SPECIFICATION FOR 33kV SWITCHGEAR
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1 Scope

1.1 This specification intended to cover Design, Engineering, Manufacturing, Assembly, Painting, Inspection, Testing at manufacturer’s works, supply & Delivery to site inclusive of packing & transportation, testing and commissioning at site of 33kV switchgear as per single line diagram and enclosed in appendices.

1.2 This specification shall be read in conjunction with Tender for Major Electrical Equipments.

1.3 Quantity of switchboard is as indicated in Tender for Major Electrical Equipments.

1.4 The scope of work also includes erection, testing and commissioning of the equipment supplied.

1.5 All equipment supplied shall be new and best of their respective kinds and shall be of the class most suitable for the purpose for which they are intended.

1.6 Modification of schemes/changes in components, if any suggested during scrutiny/approval of drawings and execution of work, shall be carried out by successful contractor at no extra cost.

1.7 The scope of Contractor includes all associated items / sensors / interlocks required for smooth and efficient working of system and required during installation, testing & commissioning. All such items are deemed to have been included in the contractor’s scope.

1.8 Safety interlocks, necessary to ensure maintenance operation shall be provided.

2 Technical Specification

2.1 Construction

The general constructional features of 33kV Switchgear shall incorporate the following as a minimum:

2.1.1 The switchboard shall be metal enclosed, fully drawout, free standing, dust and vermin proof, totally enclosed, fully compartmentalised, floor mounted type. The circuit breaker panels shall be drawout, multi-compartmental unit type with min. IP-4X degree of protection. The unit shall be robust design to withstand the stresses encountered in the event of an electrical fault.

2.1.2 Adequate lifting facilities such as hooks for ease of handling at site shall be provided. These hooks when removed shall not leave any openings in the switchgear.

2.1.3 Front / Rear access shall be available to all components in cubicle which requires adjustment, maintenance or replacement.

2.1.4 Rear access shall be available to all cable boxes and glands and multi-core terminal blocks. Rear side of cable chamber shall be provided with shrouds/segregation plates of non-flammable material, with high voltage danger notice board. It shall be possible to remove & install these shrouds/segregation plates after cables have been terminated.

2.1.5 The individual panels shall comprise two main portions, i.e. the fixed and the moving portion. Fixed portion shall house busbars, current transformers, relays and instruments. Moving portion shall be circuit breaker. The busbar chamber shall be completely segregated from the rest of the panel. The busbars shall be suitably sized and supported on insulators of suitable grade and shall be brazed to withstand the fault level specified. The connection between the busbars and the terminals of the circuit breakers shall be suitably shrouded. Similarly, all Busbar joints shall be shrouded.

2.1.6 Each unit of switchgear shall have necessary interior sheet metal barriers to form separate compartments for buses, switching devices, entering cable connections, etc. Each compartment must be constructed and segregated to confine the damage caused by an internal fault to that compartment.
2.1.7 Automatic safety shutters shall be provided to shroud bus side and cable side main disconnecting contacts of the circuit breaker when the circuit breaker is taken to test position. The shutters shall have Caution Label.

2.1.8 In addition, caution board shall be provided on the vertical face separating circuit breaker compartment with other compartments. Current transformer shall be provided on the cable side of circuit breaker.

2.1.9 The instrument / control chamber shall incorporate the indicating instruments, lamps and components of the control circuit. The instrument chamber shall be provided with a separate door which can be opened when the circuit breaker is ‘ON’. The instrument chamber shall also be totally segregated from the rest of the panel. Wherever equipments are mounted on the door, the wiring shall be with flexible wires. The wires shall be neatly bunched and clamped and shall be sufficiently long so that the door can be opened without causing unnecessary stress on the terminations at the instruments. All instrument and relays belonging to one panel shall be mounted on the same panel. In case of shortage of space, rear instrument panel above cable chamber can be utilised.

2.1.10 All barriers shall be of non inflammable material.

2.1.11 Doors of all switchgears shall be gasketed to prevent entry of vermin and dust. No opening should be left. Steel screws, bolts and washers shall be plated.

2.1.12 Adequate packaging against damage / deterioration shall be provided for transportation to site and subsequent storage prior to reassembly. Each panel after packing shall be identified with details of panel by indelible ink.

