Amendment No.-I dated 23.06.2025 to the Bidding Documents for AIS Bay extension works (SS-02)

i) Under NERES-XXIII

a) Extension of 132kV Pasighat (DoP, Arunachal Pradesh) S/s.

b) Extension 132kV Roing (POWERGRID) S/s.

c) Extension 132kV Tezu (POWERGRID) S/s.

d) Extension of 132kV Namsai (POWERGRID) S/s

ii) Under NERES-29A

a) Installation of new 1x50MVA, 132/33kV (3rd) ICT at Namsai (POWERGRID) S/s

(Specification No. NER/NT/W-AIS/DOM/H00/25/08534)

S No.	Volume/ Section/ Clause No.	Existing Provision/ Bidder's Queries	Amended as/ POWERGRID's Reply
1	Volume II- Technical Specifications	**Existing Provision** - NIL	**Amended as New Documents**: 1) *48V & 110V DCDB*- **LT switchgear specification is enclosed.** 2) *36 kV Indoor Switchgear Panel Transformer Module*- **36kV indoor switchgear specification (VCB) type is enclosed.** 3) *36 kV Indoor Switchgear Panel for Bus sectionalizer Module*- **36kV indoor switchgear specification (VCB) type is enclosed.**

			4) *415 V ACDB*- **LT switchgear specification is enclosed.**
2	Volume II- Technical Specifications	**Bidder's Queries**: 1) *33 KV Bus Post Insulator*	**POWERGRID's Reply**: 1) IS/IEC as per section switchyard erection (already enclosed in tender) may be followed.

MODEL TECHNICAL SPECIFICATION

SECTION: LT SWITCHGEAR

SECTION: LTSWITCHGEAR

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SECTION: LT SWITCHGEAR

1.1. CONSTRUCTIONAL DETAILS OF SWITCHBOARDS AND DISTRIBUTION BOARDS

1.1.1. All boards shall be of metal enclosed, indoor floor mounted, compartmentalised double front construction and freestanding type.

1.1.2. All board frames, shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. ***Gland plate shall be cold rolled sheet steel having thickness not less than 3 mm in all cases. However, in case of termination of single core power cables, gland plate shall be of non-magnetic material of at least 4mm thickness.***

1.1.3. All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.

1.1.4. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.

1.1.5. All boards shall be of dust and vermin proof construction and shall be provided with a degree of protection of IP: 52, ***for category I enclosure*** as per IS 13947 (Part-1). However, the busbar chambers having a degree of protection of IP: 42, in accordance with IS 13947 (Part-1), are also acceptable where continuous busbar rating exceeds 1000 Amp. Provision shall be made in all ***draw out Air Circuit Breaker*** compartments for providing IP: 52 degree of protection, when Circuit breaker trolley, has been removed. ***Panels with lighting transformers shall have IP 31 degree of protection in accordance with IS 13947 (Part-1)***. ***Door frame of panels, meters, relays, Breaker*** cut-outs shall be provided with neoprene ***rubber*** gaskets ***generally conforming to Type-II, Class 2A as per IS: 11149.***

1.1.6. Provision of louvers on boards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating exceeds 1000 Amps. ***Panels with lighting transformers in lighting distribution boards shall have louvers.***

1.1.7. All boards shall be of uniform height not exceeding 2450 mm.

1.1.8. Boards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers ***of bus bar chambers***.

1.1.9. Boards shall be supplied with base frames made of structural steel sections, alongwith all necessary mounting hardware required for welding the base frames to the insert plates.

1.1.10. ***a)*** All boards shall be *of* double front construction and shall have ÷

(i) A completely enclosed busbar compartment for running horizontal busbars and vertical busbars. Busbar chambers shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical busbars for repair and maintenance, which shall be feasible without disturbing feeder compartment. Vertical bus bar chambers shall be accessible from front as well as back side of the panel ***and shall be of at least 350 mm width***. One set of vertical busbars shall be used in between two adjacent sections for switchgear connections. In case of ACB feeders, ***the panel shall have single front without any vertical busbar chamber, however*** vertical busbars ***associated with ACBs shall be*** located in rear side ***and*** shall be additionally covered with metallic perforated***/ transparent acrylic or polyvinyl*** bolted sheets to avoid direct access after opening rear door of chamber.

(ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.

(iii) A distinct compartment or alley for power and control cables on each side of panel. Cable alley compartment shall have a through metallic partition for segregating cables on both sides. Cable alley door shall preferably be hinged. Cable alley shall have no exposed live parts. Any live terminals shall be fully shrouded/insulated from safety aspects. However, it shall be of atleast 350mm width.

(iv) A compartment for relays and other control devices associated with a circuit breaker.

b) ***Lighting transformers shall be supplied in separate and distinct panel completely assembled for incoming cable connection from bottom and outgoing connection through busbar with adjacent associated lighting distribution board. Lighting transformers shall have provision of base channel with rollers for taking in and out from the panel in case of maintenance after disconnecting incoming and outgoing connections. Provision of single phase fans at least two (2) numbers of suitable ratings shall be made in the panel for ventilation. These fans shall run in sequential mode at suitable time interval to be controlled by thermostat and timer. The offered design of panel should be such that in no case, temperature rise of lighting transformers shall exceed the permissible limits for the class of insulation of lighting transformer.***

1.1.11. Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. Each shipping section shall have full metal sheets at both ends for transport and storage.

1.1.12. All equipments associated with a single circuit except MCB circuits shall be housed in a separate compartment of the vertical section. The Compartment shall be sheet steel enclosed on all sides with the withdrawal units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities.
In case of circuits controlled by MCBs, group of MCB feeders can be offered in common compartment. In such case number of MCB feeder to be used in a common compartment shall not exceed 4 (four) and front of MCB compartment, shall have a viewing port of

toughen glass sheet for viewing and sheet steel door of module shall be lockable with star knob/panel key.

1.1.13. After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.

1.1.14. The minimum clearance in air between phases and between phase and earth for the entire run of horizontal and vertical busbars, shall be 25 mm. For all other components, the clearance between "two live parts", " A live part and an earthed part" and isolating distance shall be atleast ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal run of busbar minimum clearance of 25 mm should be maintained even if they are sleeved.

1.1.15. The temperature rise of horizontal & vertical busbars when carrying rated current along its full run shall in no case exceed 55°C, with silver plated joints and 40°C with all other type of joints over an outside ambient temperature of 50°C.

1.1.16. All busbar chambers shall be provided with removable bolted covers . The covers shall be provided with danger labels.

1.1.17. All identical circuit breakers and module chassis of same test size shall be fully interchangeable without having to carryout modifications.

1.1.18. All Circuit breaker boards shall be of Single Front type, with fully drawout circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position.

1.1.19. Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.

1.1.20. All disconnecting contacts for power circuits shall be of robust design and fully self aligning. Fixed and moving contacts of the power drawout contact system shall be silver plated. Both fixed and moving contacts shall be replaceable.

1.1.21. All AC & DC boards shall be of double Front type.

1.1.22. All module shall be fixed type except air circuit breaker module, which shall be drawout type.

1.1.23. The connections from busbars to the main switch shall be fully insulated/shrouded, and securely bolted. The partition between the feeder compartment and cable alley may be non-metallic and shall be of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.

1.1.24. All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to PURCHASER approval. Bidder shall submit dimensional drawings showing complete internal details of Busbars and module components, for each type and rating for approval.

1.1.25. The tentative power and control cable entries shall be from bottom. However, Purchaser reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implication.

1.1.26. Adopter panels and dummy panels required to meet the various busbar arrangements and layouts required shall be included in Bidder's scope of work.

1.2. DERATING OF EQUIPMENTS

1.2.1. The current ratings of all equipments as specified in the ***Single Line Diagram For AC & DC System*** are the minimum standards current ratings at a reference ambient temperature as per relevant Indian Standards.

1.3. POWER BUS BARS AND INSULATORS

1.3.1. All AC Distribution Boards shall be provided with three phase buses and a neutral bus bars and the DC Distribution Boards shall be provided with two busbars.

1.3.2. All busbars and jumper connections shall be of high conductivity aluminium/copper of adequate size.

1.3.3. The Cross-Section of the busbars shall be uniform through out the length of Switchgear and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.

1.3.4. All busbars shall be adequately supported by ***adequate numbers of*** high strength type Polyester fibre glass Moulded Insulators ***to withstand short circuit withstand capability of panel***. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided anti-tracking barriers shall be provided between the supports.

1.3.5. All busbars joints shall be provided with high tensile steel bolts. Belleville/spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated Busbars joints shall be thoroughly cleaned at the joint locations and a suitable contact grease shall be applied just before making a joint.

1.3.6. All busbars shall be colour coded as per IS: 11353-***1985: Guide for Uniform System of Marking and Identification of Conductors and Apparatus Terminals.***

1.3.7. The Bidder shall furnish calculations, establishing the adequacy of busbar sizes for specified current ratings, On the basis of short circuit current and temperature rise consideration at specified ambient temp.

1.4. EARTH BUS

1.4.1. A galvanised steel earthing shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded/bolted to the frame work of each panel and breaker earthing contact bar vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus.

1.4.2. The earth bus shall have sufficient cross-section to carry the momentary short circuit and short time fault currents to earth without exceeding the allowable temperature rise.

1.4.3. Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Purchaser's earthing conductors. The horizontal earth bus shall project out the switchboard ends and shall have predrilled holes for this connection. A joint spaced and taps to earth bus shall be made through at least two bolts.

1.4.4. All non-current metal work of the Switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosures frame work and the truck shall be maintained even after painting.

1.4.5. The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions. SERVICES & ISOLATED, as well as through out the intermediate travel.

1.4.6. ***Air Circuit Breaker (ACB)*** module frame shall get engaged to the vertical earth bus, before the disconnecting contacts on these module are engaged to the vertical busbar.

1.4.7. All metallic cases of relays, instruments and other panel mounted equipments shall be connected to earth by independent stranded copper wires of size not less than 2.5 mm^2. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering is not acceptable. Looping of earth Connection which would result in loss of earth connection to the devices when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths or earth bus is acceptable.

1.4.8. VT and CT secondary neutral point earthing shall be at one place only, on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.

1.4.9. All hinged doors shall be earthed through flexible earthing braid.

1.4.10. Caution nameplate `Caution-Live Terminals' shall be provided at all points where the terminals are like to remain live and isolation is possible only at remote end.

1.5. AIR CIRCUIT BREAKERS

1.5.1. Circuit breakers shall be three-pole air break horizontal drawout type and shall have inherent fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable.

1.5.2. Circuit breakers shall be mounted along with it operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimise misalignment of the breaker.

1.5.3. There shall be `Service', `Test' and `Fully withdrawn positions for the breakers. In `Test' position the circuit breaker shall be capable of being tested for operation without energising the power circuits i.e. the power Contacts shall be disconnected while the Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the `SERVICE', `TEST' OR FULLY WITHDRAWN' position. It shall be possible to close the door in TEST position.

