SECTION – 2.09

LV Panels Switchgear and Distribution Boards

1.0.0 INTRODUCTION

This section covers requirement of LV switchgear and DBs (as applicable) for 20MW/120MWh Vanadium Redox Flow Battery project in GIPCL complex.

2.0.0 SCOPE OF WORK

2.1.0 The scope of work shall include the following equipment.

- 415V, 2500A, 3 phase 4 wire - Main LT Panel
- 415V, 3 Phase 4 wire - Sub-ACDB (MCR – only if separate panel is required)
- 415V, 3 Phase 4 wire - MCR Emergency Lighting Distribution Board (ELDB – only if separate panel is required)
- 415V, 3 Phase 4 wire - MCR Outdoor and Indoor Lighting Distribution Board (only if separate panel is required)
- 240V, 1 Phase, 3 wire - UPS DB

2.2.0 The Bidder shall refer to the conceptual and tentative SLD of the MCR LT Panel. For the BESS Plant (B-Plot), the detailed scheme shall be developed and proposed by the Bidder during the engineering stage. However, the quantities, including those of auxiliary system distribution boards, shall be determined in accordance with the EPC design requirements and shall be deemed to be within the Bidder's scope without any cost to the owner.

2.3.0 Balance of Plant (BoP) loads of the BESS plant area (i.e., lighting and air-conditioning loads other than BESS inherent process loads) may be supplied from the LT panel located at the MCR for optimization, through suitably sized redundant power cables. However, the bidder may alternatively opt to arrange a separate DISCOM supply along with an independent reticulation system for BESS BoP loads, at no cost to the Owner.

2.4.0 The bidder shall arrange the required DISCOM power supply, including but not limited to cabling, energy meter installation, testing, and associated works. All liaisoning activities shall be in the bidder's scope. GIPCL shall reimburse applicable charges and fees against submission of original DISCOM receipts through running bills.

2.5.0 Energy meters along with associated CTs , PTs (as applicable) shall normally be sourced from DISCOM, subject to timely allotment. In case timely allotment is not feasible, the bidder shall supply energy meters as per DISCOM requirements. Energy meters shall preferably be installed in the LT panel metering compartment, subject to DISCOM approval; otherwise, installation shall be carried out as per DISCOM guidelines.

3.0.0 CODES AND STANDARDS

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant IS / IEC standards including amendments, if any, except where modified and /or supplemented by this specification. Some of the applicable standards are listed below:

a) IS 8623 Specification for low voltage switchgear and control gear Assemblies

b)	IS 10118	Code of practice for selection, installation and maintenance of switchgear and control gear
c)	IS/IEC 60715	Dimensions of low-voltage switchgear and control gear - standardized mounting on rails of mechanical support of electrical devices in switchgear and control gear installations
d)	IS 12021	Specification for control transformers for switchgear and control gear for voltages not exceeding 1000V
e)	IS 13032	Miniature circuit breaker boards for voltages not exceeding 1000V
f)	IS/IEC 60947	Specification for low voltage switchgear and control gear
g)	IS 6005	Code of practice for phosphate of iron and steel
h)	IS 11353	Guide for uniform system of marking and identification of conductors and apparatus terminals
i)	IS/IEC 60529	Degrees of protection provided by enclosures (IP code)
j)	IEC 60439	Low voltage switchgear and control gear assemblies
k)	IEC 61439	Low voltage switchgear and control gear assemblies
l)	IEC 60947	Low voltage switchgear and control gear
m)	IEC 60529	Degrees of protection provided by enclosures (IP Code)

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 Design Features

4.1.1 The switchgear and its components shall be designed for design ambient temperature of 48ºC or CEA guidelines whichever is higher. Switchgear shall be designed for natural air cooling. No forced cooling is acceptable.

4.1.2 Short circuit withstand rating of the switchgear shall be 25 kA (Minimum) for 1 sec. However, the same may get change as per the system studies carried out by the EPC contractor during detail engineering stage.

4.1.3 415V system shall be solidly earthed.

4.1.4 All LT Panels and DB's shall be integrated with SAS / SCADA for smooth monitoring and operation.

4.1.5 415 V auxiliary contact signals shall be interfaced to the numerical relay digital inputs through interposing relays or interface modules, converting them into suitable low-voltage potential-free signals for hardwired connection to the relay I/O module.