2.1.13 Vendor shall take necessary measures to comply internal arc classification as per IEC 62271-200.

2.1.14 The height of the panel throughout the length shall be uniform.

2.1.15 Cable compartment

This compartment shall be accessible from the rear of the cubicle and designed to accommodate the following equipment:

- Current Transformers.
- Voltage Transformers.
- Earth Switch.
- Cable-end Boxes. Cable box shall be suitable for the cable sizes as mentioned in the enclosed SLD.
- The normal arrangement of the cubicle shall be for cable entry from below the cable boxes being fitted at floor level.

2.1.16 Low Voltage Compartment

In order to accommodate the protection relays, control and indicating equipment a separate compartment in the upper part of the cubicle front shall be provided.

All indicating equipment such as relays, ammeters etc. shall be mounted on the front door. Auxiliary relays, fuses, CT terminals, MCB’s etc. shall be mounted and wired in the LV compartment.

Auxiliary contactors / relays / terminals shall be suitable for mounting on DIN rail. Separate terminal blocks shall be considered for “Closing signals”, “Tripping Signals”, “Auxiliary Contacts”, mA Signals (if any)” etc.
2.1.17 Base Frame

Switchgears shall be provided with integral base frame which shall be bolted/welded on the cross members provided by owner. Base channel of height 75mm shall be provided. Amply dimensioned oblong holes shall be provided on the base frame. The base frame shall be of standard sections, re-rolled sections will not be acceptable. Vendor shall give base frame details in foundation drawing. Foundation on which base frame is mounted is excluded from Vendor’s Scope of supply. Vendor shall provide the dummy panel wherever the floor beam fouls with cable entry. Requirement of Dummy panel will be confirmed later. Vendor shall provide the Unit Rate of dummy panel.

2.2 Busbars

2.2.1 All busbars and their main current carrying connections shall have the same sectional area throughout their length. Busbars shall be sized to continuously carry the rated current without exceeding the final temperature of 95°C and the same shall be capable of withstanding the full fault level without any deformation. The continuous current rating of busbars shall be as per Single Line Diagram. Busbars shall be of Aluminium with proper plating at joints. The busbars shall be provided with cast epoxy sleeving or nylon film of suitable insulation class throughout their lengths and vertical droppers and colour coded. Joints in busbars shall be provided with shrouds. For long busbars, suitable expansion joints shall be provided.

2.2.2 The busbars shall be supported by epoxy resin cast insulators with suitable Creepage distance & capable to withstand the specified fault level. The clearance between live parts and the earth shall be as per the IS.

2.2.3 Busbars and connections shall be secured in such a manner that the insulators are not subjected to bending forces under short circuit conditions. Dynamic stresses shall be calculated on the basis of peak short circuit current.

2.2.4 The vertical droppers shall be sized to carry continuously at least the rated current of the connected circuit breaker.

2.2.5 Thermal design of the busbars shall be based on installation of the switchgear in poorly ventilated conditions. The cooling air volume shall take into account only the bus enclosure.

2.3 Circuit Breaker

2.3.1 Circuit breaker shall be VCB/SF6 type & shall be triple pole arranged for motor operated spring charged, independent closing and shunt tripping from suitable voltage from battery. The close / trip control switch shall be interlocked to trip before close. The closing and tripping circuits shall be self-opening on completion of their respective functions irrespective of the position of the control switch.

2.3.2 Mechanical OFF push actuators shall be provided on breaker mechanism door. This shall be operable without the need to open panel door.

2.3.3 All operating mechanism shall be designed to give trouble free service over extended periods and shall not require attention more often than every 1000 operations or once a year, whichever is the shorter period. Each breaker shall be fitted with operation counter reading at least up to 999 figures.

2.3.4 A visual ON / OFF indicator shall be provided positively coupled to the operating mechanism. This indicator shall be visible through a glass window from the front with the cubicle door closed.

2.3.5 The circuit breaker shall have facility to charge the spring manually and close the breaker in the event of failure of motor / control supply to motor. The spring charging motor shall start after closing of breaker and not after opening of breaker. In case the limit switch fails to cut out the
spring charging motor when the springs are fully charged, the motor shall be automatically de-coupled and annunciation for this shall be provided. Mechanical indication for spring charged / discharged shall be provided.

2.3.6 SF6 breaker shall be provided with the gas density monitoring device and necessary interlock alarm facilities.

2.3.7 Manual closing devices shall also be provided.

2.3.8 Mechanism shall be trip free and shall have antipumping facilities.

2.3.9 Each circuit breaker shall have necessary auxiliary contacts for indication, protection, interlocking supervision, metering and other purposes. Minimum 4 ‘NO’ + 4 ‘NC’ shall be provided for owner's exclusive use. All spare contacts shall be wired up to the terminal blocks. All contacts shall be positively operated by main apparatus and all contacts shall be adequate to make, carry and interrupt the currents in their circuits. Auxiliary relay shall be used to multiply contacts. Service position contact of circuit breaker shall be used for the multiplying relay. The shunt trip of the circuit breaker shall be wired through an advanced 'NO' contact which shall make before the main contact close.