1.5.4. All circuit breakers shall be provided with 4 NO and 4 NC potentially free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be

provided in both `SERVICE' & `TEST' position of the breaker. All contacts shall be rated for making continuously carrying and breaking 10 Amps at 240V AC and 1 Amp (Inductive) at 220V DC.

1.5.5. Suitable mechanical indications shall be provided on all circuit breakers to show `OPEN'. `CLOSE', `SERVICE', `TEST' and `SPRING CHARGED' positions.

1.5.6. Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half cycle of rated frequency.

1.5.7. All circuit breakers shall be provided with the interlocks as explained in further clauses.

1.5.8. Movement of a circuit breaker between SERVICE AND TEST positions shall not be possible unless it is in OPEN position. Attempted with drawl of a closed circuit breaker shall trip the circuit breaker.

1.5.9. Closing of a circuit breaker shall not be possible unless it is in SERVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.

1.5.10. Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn. It shall however, be possible to open the shutters intentionally, against spring pressure for testing purpose.

1.5.11. A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

1.5.12. Circuit breakers shall be provided with electrical anti-pumping and trip free feature, even if mechanical antipumping feature is provided.

1.5.13. Mechanical tripping shall be possible by means of front mounted RED `Trip' push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.

1.5.14. Breaker controlled motors shall operate satisfactorily under the following conditions:

(i) Direct on-line starting of Induction Motors rated 110 kW to 220 kW with a locked rotor current of seven times the rated current, and starting time of up to 30 seconds.

(ii) Breaking on-load, full load and locked rotor currents of Induction Motors for rated 100 kW to 220 kW.

1.5.15. Means shall be provided to slowly close the circuit breaker in withdrawn position. If required for inspection and setting of Contacts, in service position slow closing shall not be possible.

1.5.16. Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC Control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class `E' or better.

1.5.17. The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring.

1.5.18. Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.

1.5.19. The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

1.5.20. Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

1.5.21. All circuit breakers shall be provided with closing and trip coils. The closing coils shall operate correctly at all values of Voltage between 85% to 110% at rated control voltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.

1.5.22. Provision for mechanical closing of the breaker only in `TEST' and `WITHDRAWN' positions shall be made.

1.5.23. **PROTECTION CO-ORDINATION**

1.5.23.1. It shall be the responsibility of the Contractor to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and down stream circuit breakers/fuses/motor starters, to provide satisfactory discrimination.

1.6. MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB

1.6.1. MCCB shall in general conform to IS: 13947 Part-2. All MCCB ***offered*** shall ***have Ics = 100% Icu rating***. ***Type test reports for offered model of MCCB shall be submitted during detailed engineering for owner's acceptance.***

1.6.2. MCCB shall be flush mounted on the AC/DC distribution boards ***and shall have extended handle.***

1.6.3 MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The setting of the thermal release shall be adjustable between ***80%*** to 100% of the rated current. The MCCB shall have breaking capacity not less than 20kA.

1.6.4 MCCBs used for ACDB incomers and Bus coupler shall be equipped with stored energy mechanism for electrical closing and tripping. All other MCCBs shall be manually operated. The operating handle should give a clear trip indication.

1.6.5 Miniature circuit breaker (MCB) shall conform to IEC: 898-1987 and IS: 8828.

1.7 **RELAYS**

1.7.1 All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-drawout cases.

1.7.2 All AC relays shall be suitable for operation, at 50 Hz with 110 volts VT secondary and 1 amp or 5 amp CT secondary.

1.7.3 All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.

1.7.4 All protective relays auxiliary relays and timers shall be provided with hand reset operation indicators (Flags) for analysing the cause of operation.

1.7.5 All relays shall withstand a test voltage of 2 KV (rms) for one minute.

1.7.6 Motor starters shall be provided with three element, ambient temperature compensated, time lagged, hand reset type overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relays shall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.

1.7.7 All fuse-protected contactor-controlled motors shall have single phasing protection, either as a distinct feature in the overload relays (by differential movement of bimetallic strips), or as a separate device. The single phasing protection shall operate even with 80% of the set current flowing in two of the phases.

1.8 CONTACTORS

1.8.1 Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IS:13947 (Part 4).

1.8.2 Contactors shall be double break, non-gravity type and their main contacts shall be silver faced.

1.8.3 Direct on line starter contactors shall be of utilisation category AC2. These contactors shall be as per IS:13947 (Part 4).

1.8.4 Each contactor shall be provided with two (2) normally open (NO) and two (2) normally close (NC) auxiliary contacts.

1.8.5 Operating coils of contactors shall be of 240V AC Unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall drop out at 70% of the rated voltage.

1.9 INSTRUMENT TRANSFORMERS

1.9.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the outside ambient temperature is 50°C.

1.9.2 All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.

1.9.3 All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

1.9.4 Current transformers may be multi or single core type. All voltage transformers shall be single phase type. The Bus VTs shall be housed in a separate compartment.

1.9.5 All VTs shall have readily accessible ***MCBs*** on both primary and secondary sides.

1.10 INDICATING INSTRUMENTS

1.10.1 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall have an accuracy class of 2.5 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

1.10.2 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.

1.10.3 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

1.10.4 Ammeters provided on Motor feeders shall have a compressed scale at the upper current region to cover the starting current.

1.10.5 Watt-hour meters shall be of 3 phase three element type, Maximum demand indicators need not be provided.

1.11 CONTROL & SELECTOR SWITCHES

1.11.1 Control & Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred.

1.11.2 Circuit breaker selector switches for breaker Controlled motor shall have three stay put positions marked `Switchgear', `Normal' and `Trial' respectively. They shall have two contacts of each of the three positions and shall have black shade handles.

1.11.3 Ammeter and voltmeter selector switches shall have four stayput position with adequate number of contacts for three phase 4 wire system. These shall have oval handles Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.

1.11.4 Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.

1.11.5 The contact ratings shall be at least the following :

(i)	Make and carry continuously	10 Amp.
(ii)	Breaking current at 220V DC	1 Amp (Inductive)
(iii)	Breaking current at 240V AC	5 Amp (at 0.3 pf lagging)

1.12 **AIR BREAK SWITCHES**

1.12.1 Air breaker switch shall be of the heavy duty, single throw group operated, load break, fault make type complying with IS:***13947,Part-3.***

1.12.2 The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such as overload, locked motor, short circuit etc.

1.12.3 Switch operating handles shall be provided with padlocking facilities to lock them in `OFF' position.

1.12.4 Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in `OFF' position and to close the switch only when the door is closed. However suitable means shall be provided to intentionally defeat the interlocks explained above.

1.12.5 Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

1.13 **PUSH BUTTONS**

1.13.1 Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.

1.13.2 All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.

1.13.3 All push-buttons shall be provided with integral escutcheon plates marked with its function.

1.13.4 The colour of the button shall be as follows :

(i)	GREEN	:	For motor START, Breaker CLOSE
(ii)	RED	:	For motor TRIP, Breaker OPEN
(iii)	BLACK	:	For overload reset.

1.13.5 All push-buttons on panels shall be located in such a way that Red-push-buttons shall always be to the left of green push-buttons.

1.14 **INDICATING LAMPS**

1.14.1 Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.

1.14.2 Lamps shall have translucent lamp-covers of the following colours, as warranted by the application :

(i)	RED	:	For motor ON, Breaker CLOSED
(ii)	GREEN	:	For motor OFF, Breaker OPEN
(iii)	WHITE	:	For motor Auto-Trip
(iv)	BLUE	:	For all healthy conditions (e.g. control supply, and also for 'SPRING CHARGED"

(v) AMBER : For all alarm conditions (e.g. overload) Also for `SERVICE' and `TEST' positions indicators.

1.14.3 Lamps shall be easily replaceable from the front of the cubicle.

1.14.4 Indication lamps should be located just above the associated push buttons/control switches. Red lamps shall invariable be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and Amber lamps should normally be located above the Red and Green lamps.

1.14.5 When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button. All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

1.15 FUSES

1.15.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC Circuits shall be of class 2 type, 20 kA (RMS) breaking current at 415 AC, and for DC circuits Class 1 type 4 kA breaking current.

1.15.2 Fuses shall have visible operation indicators.

1.15.3 Fuses shall be mounted on fuses carriers, which are mounted on fuse bases, wherever it is not possible to mount fuses on carriers fuses shall be directly mounted on plug in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

1.15.4 Fuse rating shall be chosen by the Bidder depending upon the circuit requirements and these shall be subject to approval of PURCHASER.

1.16 TERMINAL BLOCKS

1.16.1 Terminal blocks shall be of 750 volts grade and have continuous rating to carry the maximum expected current on the terminals. It shall be complete with insulating barriers, clip-on-type/stud type terminals for Control Cables and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to `ELEMEX' standard type terminals, cage clamp type of Phoenix or WAGO or equivalent

1.16.2 Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities. It shall be similar to `Elem.' `CATD' - Type.

1.16.3 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also be available.

1.16.4 All terminal blocks shall be suitable for terminating on each side, two (2) Nos. of 2.5 mm square size standard copper conductors.

1.16.5 All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.

1.16.6 Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

1.16.7 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.

1.17 NAME PLATES AND LABELS

1.17.1 All switchgears, AC/DC distribution boards, shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

1.17.2 All name plates shall be of non-rusting metal or 3-ply lamicoid with white engraved lettering on black back ground. Inscriptions and lettering sizes shall be subject to PURCHASER approval.

1.17.3 Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so as to be clearly visible and shall give the device number as mentioned in the module wiring drawings.

1.18 SPACE HEATER

1.18.1 Space heater shall be provided in all the boards for preventing harmful moisture condensation.

1.18.2 The space heaters shall be suitable for continuous operation on 240V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

1.19 CONTROL AND SECONDARY WIRING

1.19.1 All switchboards shall be supplied completely wired internally upto the terminal blocks ready to receive Purchaser's control cables.

1.19.2 All inter cubicle and inter panel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the bidder.

1.19.3 All internal wiring shall be carried out with 1100 V grade, single core, 1.5 square mm or larger stranded copper wires having colour coded, PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires. Voltage grade and insulation shall be same as above.

1.19.4 Extra-flexible wires shall be used for wiring to device mounted on moving parts such as hinged doors.

1.19.5 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminals blocks.

1.20 POWER CABLES TERMINATION

1.20.1 Cable termination compartment and arrangement for power cables shall be suitable for stranded aluminium conductor, armoured XLPE/PVC insulated and sheathed, single core/three core, 1100 V grade cables.

1.20.2 All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc. shall be provided by the successful bidder, to suit the final cable sizes which would be advised later.

1.20.3 The gland plate shall be of removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable glands. For all single core cables, gland plates shall be of non-magnetic Material.