4.1.6 Bus bar, breaker and other components shall be designed for continuous operation at rated current considering the maximum ambient temperature prevailing inside the cubicle

4.1.7 The continuous current rating of the bus bars, incomers and bus couplers of the board shall be the maximum load on the bus due to all the running auxiliaries during any operating condition plus 10% margin rounded off to the next higher standard rating.

4.1.8 Minimum 20% (Rounded up to next whole number) of each type and rating of feeders shall be provided (excluding incomer). Spare feeders shall be completely wired up.

4.1.9 10% of control terminals in each module shall be provided as spare subject to a minimum of 6 terminals.

4.1.10 For breaker operated feeders control supply voltage shall be redundant 110V DC. No release is acceptable for breaker feeders.

4.1.11 MCCB/MPCB/MCB, contactor and overload relay shall meet type 2 co-ordination as per applicable standard.

4.1.12 Less than or equal to 63 A: MCB (DP for single phase, 4P/TPN for three phase) shall be provided; Greater than 63 A and less than or equal to 400 A: MCCB (4P / TPN) shall be provided; Greater than 400 A: ACB shall be provided

4.2.0 **Air Circuit Breaker**

4.2.1 Air Circuit Breaker (ACB) shall be air break, horizontal drawout type, and shall have fault making and breaking capacities as specified. It shall be TPN for Incomer/Bus coupler feeders. There shall be 'Service', 'Test' and 'Isolated' positions for the breaker. In 'Test' position the circuit breaker shall be capable of being tested for operation without energizing 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 'Isolated' position. It shall be possible to close the door in 'Test' position.

4.2.2 Each breaker feeder shall be provided with the following as a minimum:

- Electrical anti-pumping feature
- Motor charged spring operating mechanism.
- Manual spring charging
- Mechanical indication of spring charge
- Mechanical position indicator
- Closing coil
- Shunt trip coil
- Manual trip push button
- Operation counter
- Phase barriers
- Shutter assembly
- Door interlock kit
- Any other feature required for protection and control of the feeder
- Microprocessor based releases for over current and earth fault protection.

4.2.3 The closing coil and spring charging motor shall operate satisfactorily at all values of control supply voltage between 80 and 110 percent of the rated voltage. The closing coil and shunt trip coil shall be rated for 100% continuous duty. One Open-Close-Open operation of the circuit breaker shall be possible after failure of power supply to motor.

4.2.4 The shunt trip coil shall operate satisfactorily for all values of control supply voltage between 70 and 110 percent of the rated voltage.

4.2.5 Spring charging motor shall be provided with over current protection. Motor windings shall be provided with class B insulation or better. Supply for charging motor shall be 110 V DC

4.2.6 Circuit breaker of the same type and ampere rating shall be wired alike and shall be mechanically interchangeable.

4.2.7 The ACB shall be provided with the following interlocks:

- Movement of a circuit breaker between 'Service' and 'Test' position shall not be possible unless it is in open position.
- Closing of a circuit breaker shall not be possible unless it is in 'Service' position, 'Test' position or in 'Isolated' position.
- Once the closing springs are discharged, after one closing operation of circuit breaker, it shall automatically initiate recharging of the spring.

4.3.0 **Miniature Circuit Breaker (MCB)**

4.3.1 Miniature circuit breaker (MCB) shall conform to IEC 898 and IS 8828. MCB shall be provided with thermo-magnetic type release for over current and short circuit protection. The MCB shall have breaking capacity not less than 10kA. MCB's are to be mounted on DIN channel only.

4.3.2 The MCB toggle/actuator shall clearly indicate the tripped condition by moving to a distinct intermediate position between the ON and OFF positions.

4.4.0 **Moulded case Circuit Breakers (MCCB)**

4.4.1 MCCBs shall be of three / four pole construction for panel mounting. The MCCBs shall be provided with front operating handles and mechanical ON / OFF indicators. MCCBs shall be of motorized type for incomer feeders and shall be provided with manual locking facility.

4.4.2 The Moulded Case Circuit breaker shall be provided with spring assisted quick-make, quick-break, current limiting type manually operated trip free mechanism, mechanical ON/OFF/TRIP position indicators, thermal tripping devices of inverse characteristics, instantaneous short circuit tripping devices and necessary auxiliary and alarm contacts. The thermal and short circuit tripping device shall be adjustable type. MCCB's shall be provided with OEM supplied shrouds / inter phase barriers / Spreader terminals etc.

