



Gujarat University

TECHNICAL SPECIFICATIONS

ELECTRICAL WORK - I

Tender No: GU/ESTATE/EAC/2020-21/03

**TENDER DOCUMENT
FOR
ELECTRIFICATION AND EXTENSION OF H.T. POWER
AND ALLIED WORKS AT GUJARAT UNIVERSITY.**

L.T. PANEL BOARD

SCOPE

This specification covers the Design, Manufacture and Supply of various L.T. Panel Boards as per Single Line Diagram suitable for Indoor application.

CODES & STANDARDS:

All equipments and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.

The equipment shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of practice, Fire Insurance Association and all statutory regulations and safety codes In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

GENERAL SPECIFICATIONS:

All the Panels shall be metal clad, totally enclosed, rigid, floor/wall mounting, air insulated, cubicle type suitable for operation on three phase/single phase, 415 V/230 V/240 V, 50 Hz., neutral effectively grounded at transformer and short circuit level as mentioned in the drawings. All the panels shall be IP-51 protection class construction. The painting of all the metal part shall be with seven-tank process followed by powder coating as per the standard.

CONSTRUCTION STRUCTURE:

The Panel shall be of compartmentalized design so that circuit arc/flash products do not create secondary faults and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor/wall mounting type. All CRCA sheet steel used in the construction of Panels shall be 14/16 SWG Thick and shall be folded and braced as necessary to provide a rigid support for all components. Joint of any kind in sheet steel shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal. The Panels shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP: 54. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasket with foam rubber and /or rubber strips and shall be lockable. All Panels and covers shall be properly fitted and screwed with the frame and holds in the panel correctly positioned. Fixing screws shall enter into holes, taped into an adequate thickness of metal or provided with bolts and nuts. Self threading screws shall not be used in the construction of Panels. A base channel of 75 mm.x 40 mm. X 6 mm. Thick shall be provided at the bottom. A clearance of 300mm. between the floor of the Panels and the bottom of the units shall be provided.

Panels shall be preferably arranged in multi-tier formation. The Panels shall be adequate size with a provision of 20% spare space to accommodate possible future additional switchgear. The size of the Panels shall be designed in such a way that the internal space is sufficient for hot air movement and the electrical components do not attain temperature more than 50 Deg C. If necessary, openings shall be provided for neutral ventilation, but the said openings shall be screened with fine weld mesh. The entire electrical component shall be derated for 50

Deg. C. Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the number, and the size of incoming and outgoing conduits/cables. Alternately, the Panels shall be provided with removable sheet steel plates at top and bottom to drill holes for cable/conduit entry at site. The panels shall be designed to facilitate easy inspection, maintenance and repair. The Panels shall be sufficient rigid to support the equipment without distortion under normal and under short circuit condition. They shall be suitable braced for short circuit duty.

PROTECTION CLASS:

All the indoor Panels shall protection class of IP: 54

PAINTING:

The painting shall be seven tank process followed by powder coating.

CIRCUIT COMPARTMENTS:

Each circuit breaker and switch fuse unit shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker in 'ON' and 'OFF' position. The door shall not form an integral part of draw out position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.

INSTRUMENT COMPARTMENTS:

Separate adequate compartment shall be provided for accommodating instruments, indicating lamps, control contractors/relays and control fuses etc. These components shall be accessible for testing and maintenance

BUSBAR:

The busbar shall be air insulated and made of high quality, high conductivity, high strength Copper. The busbar shall be of 3 phase and neutral system with separate neutral and earth bar. The size of neutral busbar in all main panels or lighting panels and feeders for LDB shall be equal to phase busbar. The busbar and interconnection between busbar and various components shall be of high conductivity Copper. The busbar shall be of rectangular cross-section designed to with stand full load current for phase busbar and half rated current for neutral busbar in case of MCC panels only and shall be extensible on either side. The busbar size shall be as per drawing. The busbar shall have uniform cross-section throughout the length. The busbars and interconnections shall be insulated with epoxy coated bur sleeves. The busbar shall be supported on bus insulators of SMD/DMC type at sufficiently close intervals to prevent busbars sag and shall effectively withstand electronic stresses in the event of short circuit. The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm. Thick bakelite sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearance between the busbars is maintained as below:

- Between phases : 25 mm. minimum
- Between phase and neutral : 25 mm.
- Between phase and earth : 25mm.
- Between neutral and earth : 20mm. Minimum

All busbar connections shall be done by drilling holes in busbars and connecting by chromium plated or tinned plated brass bolts and nuts. Additional core-section of busbar shall be provided in all Panels to cover up the holes drilled in the busbar. Spring and flat washers shall be used for tightening the bolts. All connections between busbars and circuit breakers/switches and cables terminals shall be through Copper strips of proper size to carry full rated current. These strips shall be insulated with insulating tapes. Busbar shall be calculated on 50 deg C. ambient temp. And 85 deg.C. for continuous and short time rating. Busbar surrounding air temp. Shall be considered 70 deg. C. for busbar calculation. All joints shall have non-flammable insulation shrouds for secondary insulation purpose.