1.21 TYPE TESTS

1.21.1 Type tests reports on Panels (Switchgear and Control gear assemblies) as per IS 8623 Part-I shall be submitted for the following tests in line with clause 9.0 of Section GTR :

i) Verification of temperature rise limits
ii) Verification of the dielectric properties
iii) Verification of short circuit strength
iv) Verification of the continuity of the protective circuit
v) Verification of clearances and creepage distances
vi) Verification of mechanical operation
vii) Verification of degree of protection

1.21.2 Contractor shall submit type test reports for the following Switchgear and Control gears before the fabrication of switchgear is started:

1. Circuit breakers/MCCB as per IS 13947 Part-II
2. Protective Relays as per IEC: 60255.
3. ***Lighting transformers as per IS:2026***

For above equipments, test conducted once are acceptable (i.e. The requirement of test conducted within last ***ten*** years shall not be applicable)

1.22 ERECTION, TESTING AND COMMISSIONING

1.22.1 The Contractor shall unload, erect, install, test and put into commercial use all electrical equipment included in this specification.

1.22.2 Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerance shall be as established in Contractor's drawings or as stipulated by purchaser. No equipment shall be permanently bolted down to foundations until the alignment has been checked and found acceptable by the purchaser.

1.22.3 Contractor shall furnish all supervision, labour tools equipment rigging materials, bolts, wedges, anchors, concrete inserts etc. in proper time required to completely install, test and commission the equipment.

1.22.4 Manufacturer's and purchaser's instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.

1.22.5 Contractor shall move all equipment into the respective room through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilised to lift or erect any equipment without prior permission of Purchaser.

1.22.6 All boards shall be installed in accordance with ***relevant code of practices*** and at Purchaser's instructions. All boards shall be installed on finished surfaces, concrete or steel stills. Contractor shall be required to install and align any channel sills which form part of foundations. In joining shipping sections of switchboards together adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has been completed. Power bus, enclosures ground and control splices of conventional nature shall be cleaned and bolted together being drawn up with torque spanner of proper size or by other approved means.

1.22.7 All boards shall be made completely vermin proof.

1.22.8 Contractor shall take utmost care in holding instruments, relaying and other delicate mechanism wherever the instruments and relays are supplied separately they shall be mentioned only after the associated panels have been erected and aligned. The packing materials employed for safe transit of instrument and relays shall be removed after ensuring that panel have been completely installed and to further movement of the same should be necessary. Any damage shall be immediately reported to Purchaser.

1.22.9 Equipment furnished with finished coats of paint shall be touched by up Contractor if their surface is specified or marred while handling.

1.22.10 After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switch-boards/panels and correctness of all equipment in each and every respect. The cable opening and cables entries for cables terminating to the panels shall be sealed with fire sealing materials.

1.23 COMMISSIONING CHECK TESTS

The Contractor shall carry out the following commissioning checks, in addition to the other checks and tests recommended by the manufacturers.

1.23.1 General

1.23.1.1 Check name plate details according to the specification.

1.23.1.2 check for physical damage.

1.23.1.3 Check tightness of all bolts, clamps, joints connecting terminals.

1.23.1.4 Check earth connection.

1.23.1.5 Check cleanliness of insulators and bushings.

1.23.1.6 Check all moving parts for proper lubrication.

1.23.1.7 Check settings of all the relays.

1.23.2 Circuit Breakers

1.23.2.1 Check alignment of breaker truck for free movement.

1.23.2.2 Check correct operation of shutters.

1.23.2.3 Check control wiring for correctness of connections, continuity and IR values.

1.23.2.4 Manual operation of breaker completely assembled.

1.23.2.5 Power closing/opening operation, manually and electrically.

1.23.2.6 Breaker closing and tripping time.

1.23.2.7 Trip free and anti-pumping operation.

1.23.2.8 IR values, minimum pick up voltage and resistance of coils.

1.23.2.9 Contact resistance

1.23.2.10 Simultaneous closing of all the three phases.

1.23.2.11 Check electrical & mechanical interlocks provided.

1.23.2.12 Check on spring charging motor, correct operation of limit switches, and time of charging.

1.23.2.13 All functional checks.

1.23.3 **Current Transformers**

1.23.3.1 Megger between winding and winding terminals to body.

1.23.3.2 Polarity test

1.23.3.3 Ratio identification checking of all ratios on all cores by primary injection of current.

1.23.3.4 Spare CT cores, if available, to be shorted and earthed.

1.23.4 **Voltage Transformer**

1.23.4.1 Insulation resistance test

1.23.4.2 Ratio test on all cores.

1.23.4.3 Polarity test.

1.23.4.4 Line connections as per connection diagram.

1.23.5 **Cubicle Wiring**

1.23.5.1 Check all switch developments.

1.23.5.2 Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawing. All interconnections between panels/equipment shall be similarly checked.

1.23.5.3 All the wires shall be meggered to earth.

1.23.5.4 Functional checking of all control circuit e.g. closing, tripping control, interlock, supervision and alarm circuit.

1.23.6 **Relays**

1.23.6.1 Check connections and wiring.

1.23.6.2 Megger all terminals to body.

1.23.6.3 Megger AC to DC terminals.

1.23.6.4 Check operating characteristics by secondary injection.

1.23.6.5 Check minimum pick up voltage of DC coils.

1.23.6.6 Check operation of electrical/mechanical targets.

1.23.6.7 Relays settings.

1.23.6.8 Check CT and VT connections with particular reference to their polarities for directional relays, wherever required.

1.23.7 **Meters**

1.23.7.1 Check calibration by comparing it with a sub-standard.

1.23.7.2 Megger all insulated portions.

1.23.7.3 Check CT and VT connections with particular reference to their polarities for power type meters.

1.24 **SPECIAL TOOLS AND TACKLES**

1.24.1 The Bidder shall include in his proposal any special tools and tackles required for erection, testing commissioning and maintenance of the equipments offered.

1.24.2 The list of these special tools and tackles shall be given in the bid proposal sheets alongwith their respective prices.

1.24.3 The total price of the special tools and tackles shall be included in proposal sheets.

1.25 **EQUIPMENT TO BE FURNISHED**

1.25.1 The Bidder shall quote for various AC/DC distribution boards in accordance with this specification.

1.25.2 Standard scheme of interconnection of switchboards and distribution boards alongwith tentative feeder disposition for each board is indicated in Standard SLD of AC & DC system enclosed alongwith bid documents. The bidder shall quote board prices on the basis of standard SLD and their estimation of feeders for entire present and future bays

requirement. Any other feeder required as per system requirement for efficient and reliable operation shall be deemed to be included in bidder's scope.

1.25.3 The Bill of Materials for each type of module shall be as under. These are minimum indicative requirement of the system. The necessary auxiliary relays, push buttons and indicating lamps shall be provided as per scheme requirement. Any other item/component required with in a module for efficient and reliable operation shall be deemed to be included in bidder's scope.

1.25.4 Module Type AE (Electrically controlled circuit breaker for incoming and Bus Coupler Circuit).

(i)	One (1)	Triple pole air circuit breaker complete with all accessories and power operated mechanism as specified.
(ii)	Two (2)	Neutral link.
(iii)	Three (3)	Current Transformer for metering.
(iv)	One (1)	Ammeter with selector switch.
(v)	Three (3)	Current Transformer for relaying.
(vi)	One (1)	Triple pole instantaneous over-current relay having the setting range of 200-800% or 500-2000% of CT secondary and adjustable definite minimum time.
(vii)	One (1)	Instantaneous earth fault relay having an adjustable setting range of 10-40% or 20 - 80% of CT secondary current and adjustable definite minimum time. The earth fault relay shall be provided with a stabilising resistor.
(viii)	***One(1) set***	***Current and Voltage transducers.***
(ix)	***One(1) set***	***High speed tripping relays.***

1.25.5 **Module Type - M1 (Circuit Breaker Controlled Motor Feeder)**

(i)	One (1)	Triple pole Air Circuit Breaker complete with accessories, and power operated mechanism as specified.
(ii)	One (1)	Three position 6 pole selector switch 'SWITCHGEAR/NORMAL /TRIAL'.
(iii)	Three (3)	Current Transformer for metering.
(iv)	One (1)	Ammeter with Ammeter Selector Switch
(v)	Three (3)	Current Transformer for relaying.
(vi)	One (1)	Triple pole instantaneous over-current relay for providing positive sequence current protection in all the three phases. The relay setting range shall be continuously adjustable between 200-800% or 400-1600% of CT secondary rated current as required.

(vii) One (1) Double pole inverse definite minimum time over current relays connected in R & B phases for over current protection of motor rated 110 kW - 200 kW. The relay shall have an adjustable setting range of 50% - 200% of CT Secondary current and time setting range of 0-30 Second. The relay shall be CDGM-22 of EE or equivalent.

(viii) One (1) Single pole adjustable definite time delay relay for motor overload alarm connected in Y-phase only. The relay shall have resetting ratio of not less than 90%. The relay shall have continuously adjustable time delay range of 2.5 to 25 Sec.

(ix) One (1) Instantaneous earth fault relay having an adjustable setting range of 10-40% or 20-80% of CT secondary current. The earth fault relay shall be provided with a stabilising resistor.

(x) ***One(1) set*** ***Current and Voltage transducers.***

(xi) ***One(1) set*** ***High speed tripping relay.***

1.25.6 **Module Type E**

(i) One (1) Four pole MCCB

1.25.7 **Module G-1 (VT Module with under Voltage Relay)**

(i) Three (3) $\frac{415}{\sqrt{3}} / \frac{110}{\sqrt{3}}$ volts single phase voltage transformer star/star connect with star point solidly earthed mounted on common draw out chassis. Accuracy Class 0.5 for protection and metering with 50VA Burden.

(ii) Six (6) HRC Fuses mounted on the above chassis.

(iii) One (1) Four position voltmeter selector switch.

(iv) One (1) Voltmeter (0-500V)

(v) One (1) Double pole instantaneous under voltage relays with continuous variable setting range of 40-80% of 110 Volts.

(vi) One (1) Time delay pick up relay having a time setting range of 0.5 to 3 secs. with 3 `NO'. Self reset contacts, suitable for 220V DC.

(vii) One (1) Auxiliary relay 220V DC with 2 NO. self reset contacts.

(viii) Three (3) Indicating lamps with series resistor and colour lenses (Red, Blue & Yellow).

1.25.8 **Module Type G-2**

(i) Three (3) HRC Fuse

(ii) One (1) Voltmeter (0-500V)

(iii) One (1) Voltmeter selector switch four position (R-Y, Y-B, B-R OFF).

(iv) Three (3) Indication lamps (Red, Blue & Yellow)

1.25.9 **Module Type H & H (BC) (Isolating Switch Controlled Incoming Circuit)**

(i) One (1) Four pole MCCB

(ii) One (1) Red Indicating lamp to indicate isolating switch closed position.

1.25.10 **Module Type S : (DC Metering and Protection Module)**

(i) One (1) Voltmeter 300-0-300V DC for 220V DC DB/Voltmeter 0-75V DC for 50V DCDB

(ii) One (1) Three (3) position voltmeter selector switch

(iii) One (1) Instantaneous under voltage relay with 95% of 220V DC. The resetting ratio of relay of relay should not be more than 1.25. The relay shall be provided with a series resistor and a push button across if for resetting (pick up) the relay at about 105% of the drop out voltage.

(iv) One (1) Instantaneous over voltage relay with setting range of 110% of 220V DC. The resetting ratio of relay should not be less than 0.8. The relay shall have a push button in series of resetting the relay at about 95% of the operating voltage.