4.4.3 MCCBs shall be provided with overload thermal release setting range of 50% to 100% of rated current and adjustable short circuit magnetic release of 5 to 10 times rated current.

4.4.4 MCCBs shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings of the motor starting equipment and the mechanical stress caused by the peak short circuit current of value associated with the switchgear rating. The maximum tripping time under short circuit shall not exceed 20 ms. When used for motor circuit, shunt trip devices shall be provided and the let through power of controlling MCCB shall be lower than the respective contactor, Contactor and overload relays shall be selected so as to withstand the let-through energy of the connected MCCB/MPCB in the feeder and consequent thermal and dynamic effects. All power feeder module MCCBs shall be equipped with earth fault release.

4.4.5 All motor feeders shall have SCADA / SAS integrated DOL starter with contactor, EOCR & current limiting MCCB. Any Auto operation required feeders shall have DOL starter, EOCR along with auto water level controller (wherever applicable) embedded in Distribution Board only.

4.4.6 The DC circuits shall be provided with DC MCCB / MCBs.

4.4.7 MCCBs shall have following accessories and features:

a) Shunt trip release
b) Auxiliary contact set of 1 NO + 1 NC
c) Fault signaling contact set of 1 NO + 1 NC
d) Insulation shields to isolate the connection between each pole
e) Finger protection plate to prevent accidental contact
f) The compartment door shall be interlocked with handle of MCCB/MPCB.
g) OEM supplied Interphase Barriers, shrouds, spreader terminal etc.

4.5.0 **Contactor**

4.5.1 The number of normally open (NO) and normally closed (NC) auxiliary contacts of a contactor shall be as per requirement. It shall, however, be not less than 2NO+2NC. And, at least one spare NO & NC contact shall be wired up to TB for future use.

4.5.2 The contactor shall operate satisfactorily between 85% to 110% of the rated voltage. The contactor shall not drop out at 70% of the rated voltage but shall definitely drop out at 20% of the rated voltage.

4.5.3 The contactor rating shall be chosen to provide type-2 discrimination. However the minimum rating shall be 9A.

4.5.4 All contactor shall be of AC-3 duty.

4.6.0 **Overload Relay**

4.6.1 3 Phase, 3 element type Electronic protection relay - preferably with digital display and single phasing preventer and reverse phase sequence relay shall be provided for motor protection.

4.6.2 The relay shall be manually reset type with changeover contact.

4.7.0 **Control and Selector Switches**

4.7.1 Control and selector switches shall be of rotary type, with escutcheon plates clearly marked to show the function and positions. Circuit breaker control switches shall have three positions and shall be spring return to 'Neutral' from 'Close' and 'Trip' positions and shall have pistol grip handles. Circuit breaker selector switches shall have two stay put positions marked `Local' and `Remote', respectively. They shall have black spade handles.

4.7.2 Ammeter and voltmeter selector switches shall have four stay put positions with adequate number of contacts for 3 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 secondary.

4.8.0 **Instrument Transformers**

4.8.1 Current transformer (CT) shall be mounted on the switchgear stationary parts. For metering, separate core shall be provided. The CT shall be of cast resin, bar primary type and of class E or better insulation. CT secondary current shall be 1A. Accuracy class of the CT shall be as indicated below:

a. Class 5P20 for relaying
b. Class 0.2s and ISF < 5 for metering

4.8.2 CTs for current rating less than 50A shall be 'wound primary' type and above 50A shall be 'bar primary' type.

4.8.3 Voltage transformer (VT) shall be cast-resin, draw-out type for ACB feeders and removable type for other feeders and shall have an accuracy class of 0.2.

4.8.4 The following over voltage factors shall be considered for VT:

- 120% for continuous duty
- 150% for 30 sec

4.8.5 Bus VT shall be housed in a separate compartment. All VTs shall have readily accessible MCBs on primary and secondary sides respectively.

4.9.0 **Metering**

4.9.1 Main ACDB shall have the following meters:

- 0.2s class MFM, 3 phase, 4 wire, 3 element, 110V DC Auxiliary power, with RS485 port –. MFM's are to integrated with SAS / SCADA / EnMS.

- All panel meters shall be minimum size of 96X96 sq. mm.
- Digital Voltmeter for each bus section

4.9.2 All MFM's shall be of HT type only with CT/PT input. MFM shall be of 0.2s class with RS-485 communication port, separate auxiliary supply – 110V DC and CT/PT shall be of 0.2s / 0.2 class respectively.