For Aluminium busbar 0.8 Current density to be considered.

For Copper Busbar 1.2 current density to be considered.

ELECTRICAL POWER AND CONTROL WIRING CONNECTION:

Terminal for both incoming and outgoing cable connections shall be suitable for 1100 V grade aluminum /copper conductor PVC insulated and PVC sheathed, armoured cable and shall be suitable for connections of solder less sockets for the cable size as indicated on the appended drawings for the Panels. Power connections for incoming feeders of the main Panels shall be suitable for 1100 V grade aluminum conductor (PVC) cables. Both control and power terminals shall be properly shrouded. Clip on type terminals shall be provided up to 10 sq.mm conductor and above 10 sq.mm bolt type terminals shall be used. 10 % spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block, so that not more than one outgoing wire is connected per terminal. Terminal strips for power and control shall preferably be separate from each other by suitable barriers. Wiring inside the modules for power, control, protection and instruments etc. shall be done with use of 660/100 V grade,PVC insulated copper conductor wires conforming to IS : 694 & 8130 Power wiring inside the starter module shall be rated for full current rating of respective contactor, but not less than 4.0 sq.mm cross-section area. For current transformer circuits, 2.5 sq.mm. Copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq.mm copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals. Control power supply to modules through the control transformer only. Control power wiring shall have MCB for circuit protection. All indicating lamps shall be protected by MCB. Particular care shall be taken to ensure that the layout of wiring is neat and orderly. Identification ferrules shall be fitted to all the wire termination for ease of identification and to facilitate checking and testing. Spring type washers shall be used for all copper and aluminum connections. Final wiring diagram of the Panels power and control circuit with ferrules numbers shall be submitted along with the Panels as one of the documents against the contract.

TERMINALS:

The outgoing terminals and neutral link shall be brought out to a cable alley suitable located and accessible from the panel front. The current transformers for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted and only one conductor may be connected in one terminal.

WIREWAYS:

A horizontal/vertical/AI. Wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.

CABLE COMPARTMENTS:

Cable compartment of minimum 300 mm size shall be provided in the panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in the cable compartments to support cables. All outgoing and incoming feeder terminals shall be brought out to terminal blocks in the cable compartment.

EARTHING:

GI earth bars of 50 mm x 6 mm shall be provided in the Panels for the entire length of the panel. The framework of the Panels shall be connected to this earth bar. Provisions shall be made for connection from this earth bar to the main earthing bar coming from the earth pit on both sides of the Panels. The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The Armor shall be properly connected with earthing clamp, and the clamp shall be ultimately bonded with the earth bar.

LABELS:

Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

NAME PLATE:

A name plate with the Panel's designation in bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door. Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc, shall suitably be identified by providing stickers.

DANGER NOTICE PLATES:

The danger notice plate shall be affixed in a permanent manner on opening side of all the Panels.

INTERNAL COMPONENTS:

The Panels shall be equipped complete with all types of required number of MCCB's, contactors, relays, fuses, meters, instruments, indicating lamps, push buttons, fittings, busbars, cable connectors etc. and all the necessary internal connections/wiring as required and as indicated on relevant drawings. Components necessary for the proper and complete functioning of the Panels but not indicated on the drawings shall be supplied and installed on the Panels. All parts of the Panels carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at the part of the Panels.

COMPONENTS

GENERAL:

The type, size and rating of the components shall be as indicated on the relevant drawings. While selection of the capacity of the components resulting from the prevailing conditions like ambient temperature shall be allowed for the thermal and magnetic trip rating shall be compensated for the ambient temperature. The rating indicated on the drawing is ratings anticipated at prevailing site conditions.