(v) One (1) Earth leakage relay only for 220V DC system having adjustable pick up range between 3 to 7 milliamps the relay shall be suitable for 220V DC/240V AC Auxiliary supply.

1.25.11 **Module Type X**

One (1) Double pole 250 V MCB

1.25.12 **Module Type-DC (Incomer from Battery & Chargers)**

(i) One (1) Double pole 250V DC MCCB for incomer from Battery.

(ii) One (1) DC ammeter with shunt and range of 90-0-400 Amps. For 220V DC DB and 90-0-200 Amp for 50V DC DB.

(iii) Two (2) Double pole 250V DC MCCB/MCB

(iv) One (1) Double pole single throw 250V DC air break switch connecting battery & charger sections to DC DB.

(v) One(1) set Voltage and Current Transducers

1.25.13 **Module Type DG-1 (Electrically Controlled Circuit Breaker for Incomer from DG Set)**

a)	One (1)	Triple pole circuit breaker complete with all accessories and power operated mechanism as specified.
b)	One (1)	Frequency meter.
c)	One (1)	Voltmeter with selector switch.
d)	One (1)	Remote/Local Selector switch.
e)	Three (3)	Current transformer for metering.
f)	Six (6)	Current Transformers for differential protection (out of this 3 Nos. will be supplied loose for mounting in DG set panel).
g)	Three (3)	Current transformer for relaying.
h)	One (1)	Ammeter Selector Switch.
i)	One (1)	Ammeter
j)	One (1)	Wattmeter of range 0-300 KW.
k)	One (1)	Three pole voltage controlled definite time delay relay having current setting range of 50-200% of CT secondary current and adjustable time delay 0.3 to 3 secs.
l)	One (1)	Watt hour meter with six (6) digits and minimum count of one (1) kwh.
m)	One (1)	Single pole definite time over current relay having a continuous setting range of 50-200% of CT secondary current and a time delay of 2.5-25 secs connected in CT of Y phase for overload alarm. The relay shall have a setting ratio of not less than 90%.
n)	One (1)	Three pole differential protection relay having an operating current setting range of 10-40% of generator full load current. The relay shall be of high impedance type, with necessary stabilizing resistors.
o)	Two (2)	Push buttons for Remote starting & stopping of DG Set (Red, Green).
p)	***One(1) set***	***Current and Voltage transducers.***
q)	***One(1) set***	***High speed tripping relays.***

1.25.14 **Module Type H1**

One (1) Double pole DC Switch with pad locking facility in off position.

1.25.15 **Module Type EL**

(i) One (1) Four pole MCCB

(ii) One (1) Contactor

(iii) Electronic Timer suitable for continuous operation, push button and selector switch be as per scheme requirement

1.26 **PARAMETERS**

1.26.1 **Power Supply**

1.26.1.1	AC System		3 phase, 4 wire, solidly earthed
	a)	Voltage	415 Volts, ± 10%
	b)	Frequency	50 Hz ± 5%
	c)	Combined variation	± 10% Absolute Sum in Voltage & frequency
	d)	Fault Level	20 kA (rms)
1.26.1.2	**DC System**		2 Wire, unearthed
	a)	System voltage	220V ± 10%
	b)	Fault Level	4 kA
	c)	System Voltage	***48*** V ± 10%
	d)	Fault Level	--

1.26.2 **Control Supply Voltage**

a)	Trip and closing coils	220V DC Unearthed
b)	Spring charging	220V DC Unearthed

1.26.3 **Cubicle Data**

1.26.3.1 **Busbar Rating**

a) Continuous As specified in ***Standard SLD***

		for Vertical panels.	***For AC & DC system.***
	b)	Short time (1 sec. kA (rms)	20 kA
	c)	Momentary (kA) PEAK	45 kA
	d)	**Ambient Temperature**	**50°C**
	e)	**One Minute Power Frequency Withstand**	
		I. Power Circuit	2500 Volts (rms)
		II. Control Circuit	2500 Volts (rms)

1.26.3.2 **Cubicle Colour Finish**

a)	Interior	Smoke Grey shade No.692 of IS:5
b)	Exterior	Smoke Grey shade No.692 of IS:5

1.26.4 **Circuit Breaker**

a)	Type	Air Break
b)	No. of poles	3
c)	Voltage & Frequency	415 ± 10%, 50 HZ + 5%
d)	Rated Operating Duty	As per IS
e)	Rated service short-circuit Breaking capacity (Ics)	20 kA (RMS)
f)	Short Circuit making current	45 kA (Peak)
g)	Short time withstand current for 1 sec. duration.	20 kA (RMS) for 1 sec.
h)	Operating Mechanism current for 1 sec. duration.	20 kA (RMS) for 1 sec.
i)	No. of auxiliary contacts	4 NO & 4 NC contacts for Purchaser's use on fixed portion of the cubicle
j)	Short Circuit breaking current	
	I. AC Component	20 kA (RMS)
	II. DC Component	As per IS: 13947 (Part 2)

1.26.5 **MOULDED CASE CIRCUIT BREAKER**

		AC System	DC System
a)	No. of poles	4	2
b)	Voltage & Frequency	415 ± 10%, 50 HZ ± 5%	250V
c)	Rated Operating Duty	As per IS	
d)	Rated service short-circuit Breaking capacity (Ics)	20 kA (RMS)	4 kA
e)	Short Circuit making current	45 kA (Peak)	-
f)	No. of auxiliary Contacts ***(only for incomer And bus-coupler MCCBs)***	***1*** NO &***1*** NC	***1*** NO &***1*** NC
g)	***Rated Ultimate*** Short Circuit ***breaking capacity***		
	I. AC Component	20 kA (RMS)	As per IS
	II. DC Component	As per IS 13947	As per IS 13947

1.26.6 **Meters**

a)	Accuracy class	2.5
b)	One minute power frequency withstand test voltage in KV	2.0

1.26.7 **Current Transformers**

a)	Type	Cast resin, Bar primary
b)	Voltage class and frequency	650V, 50 Hz
c)	Class of Insulation	E or better
d)	Accuracy class metering CT	Class 1, VA adequate for application but not less than 7.5 VA.
e)	Accuracy class protection CT	5 P 15, VA adequate for application, but not less than 7.5 VA.
f)	Accuracy class differential protection	PS, KPV = 300V

g)	Short Time Current Rating (for CTs Associated with circuit breakers)		
	I.	Current	20 kA (RMS)
	II.	Duration	One Second
	III.	Dynamic Rating	45 kA (Peak)
	IV.	One minute power frequency withstand test voltage.	2.5 kV (rms)

1.26.8 **Voltage Transformer**

a)	Type	Cast Resin
b)	Rated Voltage	
	Primary	415/√3 V
	Secondary	110/√3 V
c)	Method of connection	
	Primary	Star
	Secondary	Star
d)	Rated voltage factor	1.1 continuous, 1.5 for 3 seconds
e)	Class of insulation	E or better
f)	One minute power frequency withstand voltage	2.5 KV (RMS)
g)	Accuracy class	0.5, not less than 20VA

1.26.9 **Relay**

a)	One minute power Frequency withstand test	2 kV (rms)

1.26.10	***Transducers (1 phase)***	***Current***	***Voltage***
	a) Operating Voltage	***220 V DC***	***220V DC***
	b) I/P	***1A.***	***110V AC***
	c) O/P	***4-20 mA***	***4-20 mA***
	d) Type	***Analogue***	***Analogue***

1.26.11 Lighting Transformers

Lighting transformers shall be of 300 KVA rating (in case of substations where highest voltage is 765 kV)/ 100 KVA rating (in case of substations where highest voltage is 400 kV)/ 25 KVA rating (in case of substations where highest voltage level is 132kV), 415/415 V, 3 phase, 50 Hz Dry type natural air cooled ***type***. The technical parameters of these lighting transformers are as follows:

Technical Parameters of Lighting Transformer

Type of transformer	:	Dry type natural air cooled
Rating	:	***300 KVA,*** 100 KVA or 25 KVA (as applicable)
Voltage ratio	:	415/415 volts
No. of phases	:	Three
Frequency	:	50 Hz
Winding connection	:	Dyn-1
Class of insulation	:	'B' class
Impedance	:	4% ± 10%
No. of taps & steps	:	5, ± 5% in steps of 2.5%
Ref. standard	:	IS:2026

1.27 AUTOMATIC CONTROL OF OUTDOOR LIGHTING

1.27.1 EL-type module of 415V Main lighting distribution board and Emergency lighting distribution board and shall be controlled by timer and contactor module to facilitate its operation automatically.

1.28 AUTOMATIC SUPPLY CHANGEOVER

Automatic changeover between Incomer I, Incomer II, and DG set is to be carried out during the failure of supply in one/or both the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirement of changeover under various conditions are as below:

(i) Under normal conditions i.e. when supply is available in both the incomers, incomers I&II of 415 V Main switchboard, ACDB shall be in closed condition and Bus couplers and DG set breaker shall be in open condition.

(ii) In case of failure of either of the sources, the incomer of that source shall trip and Bus coupler shall get closed. On restoration of supply, normal conditions described above are to be established automatically.

iii) In case of failure of supply in both the sources, both incomers, incomers of ACDBs and ACDB Bus coupler shall trip and DG set breaker switched on.
On restoration of one or both sources, DG set breaker shall trip, DG set stopped and conditions described in paragraph (i) /(ii) shall be restored.

To avoid unnecessary operation of switchgear for momentary disturbances all changeovers from one state to another shall be initiated after a time delay, after the conditions warranting such change has been detected.

1.29 ANALOGUE INPUTS

LT System shall have provision of following analogue inputs for owner's substation automation purpose. These analogue inputs shall be generated by distinct transducers to be provided in respective modules. These inputs shall be wired up to respective terminal blocks.

<u>ANALOGUE INPUTS</u>:

i) Voltage R-Y, Y-B, B-R of Main Switch Board section-I
ii) Voltage R-Y, Y-B, B-R of Main Switch Board section-II
iii) Current from LT transformer-I
iv) Current from LT transformer-II
v) Voltage of 220V DCDB-I
vi) Voltage of 220V DCDB-II
vii) Current from 220V Battery set-I
viii) Current from 220V Battery set-II
ix) Voltage of 48V DCDB-I
x) Voltage of 48V DCDB-II
xi) Current from 48V Battery set-I
xii) Current from 48V Battery set-II

1.30 DIGITAL (Potential Free) INPUTS:

LT System shall have provision of following digital inputs for owner's substation automation purpose. These digital inputs shall be made available in the form of potential free contacts to be provided in respective modules. These potential free contacts shall be wired up to respective terminal blocks.

i) Main (MSB) Incomer-I breaker On/Off
ii) Main (MSB) Incomer-II breaker On/Off
iii) Main(MSB) 415V Bus-I/II U/V
iv) Main (MSB) bus coupler breaker on/off
v) DG set breaker on/off
vi) LT transformer-I Bunchholz Alarm & trip
vii) LT transformer-II Buchloz Alarm & trip
viii) LT transformer-I WTI Alarm & trip
ix) LT transformer-II WTI Alarm & trip
x) LT transformer-I OTI Alarm & trip
xi) LT transformer-II OTI Alarm & trip
xii) 220 V DC-I earth fault
xiii) 220V DC-II earth fault

TECHNICAL SPECIFICATION

SECTION- 33KV & 11KV INDOOR SWITCHGEAR (VCB TYPE)

CONTENTS

TECHNICAL SPECIFICATION FOR
Indoor Switchgear (VCB Type)

1.00 TECHNICAL REQUIREMENT OF EQUIPMENT

1.01 The manufacturer, whose Indoor switch gear panels are offered should have designed, manufactured, type tested as per relevant IEC/IS, supplied and commissioned the Panels of similar voltage rating. These Panels should have been in satisfactory operation for at least two (2) years as on the original scheduled date of bid opening.