4.9.3 All MFM shall have facility of RTC clock and will be connected with HPCMS. HPCMS shall have provision to generate 15 minutes data for each MFM.

4.9.4 MFM shall have record following parameters

- Phase to Neutral voltage
- Average Phase to neutral voltage
- Phase to Phase voltage
- Average Phase to Phase voltage
- Line current (L1, L2, L3 and Average)
- Active / Reactive Current
- Frequency
- Power factor
- Average Power factor
- Active Power
- Total Active Power
- Reactive Power
- Total Reactive Power
- Apparent Power
- Total Apparent Power
- Active Total Import / Export Energy
- Reactive (Q1,Q2,Q3,Q4) Energy
- Apparent Import / Export Energy
- Cumulative MD
- Phase Angle
- Power On / Off Hours
- Load On / Off Hours
- Feeder Interruptions Count (When Aux is also off)
- THD Voltage
- THD Current
- THD Power
- RPM with Freq and Voltage unbalance and current unbalance
- Modbus on RS 485

4.9.5 Test Terminal Blocks (TTB) shall be provided for all meters.

4.9.6 For ABT metering systems, the bidder shall refer to relevant sections (Sec-2.20: DTS – Tariff Metering System) for constructional features, tamper-proof sealing arrangements, and testing requirements of the complete metering system, including ABT meters and associated CTs/PTs.

4.10.0 **Protection**

4.10.1 Main LT Panel shall have the following protections by numerical relay:

- Overcurrent and earth fault protection on incomer and bus section
- Under voltage protection on bus section
- Overcurrent and earth fault protection in bus coupler (as applicable)
- Required function , features for auto change over scheme.
- Any other as per requirement of the scheme

4.10.2 All main protective relays shall be numerical type with IEC 61850 communication interface and should have Interoperability during integration of numerical relays to communicate over IEC 61850 protocol with RTU/SAS/IEDs of different OEMs.

4.10.3 All numerical relays shall be draw out / withdrawable type

4.10.4 Protective relay panels shall be provided with test blocks (with CT,PT, Trip Circuit, auxiliary supply, logical input and output contact) for online testing (secondary injection) without disturbing wiring. Adequate Numbers of multi finger test Plugs shall be provided.

4.10.5 All numerical relays shall have built in disturbance recording feature.

4.10.6 Master trip relay.

4.10.7 Relay test blocks (RTB) shall be provided for all numerical relays.

4.11.0 **Push Button**

4.11.1 Push buttons shall be provided for motor feeders and contactor feeders. It shall be of spring return, push-to-actuate type. Where specified, push button shall be stay put type. Its contacts shall be rated to make, continuously carry and break 0.5A (inductive) at 110V DC.

4.11.2 Each push-button shall have two normally open and two normally closed contact, unless specified otherwise. The contact faces shall be of silver alloy. Each push button shall have true color integral LED i.e. illuminated type with suitable color based on its' application. Push button shall be provided with integral escutcheon plate marked with its function. Emergency push-button shall be stay put / latching type..

4.11.3 The colour of the button shall be as follows:

- Green for motor START, breaker CLOSE
- Red for motor TRIP, breaker OPEN.
- Black for all annunciator functions, overload reset and miscellaneous command

4.11.4 Pushbutton with integrated LED lamps will be preferred (wherever feasible)

4.12.0 **Indicating Lamp**

Indicating lamp shall be of the panel mounting, true color LED type. Diameter of each LED shall be of 22.5 mm, 230V AC / DC universal supply. The lamp shall have escutcheon plate marked with its function, wherever necessary. Indicating lamp shall be rated for continuous operation at 85% to 110% of its rated voltage. Lamp shall have translucent lamp cover of the following colours, as warranted by the application: Integrated LED lamps with push button are preferred (wherever feasible).

- Red for motor ON, breaker CLOSED
- Green for motor OFF, breaker OPEN
- Blue for healthy conditions
- White for test, spring charged, spring discharged, lockout relay healthy
- Amber for auto trip, alarm conditions etc.
- Level High / Low wherever applicable

4.13.0 **Control Supply and Space Heater Supply**

4.13.1 The breaker operated SSB shall receive two numbers 110V DC feeders for the control supply from DCDB. Auto-changeover shall be envisaged between the two supplies. Each panel shall receive control supply through bus wires and shall be tapped off through MCB provided in the respective panel. It shall be possible to isolate any panel without disturbing the power supply to other panels. Each sub circuit shall have separate MCBs.