2.3.10 Mechanical / Electrical interlocks shall be provided to prevent mal-operation and in particular to ensure the following. All these interlocks shall be ensured irrespective of type of switchgear viz. SF6, VCB or VC.

(a) The breaker can be operated only if it is in service or in test position.
(b) Movement of the circuit breaker truck from service to test or test to isolated position OR in reverse order shall be possible only when circuit breaker is off.
(c) In the operating positions of the breaker, the circuit breaker shall be securely locked. It can be withdrawn or inserted only with appropriate operations of the interlocking levers.
(d) The operating lever facilitates to overcome the contact pressure at the main disconnecting contacts while pushing in or drawing out.
(e) Test to isolated position of circuit breaker can be achieved only when the control plug is removed.
(f) Isolated to test position of circuit breaker can be achieved only after inserting control plug.
(g) It shall not be possible to withdraw the breaker when it is in closed position.
(h) It shall not be possible to plug in a breaker with earthing switch closed.
(i) It shall not be possible to close the earthing switch with breaker plugged in.
(j) For Grid Incomer Circuit Breakers, it shall not be possible to close the earthing switch with upstream GOD (Group operating device/Isolator) in close position.
(k) Pulling out of auxiliary circuit plug with breaker in service position shall not be possible.
(l) Pushing in breaker to service position with auxiliary circuit plug not in position shall not be possible.
(m) Opening of compartment door with isolating switch in ON position and vice versa shall not be possible.

2.3.11 Breaker operating duty shall be O-0.3sec-CO-3min-CO. Breakers shall be suitable for auto reacceleration / reclosure duty.

2.3.12 All the non-conducting metal parts of the circuit breaker truck shall be bonded together and shall make perfect electrical connections to earth through substantial sliding contacts, at service and
test positions. Such sliding contacts shall be arranged to make before power plug-in and interrupt after power drawout.

2.3.13 Arc extinguishing devices shall be easily removable for routine inspection of fixed contact assemblies.

2.3.14 The mating contacts of the circuit breaker with busbar contact shall be provided with removable shrouds.

2.4 **Relays**

2.4.1 All relays shall be microprocessor based, Numerical Protection relays with communication facility.

2.4.2 All relays specified shall be flush mounted in dust proof cases and shall match the appearance of the instruments mounted on the same panel. Relay covers shall be of non-ignitable materials.

2.4.3 Breaker auxiliary contacts shall be wired up to numerical relay for status record.

2.4.4 Protective relays shall be withdrawable type. Trip circuits shall be automatically broken and current transformer secondary circuits shorted, when a relay is withdrawn from its case. A marking strip shall be provided in front of each terminal block and a diagram plate at the back of each case to identify connections.

2.4.5 Relay contacts shall withstand repeated operation and shall make or break the maximum currents in their circuits without deterioration. All spare contacts shall also be wired up to the external terminals.

2.4.6 Relay coils shall carry their normal currents indefinitely and such currents as can occur under fault conditions. Relay mechanisms shall not be affected by vibration or magnetic fields, which may occur in normal operation.

2.4.7 Auxiliary relays in tripping circuits shall have mechanically operated flag indications and shall be hand reset type. Indicators shall be capable of being reset without opening the relay case. It shall not be possible to operate any relay by hand or to alter its setting, without opening the case. For relays with combined functions such as inverse time and instantaneous trip, separate indications of each function as specified shall be provided.

2.4.8 Master tripping relay (lock-out relays) shall be of the hand / electrical reset type with self coil cut off contacts and shall have at least 2 ‘NO’ + 2 ‘NC’ spare contacts for owner’s exclusive use. Necessary multiplication by auxiliary relay shall be done.

2.4.9 Provision shall be made for insertion of test plug at the front for testing and calibration using external source of power without disconnecting permanent wiring. Test plugs shall permit the shorting of any current transformer circuits.

2.4.10 Auxiliary relays on which the function of a contact may be changed from ‘NO’ to ‘NC’ and vice-versa by simply changing the contact arrangement are preferred.