1.02 In addition to the requirements above, the Vacuum circuit breaker, CT, PT and relays should have been designed, manufactured and type tested as per relevant IEC/IS and should have been in satisfactory operation for at least two (2) years as on the original scheduled date of bid opening.

2.00 GENERAL REQUIREMENTS

2.01 The equipment offered by the Bidder shall be complete in all respects. Any material and component not specifically stated in this specification but which are necessary for trouble free operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded. All such equipment / accessories shall be supplied without any extra cost. Also all similar components shall be interchangeable and shall be of same type and rating for easy maintenance and low spare inventory.

2.02 Equipment shall be installed in a neat workman-like-manner so that it is leveled, plumbed, squared and properly aligned and oriented. Tolerances shall be as established on Contractor's drawings or as stipulated by Employer. No equipment shall be permanently bolted down / tag welded to foundation until the alignment has been checked and found acceptable by the Engineer. Contractor shall furnish all supervision labor, tools, equipment rigging materials, bolts, wedges, anchors, concrete inserts etc. in proper time, required to completely install, test and commission the equipment.

2.03 Manufacturer's and Employer's instructions and recommendations shall be correctly followed in handling, erection, testing and commissioning of all equipment.

2.04 Contractor shall move all equipment into the respective rooms through the regular door or openings specifically provided for this purpose. No parts of structure shall be utilized to lift or erect any equipment without prior permission of Engineer.

2.05 Switchgear shall be installed on finished surfaces, concrete or steel sills. Contractor shall be required to install and align any channel sills which form part of foundations. Minor modifications to foundations shall be carried out by the Contractor at no extra cost. Power bus enclosure, ground and control splices of conventional nature shall be cleaned and bolted together with torque wrench of proper size or by other approved means. Tape or compound shall be applied where called for in drawings. Contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments and relays are supplied loose along with switchgear, they shall be mounted only after the associated switchgear panels have been erected and aligned. The blocking materials,

employed for safe transit of instrument and relays shall be removed after ensuring that panels have been completely installed and no further movement of the same would be necessary. Any damage shall be immediately reported to Engineer.

3.00 CODES AND STANDARDS

3.01 All work shall be carried out as per the relevant standards, specification and codes of practices, referred to herein & in Section GTR, shall be the latest editions including all applicable official amendments and revisions as on the date of opening of bid. In case of conflict between this specification and those (IS Codes, Standards etc.) referred to herein, the former shall prevail. In addition to relevant standards specified in Section-GTR, following standards shall also be applicable:

a	IS: 2544	Porcelain post insulators for systems with nominal voltages greater than 1000 Volts
b	IS: 9431	Specification for indoor post insulators of organic material for system with nominal voltages greater than 1000 volts up to and including 300 kV
c	IS: 9921/ **IEC 62271-102**	A.C. disconnectors (isolators) and Earthing switches for voltages above 1000 V
d	IS: 13118/ **IEC 62271-100**	Specification for high voltage AC circuit breakers
e	IS/IEC:62271-200	High voltage metal enclosed switchgear and control gear
f	IEC: 60947-7-1	Terminal blocks for copper conductors
g	IS :513 (2008)	Cold Rolled Low Carbon Steel Sheets and Strips

3.02 Equipment conforming to any other internationally accepted standards will also be considered if they ensure performance and constructional features equivalent or superior to the standards listed above.

4.00 EQUIPMENT SPECIFICATION

4.01 Switchgear Panel

a) The switchgear boards shall have a single front, single tier, fully compartmentalized, metal enclosed construction complying with clause No. 3.102 of IEC 62271-200, comprising of a row of free standing floor mounted panels. Each circuit shall have a separate vertical panel with distinct compartments for circuit breaker truck, cable termination, main bus-bars and auxiliary control devices. The adjacent panels shall be completely separated by steel sheets except in bus-bar compartments where insulated barriers shall be provided to segregate adjacent panels. The Service Class Continuity of Switchgears shall be LSC 2B-PM (as per IS/IEC 622771-200). However, manufacturer's standard switchgear designs without inter panel barriers in bus-bar compartment may also be considered.

b) The circuit breakers shall be mounted on withdrawable trucks which shall roll out horizontally from service position to isolated position. For complete withdrawal from the panel, the truck shall rollout on the floor or shall roll out on telescopic rails. In case the later arrangement is offered, suitable trolley shall be provided by the Bidder for withdrawal and insertion of the truck from and into the panel. Testing of the breaker shall be possible in Isolated position by keeping the control plug connected.

c) The trucks shall have distinct SERVICE and ISOLATED positions. It shall be possible to close the breaker compartment door in isolated position also, so that the switchgear retains its specified degree of protection. While switchboard designs with doors for breaker compartments would be preferred, standard designs of reputed switchgear manufacturers where the truck front serves as the compartment cover may also be considered provided the breaker compartment is completely sealed from all other compartments and retains the IP-4X degree of protection in the Isolated position. In case the later arrangement is offered, the Bidder shall ensure that proper sealing is achieved and shall include blanking covers one for each size of panel per switchboard in his offer.

d) The switchgear assembly shall be dust, moisture, rodent and vermin proof, with the truck in any position SERVICE, ISOLATED or removed, and all doors and covers closed. All doors, removable covers and glass windows shall have gaskets all round with synthetic rubber or neoprene gaskets. **However, Panels which are type tested for IP-4X as per IEC/IS, without any gasket arrangement are also acceptable.**

e) All louvers, if provided, shall have very fine brass or GI mesh screen. Tight fitting gourmet / gaskets are to be provided at all openings in relay compartment. Numerical Relays shall be fully flush mounted on the switchgear panels at a suitable height.

f) **33kV & 11kV indoor** Switchgear shall have an Internal Arc Classification of IAC FLR **25 KA**, 1 sec. The switchgear construction shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panels shall be specially designed to withstand these. Pressure relief device shall be provided in each high voltage compartment of a panel, so that in case of a fault in a compartment, the gases produced are safely vented out, thereby minimizing the possibility of its spreading to other compartments and panels. The pressure relief device shall not however reduce the degree of protection of panels under normal working conditions. Contractor shall submit the type test report for satisfactory operation of pressure relief device in line with IEC 62271-200 Annexure – A.

g) Enclosure shall be constructed with rolled steel sections. The doors and covers shall be constructed from cold rolled steel sheets of 2.0 mm or higher thickness. Gland plates shall be 2.5 mm thick made out of hot rolled or cold rolled steel sheets and for non magnetic material it shall be 3.0 mm.Thickness of explosion vent shall be as per manufacturer's standard design.

h) The switchgear shall be cooled by natural air flow.

i) Total height of the switchgear panels **shall be finalized during detail engineering in line with building design**. The height of switches, pushbuttons and other hand operated devices shall not exceed 1800 mm and shall not be generally less than 700 mm.

j) Necessary guide channels shall be provided in the breaker compartments for proper alignment of plug and socket contacts when truck is being moved to SERVICE position. A crank or lever arrangement shall preferably be provided for smooth and positive movement of truck between Service and Isolated positions. **Suitable locking arrangement should be provided for the racking mechanism.**

k) Safety shutters complying with IEC 62271-200 shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the truck is moved to ISOLATED position. The shutters shall move automatically, through a linkage with the movement of the truck. Preferably it shall however, be possible to open the shutters of busbar side and cable side individually against spring pressure for testing purpose after defeating the interlock with truck movement deliberately. In case, insulating shutters are provided, these shall meet the requirements of IEC 62271-200 and necessary test report shall be submitted as per IEC 62271-200 Clause 5.103.3.3. A clearly visible warning label "Isolate elsewhere before earthing" shall be provided on the shutters of incoming and tie connections which could be energized from other end.

l) Switchgear construction shall have a bushing or other sealing arrangement between the circuit breaker compartment and the busbar/ cable compartments, so that there is no air communication around the isolating contacts in the shutter area with the truck in service position.

m) The breaker and the auxiliary compartments provided on the front side shall have strong hinged doors. Busbar and cabling compartments provided on the rear side shall have separate bolted covers with self retaining bolts for easy maintenance and safety. Breaker compartment doors shall have locking facility. Suitable interlock shall be provided, which will ensure that breaker is OFF before opening the back doors. For Incomer/ Bus-coupler/ Bus-Section panels, suitable interlock shall be provided to prevent opening of any compartment doors which has any of the MV (33kV/11kV) equipment, in case the incoming supply is ON.

n) In the Service position, the truck shall be so secured that it is not displaced by short circuit forces. Busbars, jumpers and other components of the switchgear shall also be properly supported to withstand all possible short circuit forces corresponding to the short circuit rating specified.

o) Suitable base frames made out of steel channels shall be supplied along with necessary anchor bolts and other hardware, for mounting of the switchgear panels. These shall be dispatched in advance so that they may be installed and leveled when the flooring is being done, welding of base frame to the insert plates shall be in

Bidder's scope. The bidder may offer panels with built in base frame ready for dispatch and suitable for installation on indoor cable trenches.

p) The switchboard shall have the facility of extension on both sides. Any adopter panels and dummy panels as required to meet the various busbar arrangements, cable / bus duct termination and layouts shall be included in Bidder's scope of work.

q) Thermostatically controlled space heater for each chamber (CB, Bus bar, cable, PT/CT chamber etc as applicable) along with common MCB shall be provided.

r) **Cassette type design for VCB Panels shall also be acceptable.**

4.02 **Circuit Breakers (VCB Type)**

a) The circuit breakers shall be of Vacuum type. They shall comprise of three separate, identical single pole interrupting units, operated through a common shaft by a sturdy operating mechanism.

b) Outgoing breakers shall be suitable for switching transformers at any load.

c) Circuit breaker shall be re-strike free, stored energy operated and trip free type. Motor wound closing spring charging shall only be acceptable. An anti-pumping relay shall be provided for each breaker, even if it has built-in mechanical anti-pumping features. An arrangement of two breakers in parallel to meet a specified current rating shall not be acceptable.

d) During closing, main poles shall not rebound objectionably and mechanism shall not require adjustments. Necessary dampers shall be provided to withstand the impact at the end of opening stroke.