4.13.2 An under voltage relay to monitor control supply shall be provided. A contact of the relay shall be wired to the terminal for external use. `Control Supply Failed' indication shall be provided.

4.13.3 For individual incomer / feeder panel module having ACB's, dual redundant 110V DC power source shall be provided. Control supply for contactor operated feeders and indication supply for MCCB / MCB feeders shall be of 110V DC. Control transformer is not envisaged

4.13.4 For all LT panels, 240V AC supply for space heater circuits shall be provided by tapping from the incomer before the main isolating switch / breaker. Necessary MCCB/MCB to isolate and distribute the supply to each panel shall be provided..

4.13.5 LT Panels and DB's (as applicable) shall be equipped with the following as required:

- Thermostatically controlled space heater(s)
- LED Illumination lamp with door switch of adequate wattage
- 5A 3pin socket with MCB protection

4.14.0 **Wiring**

4.14.1 All switchboards shall be supplied completely wired internally up to the terminals, ready to receive external cables. All internal wiring shall be carried out with 1100V grade, FRLS PVC / XLPE insulated single core, copper conductor of minimum 2.5 sq. mm. for CT circuits and 1.5 sq. mm. for other circuits.

4.14.2 All internal wiring terminations shall be made with solderless crimping type tinned copper lugs. Insulation sleeves shall be provided over the exposed parts of lugs.

4.14.3 Engraved core identification plastic ferrules marked to correspond with panel wiring diagrams shall be fitted at both ends of each wire.

4.14.4 Control terminal blocks (stud type , screw driver operated)shall be of 1.1 kV grade, rated for 10A and in one piece molding. It shall be complete with insulating barriers, clip-on type terminals and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams. Terminal blocks for CT and VT secondary leads shall be provided with test links (Disconnecting Type) and isolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities.

4.14.5 All spare contacts of relays, switches etc. shall be wired up to the terminals.

4.14.6 In all the panels at least 20% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks.

4.15.0 **Power Cable Termination**

Cable termination compartment and arrangement for power cables shall be suitable for heavy duty, 1.1kV grade, stranded aluminum conductor, PVC / XLPE insulated, armoured and FRLS PVC sheathed cables. All power cable terminals shall be of stud type and the power cable lugs shall be of tinned copper solderless crimping ring type. All lugs shall be insulated / sleeved.
Separate (Dedicated) power terminal shall be provided for each neutral connection for termination of outgoing cables.

4.16.0 **Nameplates and Labels**

4.16.1 Distribution boards shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. Danger sign boards on SS-304 shall be provided on panels and the same shall be shown in the panel drawing.

4.16.2 All name plates shall be of SS-304, with blue engraved lettering. The name plates shall be provisioned / placed on top front of the panel. Suitable stenciled paint mark shall be provided inside the panel / module for identification of all equipment, in addition to the plastic sticker labels, if provided. These labels shall be positioned so as to be clearly visible and shall have the device number.

4.16.3 Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.

4.17.0 **Bus Bars and Insulators**

4.17.1 All LT Panels shall be provided with three phase and neutral bus bars. Size of the neutral bus bar shall be same that of phase bus bar.

4.17.2 All bus bars and jumper connections shall be of high conductivity copper / aluminum / aluminum alloy of adequate size. The cross-section of the bus bars shall be uniform throughout the length of switchboard.

4.17.3 All bus bars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant and high strength sheet molded compound or equivalent type polyester fiber glass molded insulators. All bus bar joints shall be provided with high tensile steel bolts, belleville / spring washers and nuts. All horizontal and vertical joints shall be covered by removable SMC/DMC shrouds. All bus bars shall have HRPVC sleeves and colour coded.

4.17.4 Contact surfaces at all joints shall be silver plated or properly cleaned and anti-oxide grease applied to ensure an efficient and trouble free connection. Suitable bimetallic connectors shall be used for dissimilar metal connections.

4.17.5 The continuous rating of the main bus bars shall be same as that of the incomer breaker, and bus bar shall carry this continuous current without exceeding the temperature of 90ºC. For silver plated joints, temperature shall not exceed 105°C. Panels shall be designed for an ambient temperature of 48°C or as per the CEA Working Committee report, whichever is higher.