2.5 **Measuring Instruments (Digital Multifunction Meter) & Analog Meters**

2.5.1 All measuring and recording instruments shall be digital, flush mounting type, with communication facility.

2.5.2 Digital metering unit shall be provided for incoming & outgoing feeders as per SLD. The digital metering unit shall have provision to display the following:

- Phase and line voltage
- Phase currents
- kVA, kW, kVAR, kVARH, kVAH and kWh
• Power factor
• Frequency, Total harmonics
• Alarm output relay

2.5.3 3 Phase analogue ammeter shall be provided for feeders and voltmeters shall be provided in PT panels, as per SLD.

2.5.4 All auxiliary equipment such as shunts, transducers, CT’s and PT’s that are required shall be included in the scope of supply.

2.5.5 All indicating instruments and meters shall be capable of carrying continuously their full load currents and full voltage across their voltage coils. They shall not be damaged by the passage of fault currents or the existence of over voltage on the primary side of their instrument transformers for the maximum permitted duration of fault conditions which may occur during normal operation. All instruments and meters shall be back connected. Meters shall be provided with zero adjusting devices for external operation.

2.5.6 Indicating instruments shall be of 96sqmm type flush mounted having 90° full scale movement.

2.5.7 Class of accuracy shall be 1 and 1.5 for Ammeter and Voltmeter respectively.

2.6 Current Transformers

2.6.1 Current transformers shall be cast resin bar primary type with the secondary terminals housed in a terminal box. The burden, ratio and class of accuracy shall be as given in the SLD. However, current transformers shall have sufficient capacity to operate with the burden imposed by the devices shown on drawings within their accuracy classifications.

2.6.2 Unless otherwise specified the CT shall meet following requirements :
(a) Separate cores shall be used for metering and protection.
(b) If a metering load is fed from a protection CT, suitable 1/1 or 5/5 ratio, saturated interposing CT’s shall be used.

2.6.3 Current transformers shall be mounted in stationary part of switchgear.

2.6.4 These shall be capable of withstanding dynamic and thermal stresses originated by short circuit fault current for withstand time of the board.

2.6.5 Test terminal blocks shall be provided for each CT circuit.

2.6.6 CT terminal block shall be provided with shorting and disconnecting type links & terminals shall be suitable for termination of 4sq.mm cable.

2.6.7 Unless otherwise required for proper relaying one side of current transformer secondary shall be grounded in the compartment with the meters or relays which they serve and each current transformer group shall be grounded with a separate identified lead which may be disconnected for testing.

2.6.8 CT secondary terminals shall be provided with plastic covers to prevent inadvertent contact.

2.6.9 CT circuits to have provision for remote metering in all the phases for all meters.

2.6.10 CT sizing shall be verified by vendor, based on relay make & relay manufacturers recommendation.

2.7 Potential Transformers

2.7.1 The PT's shall be epoxy cast resin type. The burden and ratio and class of accuracy shall be as specified in SLD. Generally, PT shall have specified accuracy class from 10% to 120% of...
normal voltage. However, potential transformers shall have sufficient capacity to operate with the burden imposed by the devices shown on the drawing with their accuracy classification.

2.7.2 All PT’s shall be drawout type and connections between the busbars and PT shall be completely shrouded. Automatic shutter shall be provided to shroud the busbars when PT is taken out.

2.7.3 It shall be possible to remove potential transformer from the circuit breaker, whenever required.

2.7.4 HRC fuse protection shall be provided on primary. Secondary shall be provided with a 4 pole MCB.

2.7.5 Plug-in type test terminal blocks shall be provided for each PT circuit.

2.7.6 Unless otherwise specified for proper relaying one side of potential transformer secondary shall be grounded at the transformer and the ground connection shall be identified and removable for testing.

2.7.7 The primary rated voltage shall be equal to the rated voltage $V_n$ of the system or $V_n/\sqrt{3}$ if the voltage transformer is connected between phase and neutral. If not otherwise specified secondary voltage shall be 110V or 110/√3V.

2.7.8 Line PT for each incomer shall be sized for 110V metering and protection requirement.

2.7.9 Selection and sizing of PT shall be verified by vendor based on relay make.

2.8 Control Supply

2.8.1 Control supply for CB shall be 110V D.C.

2.8.2 110V DC control supply from Battery Charger shall be provided for tripping and closing circuits of circuit breakers. 240V AC control supply shall be provided for spring charging motor, auxiliary power and heater circuits. Vendor shall provide suitable control switch and fuse at the point of receiving control supply. Vendor shall be required to loop both these supply to all the panels forming one unit. Any other intermediate voltage required in the panel shall be derived by providing suitable control transformer.