e) Plug and socket isolating Contacts for main power circuit shall be silver plated, of self aligning type, of robust design and capable of withstanding the specified short circuit currents. They shall preferably be shrouded with an insulating material. Plug and socket contacts for auxiliary circuits shall also be silver plated, sturdy and of self aligning type having a high degree of reliability. Thickness of silver plating shall not be less than 10 microns.

f) All working part of the mechanism shall be of corrosion resisting material. Bearings which require greasing shall be equipped with pressure type grease fittings. Bearing pins, bolts, nuts and other parts shall be adequately secured and locked to prevent loosening or change in adjustment due to repeated operation of the breaker and the mechanism.

g) The operating mechanism shall be such that failure of any auxiliary spring shall not prevent tripping and shall not lead to closing or tripping of circuit breaker. Failure of any auxiliary spring shall also not cause damage to the circuit breaker or endanger the operator.

h) Mechanical indicators shall be provided on the breaker trucks / **front** to indicate OPEN / CLOSED conditions of the circuit breaker, and CHARGED / DISCHARGED conditions of the closing spring. An operation counter shall also be provided. These shall be visible without opening the breaker compartment door.

i) The rated control supply voltage shall be as mentioned elsewhere under Technical parameters. The closing coil and spring charging motor shall operate satisfactorily at all values of control supply voltage between **85-110% of the rated voltage**. The shunt trip coil shall operate satisfactorily under all operating conditions of the circuit breaker upto its rated short circuit breaking current at all values of control supply voltage **between 70-110% of the rated voltage.** The trip coil shall be so designed that it does not get energized when its healthiness is monitored by indicating lamps (Red) and trip coil supervision relay.

j) The time taken for charging of closing spring shall not exceed 30 seconds. The spring charging shall take place automatically preferably after a closing operation. Breaker operation shall be independent of the spring charging motor which shall only charge the closing spring. Opening spring shall get charged automatically during closing operation. As long as power supply is available to the charging motor, a continuous sequence of closing and opening operations shall be possible. One open-close- open operation of the circuit breaker shall be possible after failure of power supply to the motor. Spring charging motors shall be capable of starting and charging the closing spring twice in quick succession without exceeding acceptable winding temperature when the control supply voltage is anywhere between **85-110% of rated voltage**. The initial temperature shall be as prevalent in the switchgear panel during full load operation with 50 deg. C ambient air temperature. The motor shall be provided with Over load protection.

k) Motor windings shall be provided with class E insulation or better. The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in a hot, humid and tropical climate.

l) Circuit breaker shall be provided with inter pole barriers of insulating materials. The use of inflammable materials like Hylam shall not be acceptable.

m) **Circuit breaker pole shall be with epoxy encasing** / **epoxy encapsulation** to safe guard against mechanical impact and climatic condition such as moisture, humidity and dust.

4.03 **Control and Interlocks**

a) The circuit breaker will normally be controlled remotely from SAS/SCADA system through closing and shunt trip coils. However, it shall also be designed to locally control from Indoor Switchgear panel. Suitable mimic on Panel shall be provided.

b) Facilities shall be provided for mechanical tripping of the breaker and for manual charging of the stored energy mechanism for a complete duty cycle, in an emergency. These facilities shall be accessible only after opening the compartment door.

c) Each panel shall have two separate limit switches, one for the Service position and the other for isolated position. Each of these limit switches shall have at least four (4) contacts which shall close in the respective positions.

d) Auxiliary Contacts of breaker may be mounted in the fixed portion or in the withdrawable truck as per the standard practice of the manufacturer, and shall be directly operated by the breaker operating mechanism.

e) Auxiliary contacts mounted in the fixed portion shall not be operable by the operating mechanism, once the truck is withdrawn from the service position, but remain in the position corresponding to breaker open position. Auxiliary contacts mounted on the truck portion, and dedicated for Employer's use shall be wired out in series with a contact denoting breaker service position. With truck withdrawn, the auxiliary contacts shall be operable by hand for testing. There shall be at lease Six (2) NO and Six (2) NC breaker auxiliary contacts made available for Employer's future use.

f) The contacts of all limit switches and all breaker auxiliary contacts located on truck portion and fixed portion shall be rated to make, carry and break 1.0A, 240V DC (Inductive) / 10A, 240V AC. Contacts of control plug and socket shall be capable of carrying the above current continuously.

g) Movement of truck between SERVICE and ISOLATED positions shall be mechanically prevented when the breaker is closed. An attempt to withdraw a closed breaker shall not trip it.

h) Closing of the breaker shall be possible only when truck is either in ISOLATED or in SERVICE position and shall not be possible when truck is in between. Further, closing shall be possible only when the auxiliary circuits to breaker truck have been connected up, and closing spring is fully charged.

i) It shall be possible to easily insert breaker of one typical rating into any one of the panels meant for same rating but at the same time shall be prevented from inserting it into panels meant for a different type or rating.

j) Indications shall be provided in display unit of the relay flush mounted on the panel front as brought out in the specification elsewhere. It shall be possible to easily make out whether the truck in SERVICE OR ISOLATED POSITION even when the compartment door is closed.

4.04 **Busbars and Insulators**

a) All busbar and jumper connections shall be of high conductivity aluminium alloy / Copper of adequate size and bus bar size calculation / **supporting type test report** shall be submitted for approval. They shall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit currents.

b) Busbar cross-section shall be uniform throughout the length of switchgear. Busbars and other high voltage connection shall be sufficiently corona free at maximum working voltage.

c) Contact surfaces at all joints shall be silver plated or properly cleaned and non-oxide grease applied to ensure an efficient and trouble free connection. All bolted joints shall have necessary plain and spring washers. All connection hardware shall have high corrosion resistance. Bimetallic connectors or any other technically proven method shall be used for aluminum to copper connections.

d) Busbar insulators shall be of arc and track resistant, high strength, non-hygroscopic, non-combustible type and shall be suitable to withstand stresses due to over-voltages, and short circuit current. Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators. In case of organic insulator partial discharge shall be limited to 100pico coulomb at rated Voltage X $1.1/\sqrt{3}$. Use of insulators and barriers of in-flammable material such as Hylam shall not be accepted.

e) All busbars shall be color coded for phase identification.

f) The temperature of the busbar and all other equipment, when carrying the rated current continuously shall be limited as per the stipulations of relevant Indian Standards, duly considering the specified ambient temperature (50 deg. C). The temperature rise of the horizontal and vertical busbars when carrying the rated current shall be in line with IEC at 50 deg. C ambient.

4.05 **Earthing and Earthing Devices**

a) A copper / galvanized steel earthing bus shall be provided at the bottom and shall extend throughout the length of each switch board. It shall be bolted/ welded to the framework of each panel and each breaker earthing contact bar.

b) The earth bus shall have sufficient cross section to carry the momentary short-circuit and short time fault currents to earth as indicated under switchgear parameters without exceeding the allowable temperature rise.

c) Suitable arrangement shall be provided at each end of the earth bus for bolting to Employer's earthing conductors. All joint splices to the earth bus shall be made through at least two bolts and taps by proper lug and bolt connection.

d) All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. Electrical continuity of the whole switchgear enclosure frame work and the truck shall be maintained even after painting.

e) The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions i.e. SERVICE and ISOLATED as well as throughout the intermediate travel. The truck shall also get and remain earthed when the control plug is connected irrespective of its position.

f) All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 sq. mm. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering shall not be acceptable. Looping of earth connections which would result in loss of earth connection to other devices, when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths of earth bus is acceptable.

g) VT and CT secondary neutral point earthing shall be at one place only on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit may be removed without disturbing the earthing of other circuits.

h) Separate earthing trucks shall be provided by the Contractor for maintenance work. These trucks shall be suitable for earthing the switchgear busbars as well as outgoing / incoming cables or bus ducts. The trucks shall have a voltage transformer / **Voltage Presence Indicator (VPI)** and an interlock to prevent earthing of any live connection. The earthing trucks shall in addition have a visual/ audible annunciation to warn the operator against earthing of live connections.

As an alternative to separate earthing trucks the Bidder may also offer built-in earthing facilities for the busbars and outgoing / incoming feeders, in case such facilities are available in their standard proven switchgear design. The inbuilt earthing switches shall have provision for short circuiting and earthing a circuit intended to be earthed. These switches shall be quick make type, independent of the action of the operator and shall be operable from the front of the switchgear panel. These switches shall have suitable facility for locking in the earthed condition.

i) The earthing device (truck / switch) shall have the short circuit withstand capability equal to that of associated switchgear panel. 4 NO + 4 NC of auxiliary contacts of the earthing device shall be provided for interlocking purpose.

j) All hinged doors shall be earthed through flexible earthing braid.

k) Interlocks shall be provided to prevent :

1) Closing of the earthing switch if the associated circuit breaker truck is in Service position.

2) Insertion of the breaker truck to Service position if earthing switch is in closed

position.

3) Closing of the earth switch on a live connection.

4.06 **Painting**

All sheet steel work shall be pretreated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "Class-C" as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated. After passivation, Electrostatic Powder Coating shall be used. Powder should meet requirements of IS 13871 (Powder coating specification). Finishing paint shade for complete panels shall be RAL7032 for all boards, unless required otherwise by the Employer. The paint thickness shall not be less than 50 microns. Finished parts shall be suitably packed and wrapped with protective covering to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

4.07 **Instrument Transformers**

a) All current and voltage transformers shall be completely encapsulated cast resin insulated type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 50 deg. C. The class of insulation shall be E or better.

b) All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time ratings at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stress produced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules.

c) The parameters of instrument transformers specified in this specification are tentative and shall be finalised by the Employer in due course duly considering the actual burden of various relays and other devices finally selected. In case the Bidder finds that the specified ratings are not adequate for the relays and other devices offered by him, he shall offer instrument transformer of adequate ratings.

d) All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to separate terminals on an accessible terminal block.

e) Current transformers shall be located in the cable termination compartment. All CT/VT shall be single phase type. VT mounting shall be fixed/ withdrawable type.

f) All voltage transformers shall have suitable HRC current limiting fuses on both primary and secondary sides. Primary fuses shall be mounted suitably on the fixed / withdrawable portion.

4.08 **Numerical Protection Relays (IEDs)**

4.08.01 Indoor switchgear panels shall have communicable numerical protection relays (IEDs) complying with IEC-61850 on all feeders which shall be networked on Ethernet to communicate with substation SAS/SCADA system on IEC-61850. These IEDs shall also be used for control & monitoring the switchgear from SAS. In addition to status of devices (CBs/Isolators) and equipment alarms, Metering data shall also be made available to SAS/SCADA station from protection IEDs. Further, multifunction meters with Modbus protocol are also envisaged, which will be connected in daisy-chain-link to communicate to station SAS. Modbus to IEC 61850 converter shall be provided for integration with SAS.