4.17.6 The Vendor shall furnish calculations establishing the adequacy of bus bar size for specified current and short circuit ratings without exceeding temperature limits and the adequacy of bus bar supports and spacings to withstand electrodynamic forces associated with short circuit currents.

4.18.0 **Earthing**

4.18.1 An earthing bus of adequate size shall be provided at the bottom and shall extend through out the length of switchgear. It shall be bolted to the framework of each panel and each breaker earthing contact bar. The earth bus shall be sized to withstand specified short circuit current.

4.18.2 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', 'Test' and 'Isolated' as well as throughout the intermediate travel.

4.18.3 All non-current carrying metal work of the switchboard shall be effectively bonded to the earth bus. All hinged doors shall be earthed through flexible earthing braid. VT and CT secondary neutral point earthing shall be at one place only on the terminal block. All metallic cases of relays, instruments and other panel mounted equipment shall be effectively bonded to the earth bus by independent stranded copper wires of size not less than 2.5sq.mm.

5.0.0 CONSTRUCTIONAL FEATURES

5.1.1 Panels shall be of metal enclosed, indoor, floor mounted, free standing type. Switchboard shall be fabricated using cold rolled close annealed (CRCA) sheet steel of thickness not less than the following:

- Frames (Top & Bottom) and load bearing members: 2.5mm.
- Doors: 2.0mm.
- Side and Top covers: 1.6mm.
- Panel partition: 1.6mm
- Gland plates: 3.0mm.

5.1.2 Panels shall be of dust-proof and vermin-proof construction and shall be provided with a degree of protection of IP 55 for all indoor panels as per IS 2147. Air circuit breaker (ACB) feeders shall be draw out type.

5.1.3 All Indoor equipment, panels and cabinets shall be pre-treated as per IS 6005 before being factory-painted. Surface shall be prepared with Sand / Shot Blasting. Two Coats of Polyurethane high build enamel coating system with high build mastic primer. Epoxy based paint shade shall be RAL 7035 (Powder coating with glossy finish). Corrosivity grade C4-M as per ISO 12944 shall be considered for indoor equipment. Painting shall be carried out by approved process. Sufficient quantity of touch-up paint shall be furnished for application at site.

5.1.4 Panels shall be of uniform height not exceeding 2450 mm. Switchboards shall be easily extendable on both sides by the addition of vertical sections after removing the end covers. Module size of switchboards shall not be less than 200mm.

5.1.5 Operating height of the handles / switches shall be limited to a maximum of 1800mm and a minimum of 300mm.

5.1.6 Panels shall have bottom entry for cables.

5.1.7 Panels shall be divided into distinct vertical sections (panels), each comprising of the following:

- Main bus bar compartment
- Switchgear / feeder compartment
- Cable alley of at least 300 mm width
- Auxiliary bus bar compartment
- Control compartment for relays for ACB feeder

Lifting hooks shall be provided in case panel is in multiple parts.

5.1.8 The feeder compartment shall be sheet steel enclosed on all sides and shall have provision of chicken mesh protection in louvers. The front of the compartment shall be provided with the hinged single leaf door with captive screws for positive closure. All doors shall be provided with adequate number of best quality panel lock (with key) and hinges for easy operation.

5.1.9 All circuit breaker panels shall be of single front type. All single front switchboards shall be provided with single leaf, hinged or bolted covers at the rear. The bolts shall be of captive type. The covers shall be provided with 'Danger' labels.

5.1.10 Separate base channel ISMC-75 as per IS-2062/1999 shall be provided for all the switchboards and DBs etc.

5.1.11 Panel shall be of compartmentalized type. A maximum of four (4) single-phase, double-pole MCB feeders may be accommodated in one compartment. A maximum of two (2) three-phase, four-pole (TPN) MCB feeders may be accommodated in one compartment.

Separate dedicated compartments shall be provided for each MCCB, metering (ABT and DISCOM metering system), and each incomer.

5.2.0 **Distribution Boards (as applicable)**

5.2.1 Distribution boards such as LDB, LP etc. shall be metal enclosed, fixed type, single front, and compartmentalized construction. The distribution board frame shall be fabricated using CRCA sheet steel of thickness not less than 2.0mm. The frames shall be enclosed by CRCA sheet steel of thickness not less than 1.6mm.

5.2.2 Suitable synthetic Neoprene gaskets shall be provided to make boards completely dust and vermin-proof with a degree of protection of IP55 for indoor and IP65 for outdoor installation.