AIR CIRCUIT BREAKERS

- The ACB shall conform to IEC 60947-2 / IS 13947-2 standard.
- The ACB shall not require any derating up to 50 deg. Ambient temperature
- The ACB should be with microprocessor based release having O/L, Short time delay short circuit, Inst.short circuit and E/F protection with individual fault LED indication.
- The ACB shall have a facility to identify the reason of last fault even if acb switched ON after clearing the fault.
- ACB shall have Icu=50kA for ratings up to 2500A and 65kA for ratings up to 3200 A

The ACBs shall have following features:

230 V A.C. closing and shunt trip coil. Draw out type with “service”, “test”, “isolated” and “maintenance” position. Safety shutter of Fiber glass/polycarbonate sheet of 2mm thickness shall be provided. Mechanically trip free plus anti pumping feature is to be provided. Electrical trip free plus anti pumping shall be provided with relay ONLY and not by contractors. Electrical/Mechanical operation counter shall be provided. Door interlock with defeat features to be provided. ACB shall be lockable in isolation position. The circuit Breaker shall be air break, horizontal draw – out feature shall show 3 positions viz., SERVICE, TEST & ISOLATED. These positions along with ‘OPEN’ & ‘CLOSE’ positions shall be visibly marked. The operating mechanism shall be independent, manual / electric motor operated spring charged stored energy type. The mechanism shall ensure quick break, quick make action & the ACB shall be TRIP – FREE in operation. Electrically operated ACB shall be provided with AC closing coil. The ACB shall have 6 NO + 6 NC auxiliary contacts rated at 10A, 240V, AC ‘RED’ & ‘GREEN’ indicating lamps shall be provided on the cubicle. The ACB door shall not have any lamps or instruments. All such accessories shall be mounted on a separate compartment. The ACB shall have proper interlocks such that it cannot be ‘plugged in or out’ from the SERVICE position if the breaker is in ON condition. It shall not be possible to operate as a circuit breaker unless it is properly engaged in any of the three positions. The ACB shall have series CT operated over – current & short circuit releases with facilities to mount the under voltage & shunt trip releases or will have IDMT relays as specified.

MOULDED CASE CIRCUIT BREAKER:

- MCCB shall conform to the latest standard to IEC 60947-2.
- All MCCBs shall be with microprocessor based release for O/L, Short time delay S/C, Inst.S/C and E/F protection.
- Outgoing MCCBs shall be 3Pole type with adjustable O/L & fixed S/C.
- MCCBs supplied shall be of Current Limiting type only.
- MCCB should be with rotary drive, terminal extension links and phase barriers.

The moulded case circuit breaker (MCCB) shall be air break type and having quick make-quick break with trip free operating mechanism. Housing of the MCCB shall be of heat resistance and flame retardant insulating material. Operating handle of the MCCB shall be in front and clearly indicate ON/OFF/TRIP positions. The electrical contacts of the circuit breaker shall be of high conducting non deter deteriorating silver alloy contacts. The MCCB

shall be provided with thermal/magnetic type bi-metal overload release and electro magnetic short circuit protection device. All the releases shall operate on common trip busbar so that in case of operation of any one of the releases in any of the three phases, it will cut off all the three phases and thereby single phasing of the system is avoided. The MCCB wherever called for in the appended drawings shall provide an earth fault relay. The MCCB shall provide two sets of extra auxiliary contacts with connections for additional controls at future date. The electrical parameters of the MCCB shall be as per the description given in the appended drawings. Draw out type MCCB shall be provided for the feeder indicated in the single line diagram. The MCCB shall be provided with 230 V A.C. motor for closing and tripping/switching off for the feeders if indicated in single line diagram.

FUSE:

Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with latest IS and having high rupturing capacity of not less than 15KA at 415 V. The back-up fuse rating for each motor/equipment.

HRC fuses shall be of the make as specified in Make of Material.

MINIATURE CIRCUIT BREAKER:

Miniature Circuit breakers shall be current limiting type conformed with latest standards. The housing of MCBs shall be heat resistant and having high impact strength. The fault current of MCBs shall be provided with trip free manual operating mechanism with mechanical 'ON' and 'OFF' indications. The circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit. The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCBs shall be provided with magnetic fluid plunger release for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCBs shall be tested and certified as per Indian Standards, prior to installation.

CONTACTORS:

The contactors shall meet with the requirements of latest IS. The contactors shall have minimum making and breaking capacity in accordance with utilization category AC3 and shall be suitable for minimum Class II intermittent duty. If the contractor forms part of a distribution board then a separate enclosure is not required, but the installation of the contactor shall be such that it is not possible to make an accidental contact with live parts.

VOLTMETER:

Voltmeter shall be digital. The dial of the meter shall be square in shape of 96 x 96 mm. The voltmeter selector switch shall be arranged to provide line to line voltage reading and line neutral voltage.

AMMETER:

Ammeter shall be digital. The dial of the ammeter shall be square in 96 x 96 mm. Separate current transformer shall be provided for all ammeters.

