	Cable Schedule & interconnection diagram		✓	✓
12	Programming language manual		✓	✓
13	Details of the Communication protocol & interoperability list for the future interfacing		✓	✓
14	Equipment wise detailed circuit diagram		✓	✓
15	Electronic earthing scheme		✓	✓
16	Configuration diagram with functional write up		✓	✓
17	I/O mapping		✓	✓
18	3 nos. of working drawings		✓	✓

19	6 nos. of as-built drawings		✓	✓
20	Relay co-ordination scheme		✓	✓
21	Installation / commissioning manual		✓	✓
22	Instruction for Use		✓	✓
23	Transport / Shipping dimension drawing		✓	✓
24	QA & QC Plan	✓	✓	✓
25	Routine, Acceptance & Type Test Certificates	✓	✓	✓

19. GUARANTEED TECHNICAL PARTICULARS

S.No.	Description	Units	To be Furnished by Bidder
1	SWITCHBOARD		
a)	Architecture		
b)	Applicable standard		
c)	Dimensions (in mm) W*D*H		
d)	Internal Arc Protection		
e)	Normal Service conditions		
f)	Service Voltage	kV	
g)	Rated Voltage	kV	
h)	Rated capacity	MVA	
i)	Rated power frequency withstand voltage (rms)	kV	
j)	Rated impulse withstand voltage (1.2 , 50us)	kVP	
k)	Rated Short time withstand current	kA	
l)	Rated Peak withstand current	kA	
m)	Busbar material		
n)	Main busbars insulation		
o)	Busbar rated continuous current	A	
p)	Max current Density for Bus bar(Although it should be as per type tested design ,Bidder to share details for different compartment .)	A/sq. mm	
q)	Max. Permissible temp. rise at rated normal current		

r)	Degree of Protection for enclosure / Partitions / for meters , relays and BCU		
2	CIRCUIT BREAKER		
a)	Standard		
b)	Type		
c)	No. of poles		
d)	Rated load Breaking current	kA	
e)	Rated short circuit withstand current	kA	
f)	Rated short circuit making current	kA	
g)	Isolation		
h)	Rated Voltage	kV	
i	Service voltage	kV	
j)	Rated frequency	Hz	
k)	Rated Insulation level		
i)	Lightning impulse withstand voltage	kVP	
ii)	One min. power frequency withstand voltage	kV (rms)	
l)	Rated operating sequence		
m)	Opening time	msec	
n)	Arcing time	msec	
o)	Total break time	msec	
p)	Making time	msec	
q)	Temperature Rise		
r)	Breaker Duty		
3	OPERATING AUXILIARY VOLTAGES		
a)	Control and signaling voltage		
b)	Spring Charging Motor (Universal Motor)		
c)	Heater and lighting circuits		
d)	No. of spare auxiliary contacts		
4.1	CURRENT TRANSFORMER		
a)	Type		
b)	Short circuit withstand		
c)	Location		
d)	Ratio		
e)	Burden & Class (Metering and Protection)		

i)	Core-I		
ii)	Core-II		
h)	Core-III		
5	VOLTAGE TRANSFORMER		
a)	Make		
b)	Location		
c)	Mounting arrangement		
d)	Ratio		
e)	Burden & Class		
i)	Core-I		
ii)	Core-II		
iii)	Core-III		
6	Protection ,Control , Metering & Communication		
7	MIMIC Diagram on Relay		
8	Provision of flag indications and contacts for remote annunciation for Self powered backup relay for incomers		
9	Electricity reset type , High speed relay for tripping		
10	Anti-pumping Relay		
11	Makes for Auxiliary Relays		
12	Provision of DC fail Relay for each panel		
13	OTHERS		
a)	Cable charge indication for all panels (VPI with Potential Free Contact for Relay Input)		
b)	Cable side earthing arrangement		
c)	Busbar side earthing arrangement		
d)	TNC Switch	.	
e)	Local / Remote switch		
f)	Indication Lamps CB ON/OFF		
g)	Indication Lamps CB Auto Trip		
h)	Indication Lamps for CB Test/Service positions		
i)	Spring charged indication		
j)	Trip ckt. supervision scheme		

k)	MCB for AC		
l)	MCB for DC		
m)	MCB for space heater		
n)	MCB FOR VTs		
o)	Trip alarm scheme with hooter, Accept/ Reset PB etc		
P)	Panel anti- condensation heater with thermostat		
q)	Panel illumination		
***	Schematic Drawings		

20. SERVICE LEVEL AGREEMENT:

1) Vendor Has To Submit Standard Technical Parameters With Following Details of Spares Mentioned In The BOM & Technical Specifications of Each Type Supplied Of Each Rating Supplied Along With The Tender:

- a) Catalogue of Switchgear Spares/CT Etc.
- b) Material Code
- c) With Guarantee Period
- d) Photographs - For Effective Spare Management Within One Week Of Grid Commissioning End Date

2) Problem Troubleshooting & Restoration in Warranty Period shall be in BA's scope.

a) Service Engineer Availability To Attend, Identify & Restore Defects (Minor) Of Grid Equipment's Under Guarantee Period Within 48 Working Hours (Exclusion of Material Support Cases)

b) Spare Material Delivery For Restoration Of Grid Equipment (Major Defect) Under Guarantee Period Within Two Weeks. BA Must Keep Requisite Inventory Of Critical Switchgear Spares & Other Equipment's Covered In Guarantee Period To Restore Equipment Within Two Weeks.

c) In Case Of Complete Replacement of Equipment, Complete Equipment To Be Replaced within A Period Of 4 Weeks

3) Spare Material Continuity & Availability After Expiry Of Warranty Period:

a) All Switchgear Spares Must Be Made Available By BA For at Least 15 Yrs. post guarantee Period Expiry.

b) Other Grid Equipment Spares Must Be Made Available By BA For At Least 5 Yrs. Post Guarantee Period Expiry.

c) Lead Time For Spare Delivery Post GP Expiry Must Be Within Four Weeks of Fault Reporting To Business Associate.

21. SCHEDULE OF DEVIATIONS

(TO BE ENCLOSED WITH TECHNICAL BID)

All deviations from this specification shall be set out by the Bidders, clause by Clause in this schedule. Unless specifically mentioned in this Schedule, the tender shall be deemed to confirm the purchaser's specifications:

S. No	Clause No.	Details of deviation with justifications

We confirm that there are no deviations apart from those detailed above.

Seal of the Company:

Signature, Designation