5.2.3 The handle of incoming switch shall be mounted on the door of the board, with padlocking facility in both 'ON' and 'OFF' positions.

5.2.4 DBs shall have bottom entry for cables.

5.2.5 Cable entry facilities shall be provided with removable aluminum gland plates of suitable thickness. All incoming and outgoing cables shall be terminated on suitable terminal blocks. All the cable gland plates shall be pre-drilled. Spare holes shall be kept with grommet.

An automatic changeover scheme shall be provided between Incomer Feeder-1 (DISCOM Supply) and Incomer Feeder-2 (Alternate Supply) within the LV switchgear panel. The scheme shall ensure uninterrupted power supply to the load bus by automatically transferring between sources upon detection of supply failure or abnormality.

The automatic changeover scheme shall operate on a open-before-close sequence, ensuring that Incomer Feeder-1 is fully opened and its open status confirmed via auxiliary contact feedback prior to issuing a close command to Incomer Feeder-2. Momentary paralleling of Incomer Feeder-1 and Incomer Feeder-2 shall not be permitted under any operating condition.

The changeover shall be initiated upon detection of any of the following conditions on Incomer Feeder-1:

- Sustained undervoltage below the set pickup threshold
- Complete loss of supply (all phase voltage absent)
- Incomer Feeder-1 breaker trip due to internal fault

The scheme shall incorporate independently settable time delays for:

- Undervoltage confirmation before initiating transfer
- Dead time between Feeder-1 opening and Feeder-2 closing
- Supply restoration confirmation before initiating auto revert

5.3.2

Auto Transfer — Feeder-1 to Feeder-2: Upon detection of Feeder-1 supply failure or sustained undervoltage:

- Voltage monitoring relay detects undervoltage or loss of supply on Incomer Feeder-1.
- Settable time delay expires, confirming sustained supply failure.
- Trip command issued to Incomer Feeder-1 breaker.
- Open status of Incomer Feeder-1 confirmed via auxiliary contact.
- Settable dead time elapses.
- Healthy voltage on Incomer Feeder-2 confirmed.
- Close command issued to Incomer Feeder-2 breaker.
- Load bus energised from Incomer Feeder -2

Auto Revert — Feeder-2 to Feeder-1: Upon restoration of Feeder-1 supply:

- Voltage monitoring relay detects restoration of healthy voltage on Incomer Feeder-1.
- Settable time delay expires, confirming sustained supply restoration.
- Trip command issued to Incomer Feeder-2 breaker.
- Open status of Incomer Feeder-2 confirmed via auxiliary contact.
- Settable dead time elapses.
- Close command issued to Incomer Feeder-1 breaker.
- Load bus reverts to Incomer Feeder -1 supply.

5.3.3

As per the defined operating logic, the following interlocks shall be enforced:

Condition	Incomer Feeder-1	Incomer Feeder-2
Case-1	ON	OFF
Case-2	OFF	ON

Both incomers shall be electrically interlocked to prevent simultaneous closing — paralleling shall not be permitted under any condition.

6.0.0 DRAWINGS, DATA AND MANUAL

6.1.0 To Be Submitted After Award of Contract:

- Technical data sheet
- Dimensional general arrangement drawing
- Single line diagram
- Schematic and wiring diagram
- Quality plan
- Test certificates
- O&M manual

7.0.0 TESTS

The equipment along with components offered shall be of type tested and proven type. All type test reports shall be latest and submitted for approval of Owner / GIPCL. All routine, acceptance and special tests in accordance with the latest version of applicable standard shall also be conducted.

Type Tests

- Power frequency withstand test on power, auxiliary and control circuits
- Temperature rise test
- Measurement of resistance of the main circuit
- Short time withstand and peak withstand current tests
- Degree of protection test

In addition, type test reports for components such as breakers, contactors, MCCB/MPCB/MCBs, push buttons, instruments transformers etc. and lighting transformer shall be submitted for approval of Owner / GIPCL.

Routine Tests

- Power frequency withstand test on the main circuit
- Voltage tests on control and auxiliary circuits

- Measurement of resistance of the main circuit
- Mechanical operating tests
- Testing of protective relays by secondary injection test.
- Testing of measuring Instruments (MFM and meters).
- Testing of protection and control scheme.

In addition, routine tests for components such as breakers, contactors, MCCB/MPCB/MCBs, etc. shall be carried out.