The Bidder's scope shall include the followings:

a) Communicable Numerical Protection Relays (with IEC 61850) in each of the feeders & Bus-section

b) IED's / Numerical Relays shall have Graphical Display to facilitate settings, relay operations and to view measurement, event and alarm etc.

c) Relays shall have built in Local/Remote Switch.

d) Cat5e Ethernet cable for connection of Numerical Relays (IEDs) to Ethernet switches. Optical cable shall be used between Ethernet switch (for indoor switch gear IEDs) and ring/ redundant network of Substation LAN switch.

e) Required number of Ethernet switches mounted in Indoor Switchgear panels for communication with IEDs on IEC 61850 protocol.

f) The SAS/SCADA system has been envisaged as part of main substation. Bidder shall facilitate in successful Integration of Numerical Relays to the SAS/SCADA system through Ethernet switches.

4.08.02 All Numerical relays shall be of types, proven for the application satisfying requirements specified elsewhere and shall be subject to Employer's approval. Numerical Relays shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide required sensitivity to the satisfaction of the Employer.

4.08.03 All numerical relays shall be rated for control supply voltage as mentioned elsewhere under system parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Contacts for breaker close and trip commands shall be so rated as to be used directly used in the closing and tripping circuits of breaker without the need of any interposing / master trip relays. Threshold voltage for binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages and typically shall be more than 70% of the rated control supply voltage.

4.08.04 All IEDs shall have freely programmable optically isolated binary inputs (BI) and potential free binary output (BO) contacts as per approved scheme. These I/O points shall be used for wiring of status of devices (CBs/Isolators) and equipment alarms etc. Heavy duty binary output contacts of IEDs shall be suitable for CB closing / tripping directly and no separate master trip relay shall be used.

4.08.05 Failure of a control supply and de-energization of a relay shall not initiate any circuit breaker operation.

4.08.06 Relays shall have event recording feature, recording of abnormalities and operating parameters with time stamping. Event records & alarms shall be stored in Non-volatile memory and failure of control supply shall not result in deletion of any of these data.

4.08.07 All Numerical relays shall have features for electrical measurements including voltage, current, power (active & reactive), frequency, power-factor and energy parameters.

4.08.08 All numerical relays shall have provision of both current (CT) and voltage (VT) inputs as required for protection & measurement purposes using protection cores.

4.08.09 All numerical relays shall have key pad / keys to allow relay setting from relay front. Relay to be self or hand reset type which shall be software selectable. Manual resetting shall be possible from remote.

4.08.10 Relays shall have suitable output contact for circuit breaker failure protection (LBB) logic.

4.08.11 Relays shall have self diagnostic feature with continuous self check for power failure, program routines, memory and main CPU failures and a separate output contact for indication of any failure.

4.08.12 Contractor shall submit applicable Type Test reports for Numerical relays as per IEC including report for IEC 61850 protocol from accredited lab.

4.09 **Control & Protection System**

All numerical relays shall communicate to station SCADA / SAS on IEC-61850 communication protocol. It is envisaged that these protection IEDs shall be used for CB control & monitoring of bay equipments.

4.09.01 **Numerical Transformer Protection Relay**

a) The relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protections.

b) The over current element should have the minimum setting adjustable between 20-200% of CT secondary rated current and high set setting 500-2000%.

c) The relay shall have selectable directional & non-directional feature

d) The earth fault element of relay shall be suitable for detection of earth fault currents in the range of 5% to 80% of the CT rated current (IDMT) and high set 100-1000%.

e) For transformers of rating 5MVA and above, definite time delayed Stand by earth fault protection shall be provided having a pick up setting range of 10% to 40% with a timer delay of 0.3 sec to 3 sec.

f) The relay shall allow higher setting during transformer charging (inrush) and lower setting during normal operating condition.

g) Transformer troubles like Buchholz, Winding temperature, Oil temperature & Pressure Relief Device trips (as applicable) shall be wired to separate binary inputs of the relay and shall be configured to issue trip command to the breaker.

h) Trip circuit supervision shall be provided to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.

4.09.02 **Numerical Line Protection Relay**

a) The relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protections.

b) The over current element should have the minimum setting adjustable between **20**-200% of CT secondary rated current.

c) The relay shall have selectable directional & non-directional feature

d) The earth fault element of relay shall be suitable for detection of earth fault currents in the range of 5% to 80% of the CT rated current.

e) Trip circuit supervision shall be provided to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.

4.09.03 **Numerical Bus Coupler/Bus-Section Protection Relay**

a) The relay shall have instantaneous as well as time delayed three over current (50) and one earth fault (50N) protections.

b) The over current element should have the minimum setting adjustable between **20**-200% of CT secondary rated current.

c) The earth fault element of relay shall be suitable for detection of earth fault currents in the range of 5% to 80% of the CT rated current.

d) Bus no volt signal shall be configured in the relay for use in control logics and other Protections and Control functions in the Relays.

e) Trip circuit supervision shall be provided to monitor the circuit breaker trip circuit both in pre-trip and post-trip conditions.

4.09.04 Other Control and Protections features

a) Control of breakers shall be carried out from the station HMI of SAS/SCADA system through the LAN and the numerical relays.

b) The HMI shall have a graphical dynamic Plant Key Single Line Diagram to view the complete system status. This shall include the status of the switchgears, measurement values, operation counters, graphical alarm representation, etc. Spontaneous changes of a state, typically opening of a circuit breaker from a protection, shall have a specific colour code. All the Breakers with the status shall be clearly displayed along with values of currents, voltages, frequency, active and reactive powers etc.

c) Separate Master trip (86) relay with self-reset type for Line protection and Electrical reset type for Transformer shall be provided. Electrical reset shall be possible through IED & Substation SAS.

d) Schematics requiring auxiliary relays / timers for protection function shall be a part of numerical relay. The number of auxiliary relay and timer functions shall be as required for the application. Timer functions shall be configurable for on & off delays as per requirement.

e) The numerical relay shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery backup for real time clock in the event of power supply failure shall be provided.

f) At least 250 time tagged events / records shall be stored with time stamping. Details of at least 5 previous faults including the type of protection operated, operating time, all currents & voltages and time of fault.

g) Diagnostics Automatic testing, power on diagnostics with continuous monitoring to ensure high degree of reliability shall be shall be provided. The results of the self reset functions shall be stored in battery back memory. Test features such as examination of input quantities, status of digital inputs and relay outputs shall be shall be available on the user interface

h) The alarm/status of each individual protection function and trip operation shall be communicated to the SAS/SCADA system.

i) Sequence of events shall have 1ms resolution at device level.

j) Measurement accuracy shall be 1% for rated RMS Current and voltage (20-120% of Rated primary).

k) It shall be possible to carryout open / close operation of breakers from a laptop by interfacing from the relay front port during initial commissioning.

5.00 ETHERNET SWITCH

a) Ethernet switches shall be ‘substation hardened‘, and shall comply with IEC61850 for communications with IEDs. The Ethernet switches shall be of managed type with two (2) No. of Fiber optic cable ports and at least Sixteen (16) Copper ports to achieve the LAN configuration. More no. of switches or higher ports switch can also be supplied to meet all IEDs requirements for the LAN. The Ethernet switches shall have features to support the redundant rings. These switches shall be mounted in the switchgear Panels. The FO ports shall be Single-mode 1000Mbps ports. Copper ports shall be 10/100Mbps ports.

b) Necessary software for configuration and real-time network monitoring shall be provided along with the Ethernet switches.

6.00 POWER CABLE TERMINATION

a) Cable termination compartment shall receive the stranded Aluminium conductor, XLPE insulated, shielded, armored, PVC jacketed, single core / three core, unearthed / earthed grade power cable(s).

b) Adequate clearance shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Inter-phase clearance in the cable termination compartment shall be adequate to meet electrical and mechanical requirement besides facilitating easy connections and disconnection of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, CTs, gland plates etc. and the electrical clearances available shall be submitted for Employer's approval during detail engineering.

c) Cable termination compartment shall have provision for termination of power cables of sizes indicated in the bidding documents with removable undrilled gland plates. For all single core cables gland plates shall be of non-magnetic material. Cable entry shall generally be from the bottom; however, this shall be finalized during detail engineering.

7.00 CONFIGURATION OF INDOOR VCB PANELS

Sl. No.	Equipment	IP1 I/C	IP2 O/G	IP3 LT TR	IP4 B/S
1.	VCB as per spec	1	1	1	1
2.	CB Spring charge indicator (Mechanical)	1	1	1	1
3.	Mechanical ON/OFF indicator for CB	1	1	1	1
4.	Operation counter for CB	1	1	1	1
5.	CT (1-Phase)	3	3	3	3
6.	VT (1-Phase)	-	-	-	6
7.	Multi Function Meter	1	1	1	1
8.	Control switch for breaker(T-N-C)	1	1	1	1
9.	Green Indicating lamp for CB Open	1	1	1	1
10.	Red indicating lamp for CB Close	1	1	1	1
11.	DC healthy lamp (white)	1	1	1	1
12.	Trip circuit healthy lamp	1	1	1	1
13.	Mimic to represent SLD	1	1	1	1
14.	Voltmeter with selector switch	-	-	-	2
15.	Numerical protection relay (IED)	1	1	1	1
16.	Master Trip Relay (86)	1	1	1	1
17.	Semaphore Indicator for Line Isolator & Line Earth Switch	-	2	-	-
18.	LAN Switches and LAN/FO Cables	AS per requirement			

Notes:

1. IP1: Panel for Transformer Incomer feeder (I/C)
2. IP2: Panel for outgoing Line Feeder (O/G)
3. IP3: Panel for LT Transformer feeder (LT TR)
4. IP4: Panel for Bus Sectionaliser (B/S)
5. Location of VT (I/C or B/S Module) shall be decided during detail engineering.
6. Numerical protection relay (IED) for all type of VCB module shall preferably be interchangeable to optimize mandatory spares.

8.00 TESTS

8.01 Type Tests

The contractor shall submit the reports for the following type tests on the equipment to be supplied under the contract:

A. Switchgear Panel (with Circuit Breaker installed)
   a. Short circuit duty test
   b. Short time and peak withstand current test
   c. Power frequency withstand test
   d. Lightning impulse withstand test
   e. Temperature rise test
   f. Internal Arc Test as per IEC 62271-200 (for 1 second)
   g. Measurement of resistance of main circuit
   h. Test to verify pressure relief operation of the panel **(During internal arc test)**
   i. Cable charging test
   j. Short circuit withstand test of earthing device (truck / switch).

B. Circuit Breaker

   a. Mechanical Endurance Test

C. Current Transformer
   a. Short time current test
   b. Temperature rise test
   c. Lighting Impulse voltage withstand test

D. Potential Transformer
   a. Temperature rise test
   b. Lighting Impulse voltage withstand test

E. Switchgear Panel
   a. IP 4X test

8.02 **Routine Tests**

All acceptance and routine tests as per the specification and relevant standards IEC 62271-200 & IEC 62271-100 shall be carried out. Charges for these shall be deemed to be included in the equipment price.

The manufacturer shall furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

8.03 **Commissioning Checks / Tests**

After installation of panels, power and Control wiring and connections, Contractor shall perform commissioning checks as listed below to verify proper operation of switchgear / panels and correctness of all equipment in all respects. In addition, the Contractor shall carry out all other checks and tests recommended by the manufacturers.