2.8.3 Control Circuits

- The equipment shall be designed in accordance with IS/IEC standard recommendations to operate with an over voltage up to 10% and under voltage up to 15% except for the tripping and closing circuits.

- The tripping circuit allows an operation with 70% to 110% of rated DC Auxiliary voltage supply; the closing circuit allows an operation with 85% to 110% of rated DC or AC Auxiliary voltage supply.

- For the protection of the different circuits such as control voltage supply charging motor, heater etc., where applicable MCB’s shall be provided individually for each cubicle circuit.

- For receiving and distributing AC and DC power for control circuit suitably rated 2 pole MCB’s to be considered.

- “MCB Off” indicating lamp to be considered in case of MCB (DC) is “OFF”

2.8.4 Two number control supply feeders shall be provided for each switchgear. Suitable control supply monitoring & selection scheme shall be developed by vendor.

2.8.5 Two number 240V AC supply feeder shall be provided for feeding space heaters, etc. Suitable AC control supply monitoring & selection scheme shall be developed by vendor.
2.9 **Control Switches**

2.9.1 Each circuit breaker shall be provided with trip-neutral-close (T-N-C) control switch and local remote selector switch.

2.9.2 All circuit breaker operating switches shall be of the pistol grip type, spring return to neutral and lockable in neutral position. They shall be arranged to close the breaker by being turned clockwise. The trip, neutral and close positions shall be clearly indicated. The movement shall be such that the switch cannot be operated inadvertently and that it is mechanically interlocked to trip before close. The operating switch shall be located on the centre line at about 1.5 meters from the floor level. Two spare ways shall be provided on these switches.

2.9.3 Ammeter selector switches shall have ‘make’ before break feature on its contacts. The selector switch shall generally have four positions for reading three phase currents and the neutral current.

2.9.4 The voltmeter selector switch shall also have four positions. Three shall be used to measure phase to phase voltages and the fourth shall be ‘OFF’ position.

2.9.5 Based on operational philosophy, if required, Auto / Manual selector switch shall be provided.

2.10 **Control Fuses**

2.10.1 All control fuses shall be of ‘link’ type. Screw type ‘diazed’ fuses are not acceptable. Fuses shall generally be mounted on the upper half of the panel. All fuse links shall have HRC cartridges. Rewirable fuses are not acceptable. All fuses and links shall be provided with suitable label.

2.11 **Push Buttons**

2.11.1 Push button colours shall be as follows:

- Stop, Open, Emergency - Red
- Start-Close - Green
- Trip circuit ‘Healthy check’ - Black
- Alarm Reset - Yellow
- Lamp Test - Green

Red push buttons shall be on the left side and green push buttons on the right side.

2.12 **Indicating Lamps**

2.12.1 Indicating lamps shall be provided on breaker panel as per the SLD. The indicating lamps shall be of LED type having low voltage glow protection. The covers of the lamps shall be heat resistant.

2.12.2 Indicating lamps colours shall be as follows:

- Running / ON - Red
- Stop / OFF - Green
- Fault / Auto Trip - Amber
2.13 **Space Heaters, Illumination and Socket**

2.13.1 Panels shall be provided with 240V, 1 Phase AC supply power 2 pole MCB and shall have compact fluorescent light fitting for internal illuminating with door switch.

2.13.2 240V, 15A, SPN Industrial socket outlet, complete with MCB & earth-leakage protection shall be provided in each cubicle for hand lamp connection.

2.13.3 The cubicles shall be provided with space heaters to prevent moisture condensation and maintain cubicle temperature $5^\circ$C above the ambient. The space heaters shall be located at the bottom of the switchboards and shall be controlled through a thermostat with an adjustable setting, a manually operated switch. The thermostat shall preferably be located in the metering / relay chamber.

2.14 **Common Alarm Scheme**

2.14.1 33kV Switchgear panel shall be provided with microprocessor based annunciator unit with Audio-visual alarm, & Test / Accept / Reset push buttons.

2.14.2 No. of windows of annunciator shall be decided based on number of alarm contacts to be wired with 20% spare windows.

2.14.3 Annunciator shall have facility for repeat annunciation at remote location.

2.15 **Wiring and Identification**

2.15.1 All control signalling, protection and metering wiring shall be by PVC insulated, 660 Volt grade and copper stranded conductor wires of min. 1.5 Sq.mm. For CT secondary circuit wires of 2.5 Sq.mm copper conductor min. shall be used. Wiring shall run in enclosed channel and shall leave at least 25% spare space for future use. Wires for connection between moving parts shall be flexible stranded copper conductors and the same shall be soldered at the ends before connections are made.