CURRENT TRANSFORMER:

Where ammeters are called for C.T.s shall be provided for current measuring. Each phase shall be provided with separate current transformer of accuracy Class I and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with latest IS.

PUSH BUTTONS:

The push button unit shall comprise of the contact element, a fixing holder, and a push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. continuous current rating. The actuator shall of standard type and color as per its usage for ON, OFF and TRIP. Wiring for Remote ON, OFF push button is to be required.

INDICATING LAMPS:

Indicating lamps assembly shall be screw type with built in resistor having non fading color lens. LED type lamps are required. Wiring for Remote ON, OFF, TRIP indicating lamp is required.

Color shade for the indicating lamps shall be as below:

ON indicating lamp	:	Red
OFF indicating lamp	:	Green
TRIP indicating lamp	:	Amber
PHASE indicating lamp	:	Red, Yellow and Blue
TRIP circuit healthy lamp	:	Milky

DRAWINGS

Prior to fabrication of the Panels, the supplier/contractor shall submit for consultant's approval the shop/vendor drawings consisting of G.A. drawings, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuit rating of all the electrical components used, busbar size, internal wiring size, Panels dimension, color, mounting details etc. in 6 sets.. The contractor shall also submit manufacturer's catalogues of the electrical components installed in the Panel dimension, color, mounting details etc. in 6 sets. One set of the drawings will be returned to vendor with client/consultant's comments/remarks and required clarifications. The vendor shall incorporate the same and send three sets of revised drawings.

INSPECTION & TEST

15 days advance notice in writing shall be given to the Consultant/ Client for Inspection and Tests. All the Routine Tests as per IS shall be carried out on the Panels in presence of Client/ Consultant.

The switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

All the charges for inspection / testing shall be borne by the contractor including travel & hotel stay for Consultant & Client's engineers.

TEST CERTIFICATE

Certificate reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner. The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports. Copies of Type test certificate for test on similar switchgear shall be submitted. The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. & date of test.

COMMISSIONING

The vendor will depute their engineer at site at the time of installation, testing & commissioning for at least three times.

GUARANTEE

Vendor shall guarantee the design, materials, workmanship and performance of the equipment for a period of twelve months from the date of initial operation or eighteen months after delivery at job site, whichever is earlier.

IMPORTANT

- The vendor will depute their engineer at site at the time of installation, testing & commissioning for at least three times.
- Minimum 750mm clear space to provided from bottom of gland plate to spreader contact terminal of ACB/MCCB/MCB/terminal for outgoing/incoming Cable termination.

MAKE OF MATERIALS:

SR. NO.	ITEM	STANDARD MAKE
1	SPD (SURGE ARRASTER)	SCHNEIDER / OBO / EMERSON
2	LT SWITCHGEAR – ACB – Ics=Icu=Icw=50KA/1sec.	SIEMENS - 3WL ABB-Emax SCHNEIDER –Masterpact NW L&T – U-Power
3	LT SWITCHGEAR - MCCB Ics=100%Icu	SIEMENS – 3VL ABB-Tmax SCHNEIDER – NSX L&T – MTX-2.0
4	LT SWITCHGEAR – MCB/ELCB	SIEMENS – Betagard ABB-SH SCHNEIDER – ACTI-9 LEGRAND - DX ³ L&T
5	LT CONTACTORS	SIEMENS / ABB / SCHNEIDER
6	BUSBAR SUPPORT	POWERMAT OR EQUIVALENT
8	METERS (DIGITAL)	CONSERVE / AEC / SIEMENS
9	RELAYS	SIEMENS / ABB/ L & T
10	INDICATING LAMPS – LED TYPE	SIEMENS / SCHNEIDER / L & T
11	ELECTRIC TIMER	SIEMENS / LEGRAND / L & T
12	ROTARY SWITCH	SIEMENS / KAYCEE / SALZER
13	PUSH BUTTON AND PUSH BUTTON SET	SIEMENS / SCHNEIDER ELECTRIC / L & T
14	SELECTOR SWITCH	KEYCEE / SALZER
15	LUGS	DOWELL'S / 3D / JAINSON / COMET / HMI
16	MULTICORE FLEXIBLE CABLE {CU}	FINOLEX / POLYCAB / RR CABLE/ LAPP
17	CONNECTORS (WITH COLOUR CODE)	WAGO/ELEMAX
18	CONTROL TRANSFORMER [PT / CT]	ASHMOR / KAPPA / PRGATI
19	PAINT	NEROLAC / ASIAN PAINTS
20	BUSBAR	1 SQ.MM = 0.8A (ELECTROLYTIC GRADE) – AL 1 SQ.MM = 1.2A (ELECTROLYTIC GRADE) - CU
21	CONTROL MCB	SIEMENS / L & T / ABB
22	ACCEPT - TEST- RESET PUSH BUTTON	RASS / TEKNIC
23	GASKET	NEOPRENE TYPE
24	HARDWARE	ZINC PLATED
25	NAME PLATE	ANODISED ALUMINIUM, ENGRAVED TYPE WHITE LETTER, BLACK BACKGROUND
26	CAPACITOR – HEAVY DUTY-APP BOX TYPE	MEHER, EPCOS, NEPTURE, UNIVERSAL