8.03.01 General

a. Check name plate details according to specification.
b. Check for physical damage
c. Check tightness of all bolts, clamps and connecting terminals
d. Check earth connections.
e. Check cleanliness of insulators and bushings
f. Check heaters are provided
g. H.V. test on complete switchboard with CT & breaker in position.
h. Check all moving parts are properly lubricated.
i. Check for alignment of busbars with the insulators to ensure alignment and fitness of insulators.
j. Check for interchangeability of breakers.
k. Check continuity and IR value of space heater.
l. Check earth continuity for the complete switchgear board.

8.03.02 Circuit Breaker

a. Check alignment of trucks for free movement.
b. Check correct operation of shutters.
c. Check control wiring for correctness of connections, continuity and IR values.
d. Manual operation of breakers completely assembled.
e. Power closing / opening operation, manually and electrically
f. Closing and tripping time.
g. Trip free and anti-pumping operation.
h. IR values, resistance and minimum pick up voltage of coils.
i. Simultaneous closing of all the three phases.
j. Check electrical and mechanical interlocks provided.

k. Checks on spring charging motor, correct operation of limit switches and time of charging
l. All functional checks.

8.03.03 Current Transformers

a. Megger between windings and winding terminals to body.
b. Polarity tests.
c. Ratio identification checking of all ratios on all cores by primary injection of current.
d. Magnetization characteristics & secondary winding resistance.
e. Spare CT cores, if any to be shorted and earthed.

8.03.04 Voltage Transformers

a. Insulation resistance test.
b. Ratio test on all cores.
c. Polarity test.
d. Line connections as per connection diagram.

8.03.05 Cubicle Wiring

a. Check all switch developments.
b. It should be made sure that the wiring is as per relevant drawings. All interconnections between panels shall similarly be checked.
c. All the wires shall be meggered to earth.
d. Functional checking of all control circuit e.g. closing, tripping interlock, supervision and alarm circuit including proper functioning of component / equipment.
e. Check terminations and connections.
f. Wire ducting.
g. Gap sealing and cable bunching.

8.03.06 Relays

a. Check internal wiring.
b. IR of all terminal body.
c. IR of AC to DC terminals
d. Check operating characteristics by secondary injection.
e. Check operation of electrical/ mechanical targets.
f. Relay settings.

9.00 SYSTEM PARAMETERS:

1	Nominal System voltage	33 kV	11 kV
2	Highest System voltage	36 kV	12 kV
3	Rated Frequency	50 Hz	50 Hz
4	Number of phases/ poles	Three	Three
5	System neutral earthing	As per Vector Group of Transformers	As per Vector Group of Transformers
6	One minute power frequency withstand voltage	70	28
7	1.2/50 microsecond Impulse withstand voltage	170 kV (peak)	75 kV (peak)
8	Short time rating for bus bars, CB, CT and switchgear Assembly..	25 kA (rms) for one (1) sec.	25 kA (rms) for one (1) sec.
9	Dynamic withstand rating	62.5 kA (peak)	62.5 kA (peak)
10	IAC Rating	25 KA ,1.0 sec	25kA, 1.0 Sec
11	Control supply voltage		
12	- Trip and closing coils	As per Station DC Supply	As per Station DC Supply
	- Spring charging motor	As per Station DC Supply	As per Station DC Supply
13	Maximum ambient air temperature	50 deg. C	50 deg. C

a)	**CIRCUIT BREAKERS**		
1.	Rated Voltage	33 kV	11 kV
2.	CB rated Current		
a)	Incomer & Sectionaliser Breaker	1250A	1250A
b)	Outgoing feeder Breaker	1250A	1250A
3.	Short circuit breaker Current		
a)	A.C. component	25 kA	25kA
b)	D.C. component	As per IS: 13118 or IEC-62271	As per IS: 13118 or IEC-62271
4.	Short Circuit making current	62.5 kA (peak)	62.5 kA(peak)
5.	Out of phase breaking Current capacity	As per IEC	As per IEC
6.	Rated line/cable charging Interrupting current at 90° Leading power factor angle	As per IEC	As per IEC

7.	Maximum allowable switching Over voltage under any switching Condition	As per IEC	As per IEC
8.	Rated small inductive current Switching capability with over Voltage less than 2.3 pu	As per IEC	As per IEC
9.	First pole to clear factor	1.5	1.5
10	Operating Duty	**O-0.3 Sec-CO-3 Min-CO**	**O-0.3 Sec-CO-3 Min-CO**
11	Total break time	Not more than 4 cycles	Not more than 4 cycles
12	Total make time	Not more than 5 cycles	Not more than 5 cycles
13	Reclosing	3 phase auto reclosing	3 phase auto reclosing
14	Max. difference in the instants of closing/opening contacts between poles at rated control Voltage and rated operating and quenching media pressures	As per IEC	As per IEC
15	Auxiliary contacts	2NO+2NC for Employers future use besides scheme requirement	2NO+2NC for Employers future use besides scheme requirement
16	Operating Mechanism	Motor wound spring charged stored energy type as per IEC-62271	Motor wound spring charged stored energy type as per IEC-62271
b)	**CURRENT TRANSFORMER (Incomer/Bus coupler Feeder)**		
1.	Rated primary voltage	**33kV**	**11kV**
2.	Rated primary current	1000A	800A
3.	Type of CT	1-Phase	1-Phase
4.	Max temp rise	As per IEC:60044-1	As per IEC:60044-1
5.	Class of Insulation	Class E or better	Class E or better
6.	One minute power frequency withstand voltage between secondary terminal & earth	2kV	2kV
7.	No. of Secondary cores	3	3

c)	**CURRENT TRANSFORMER (Line Feeder)**		
1.	Rated primary voltage	**33kV**	**11kV**
2.	Rated primary current	300A	300A
3.	Max temp rise	As per IEC:60044-1	As per IEC:60044-1
4.	Class of Insulation	Class E or better	Class E or better
5.	One minute power frequency withstand voltage between secondary terminal & earth	2kV	2kV
6.	Nos. of Secondary cores	2	2
d)	**CURRENT TRANSFORMER (LT Transformer feeder)**		
1.	Rated primary Voltage	**33kV**	**11kV**
2.	Rated primary current	40A	40A
3.	Max temp rise	As per IEC:60044-1	As per IEC:60044-1
4.	Class of Insulation	Class E or better	Class E or better
5.	One minute power frequency withstand voltage between secondary terminal & earth	2kV	2kV
6.	Nos. of Secondary cores	2	2
e)	**VOLTAGE TRANSFORMERS**		
1.	Rated primary Voltage	33kV	11kV
2.	Type	1-phase	1-Phase
3.	Voltage ratio (kV)	(33/√3)/(0.11/√3)	(11/√3)/(0.11/√3)
4.	Rated Voltage Factor	1.2 continuous and 1.5 for 30 seconds	1.2 continuous and 1.5 for 30 seconds
5.	Nos. of Secondary cores	2	2
6.	Accuracy of Secondary core	Metering / Protn.	Metering / Protn.
		0.5 / 3P	0.5 / 3P
7.	Class of insulation	Class E or better	Class E or better
8.	Rated output burden (Minimum)	20VA	20VA

Notes: The ratings indicated for instrument transformers are tentative only and may be changed to meet the functional requirements.

10.00 INPUT SIGNAL TO SAS SYSTEM

The following digital input of 33kV & 11kV Indoor switchgear bays shall be provided through IEDs in the SAS system:

i) Status of CB, Isolator, Earth switch
ii) CB trouble
iii) CB operation/closing lockout
iv) Trip circuit faulty
v) Bus VT FUSE Fail
vi) Back-up overcurrent & earth fault protection Operated
vii) DC source fail

11.00 MULTIFUNCTION METER

The Multifunction meter shall have feature to measure KV, I, MW, MVAR, PF, MWhr, MVARhr with accuracy class of 0.5S. Further, multifunction meter shall have bi-directional feature to register/record MWhr values.

12.00 MANDATORY SPARES

Sl.N	Equipment	Unit	Quantity	
			33kV	11kV
1.	CB Spring charge indicator (Mechanical)	No.	1	1
2.	Mechanical ON/OFF indicator for CB	No.	1	1
3.	Operation counter for CB	No.	1	1
4.	CT (1-Phase)	No.	1 No. of Each type	1 No. of Each type
5.	VT (1-Phase)	No.	1 No. of Each type	1 No. of Each type
6.	Multi Function Meter	No.	1	1
7.	Control switch for breaker(T-N-C)	Nos.	2	2
8.	Green Indicating lamp for CB Open	Nos.	5	5
9.	Red indicating lamp for CB Close	Nos.	5	5
10.	DC healthy lamp (white)	Nos.	5	5
11.	Trip circuit healthy lamp	Nos.	5	5
12.	Voltmeter with selector switch	No.	1	1
13.	Numerical protection relay (IED)	No.	1	1
14.	Master Trip Relay (86)	No.	1 No. of Each type	1 No. of Each type
15.	Semaphore Indicator for Line Isolator & Line Earth Switch	Nos.	5 Nos. of Each type	5 Nos. of Each type
16.	LAN Switches and LAN/FO Cables	No.	1	1
17.	Trip coil assembly	No.	2	2
18.	Closing coil assembly	No.	2	2

REQUIREMENT FOR 33KV CURRENT TRANSFORMERS

(INCOMER / BUS COUPLER FEEDER)

	Metering	O/C & E/F Protn.	Diff. Protn.
Current ratio	1000-500/1	1000-500/1	1000-500/1
Accuracy class	0.2S class	5P20	PS
Knee point voltage (at minimum ratio)	-	-	400V
Rated burden	7.5VA	-	-

REQUIREMENT FOR 33KV CURRENT TRANSFORMERS (LINE FEEDER)

	Metering	O/C & E/F Protn.
Current ratio	300-150/1	300-150/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	7.5VA	-

REQUIREMENT FOR 33KV CURRENT TRANSFORMERS (LT TRANSFORMER FEEDER)

	Metering	O/C & E/F Protn.
Current ratio	40-20/1	40-20/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	7.5VA	-

REQUIREMENT FOR 11KV CURRENT TRANSFORMERS

(INCOMER / BUS COUPLER FEEDER)

	Metering	O/C & E/F Protn.	Diff. Protn.
Current ratio	800-400/1	800-400/1	800-400/1
Accuracy class	0.2S class	5P20	PS
Knee point voltage (at minimum ratio)	-	-	400V
Rated burden	7.5VA	-	-

REQUIREMENT FOR 11KV CURRENT TRANSFORMERS (LINE FEEDER)

	Metering	O/C & E/F Protn.
Current ratio	300-150/1	300-150/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	7.5VA	-

REQUIREMENT FOR 11KV CURRENT TRANSFORMERS (LT TRANSFORMER FEEDER)

	Metering	O/C & E/F Protn.
Current ratio	40-20/1	40-20/1
Accuracy class	0.2S class	5P20
Knee point voltage (at minimum ratio)	-	-
Rated burden	7.5VA	-