2.15.2 Terminal strips for connecting incoming control cables shall be channel mounted type of adequate size and shall be located conveniently for easy accessibility, without danger of contact with live part, ease of connection and shall be separated by barriers from power circuits. At least 20% spare terminals shall be provided in each terminal strips. CT secondary lead terminals shall be provided with shorting links.

2.15.3 All spare contacts of auxiliary relays, timers etc. shall be wired up to terminals block. Terminal Block shall be 600V grade 10 Amps rated.

2.15.4 Sufficient terminals shall be provided on each terminal strip to ensure that not more than one outgoing wire is connected per terminal. The wire shall be identified by numbered ferrules at each end, in accordance with the connection diagram. All ferrules shall be made of non-deteriorating materials. The ferrules shall be firmly located on each wire so that they cannot move or turn freely on the wire.

2.15.5 All interpanel control wiring shall be done by the switchgear vendor. The interpanel wiring shall be taken through PVC sleeves or suitable rubber grommets. Multipin plug provided should have scraping earth terminal.
2.15.6 Each panel shall be provided with sufficient number of test terminal blocks and test plugs for testing relays and kWh refers. The control circuit shall be designed for power frequency withstand voltage of 2kV (SMS) for 1 minute.

2.16 Earthing

2.16.1 Common earthing trolley shall be provided for all the circuit breakers. This shall be installed in cable compartment. Necessary interlocks between earthing trolley & circuit breaker shall be provided.

2.16.2 An earth bus of at least 50 mm x 10 mm Aluminium shall be provided. The earth bus shall be electrically continuous and shall run the full extent of each board. The earth bus shall be of same material as the main busbars. Each unit shall be constructed to ensure satisfactory electrical continuity between all metal parts not intended to be live and the earth terminals of the unit.

2.16.3 At each end of switchgear, suitable slots shall be provided on main earth bus for connection to Owner's Earth. The earth bus shall be accessible in each cable compartment either directly or through a branch extension to ground the cable armour and shields.

2.16.4 All doors and movable parts shall be connected to the earth bus with flexible copper connections. All non-current carrying metallic parts of the equipment shall be earthed. Earth bus shall be brought back to cable compartment and earthing bolts shall be provided to ground cable armours.

2.16.5 Circuit Breaker truck shall be provided with scrapping earth.

2.17 Cable Termination

2.17.1 MV Cable  
(a) 33kV switchgear will be connected to transformers or other equipment by XLPE cables. All power and control cables shall enter the switchgear from bottom. Sufficient space and support arrangement shall be provided in the cubicles to accommodate cables. The number of cables per circuit sizes and types shall be as per SLD. If the required number of cable terminals cannot be accommodated in the circuit breaker chamber, adaptor panel at the rear with bus extension suitable for the number of cables to be terminated shall be provided.

(b) The cable sockets shall be at such angle that the cable tails may be brought up for termination with minimum bending and setting.

(c) Terminals shall be located sufficiently away from gland plates or cable boxes to facilitate easy connection. Minimum distance between gland plate and termination shall be 800 mm. If distance is not sufficient, adaptor panels shall be provided. Additional termination points shall be provided in the outgoing bus links for power factor correction capacitor cable termination.

(d) Whenever extension box on Panels are provided, earth strip shall also be extended. In lieu of rear extension, a dummy panel may be provided for connecting cables.

(e) The switchboard shall be supplied complete with supports for clamping outgoing and incoming cables. Terminal blocks shall not be used to support cables.

2.17.2 Control Cables  
Control cables will enter the switchgear from the Bottom. Adequate space shall be provided for termination. Supporting facilities shall be provided for clamping the control cables.
2.18 Interface Requirement

2.18.1 Alarm and indication signals to plant Instrument control system (TAS) shall be potential free contacts. These contacts shall be wired to terminals for external connections. The list of signals required for indications to TAS for each circuit breaker are as follows:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Description</th>
<th>Alarm (Contacts)</th>
<th>Indication (Contacts)</th>
<th>Remarks</th>
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<td>1</td>
<td>33kV Circuit Breaker-Open</td>
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</table>

2.18.2 All parameters from Multi function meter to TAS.

2.18.3 Additional 2 Nos. Auxiliary Contactors to be provided for Interlocks.