11 KV HT BREAKER PANEL

HIGH VOLTAGE METAL ENCLOSED SWITCHGEAR

SCOPE

- This specification covers the Design, Manufacture and Supply of High voltage Metal Enclosed Switchgear rated at **12 KV** suitable for Indoor application.

The High voltage metal Enclosed switchgear boards shall be single front, single tier, fully compartmentalized construction comprising of a row of free standing, floor mounted panels. Each circuit shall have a separate vertical panel with distinct compartments for circuit breaker, main bus bars, current transformers cum cable compartment and low voltage compartment. Each compartments of individual cubicle shall be segregated by earth metallic sheet. Cubicle should be type tested for internal arc in all three compartments for as per IEC 62271-200 & As per Single line diagram.

- High voltage breaker panel shall comprise of 2nos. 1#incoming cum outgoing **SF6 / VCB** circuit breaker with necessary metering, CTs, PTs etc & protection as shown in technical data sheet and single line diagram enclosed herewith. (**As Per Drg. No. EL-01**)
- High voltage breaker panel shall comprise of 1nos. 1#incoming & 2 #outgoing **SF6 / VCB** circuit breaker with necessary metering, CTs, PTs etc & protection as shown in technical data sheet and single line diagram enclosed herewith. (**As Per Drg. No. EL-01**)
- High voltage breaker panel shall comprise of 1nos.1#incoming & 4 #outgoing **SF6 / VCB** circuit breaker with necessary metering, CTs, PTs etc & protection as shown in technical data sheet and single line diagram enclosed herewith. (**As Per Drg. No. EL-02**)

CODES & STANDARDS

- All equipments and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian & International Standards
- The equipment shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of practice, Fire Insurance Association and all statutory regulations and safety codes In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

COMPLETENES OF SUPPLY

- It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of Engineering, design and workmanship.
- Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished without any extra charge.

DESIGN BASIS

- The Switchgear shall be capable of continuous operation at specified rating under the following condition:
Voltage variation: +/- 10%
Frequency variation: +/-3%
- The system fault level for 11KV system is 350MVA-18.37KA OR as per mentioned in Drawings. The breaker shall have the breaking capacity corresponding to above fault levels specified.
- The breakers shall be **SF6 / VCB** type.

CONSTRUCTION REQUIREMENTS

- The switchgear enclosure shall conform to the degree of protection IP-54. The minimum thickness of sheet steel used shall be 2mm CRCA steel. Breaker & Metering Door shall be of Min. 2.5mm CRCA sheet. Fabrication shall be done through CNC turret punch press and CNC bending machine.
- Circuit switchgear assembly shall comprise a continuous, dead-front, line-up of free standing, vertical cubicles. Each cubicle shall have a front hinged door with latches and a removable back cover. All covers and doors shall be provided with recessed neoprene gaskets. All doors shall have pad locking arrangement. Switchgear shall be fire retardant type.
- Circuit breaker, instrument transformer, bus-bars, cable compartment etc. shall be housed in totally isolated air tight separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units. Suitable venting arrangement shall be provided to release the gas pressure developed due to live arc of fault.
- Each cubicle shall be separated from adjacent one by grounded sheet steel barrier and bus sealing arrangement. The switchgear panel shall be arc proof version.
- All relays, meters, switches and lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle.

- Each switchgear cubicle shall be provided with a thermostat controlled space heater and single phase plug point operated at 230 V AC. 50 Hz.
- Bus connection from bus compartment to breaker compartment & breaker compartment to cable compartment and bus compartment to adjacent panels shall be through sealed resin cast bushing assembly.
- Each breaker cubicle shall be provided with 'service' and 'test' position limit switches, each having at least 4 NO & 4 NC contacts. All fixing bolts, screws, etc. appearing on the panel shall be so arranged as to present a neat appearance. The swing of the door shall be more than 90 C.

BUSBARS

- The main buses and connections shall be of high conductivity electrolytic copper, sized for specified continuous and fault current ratings with maximum temperature limited to 85 deg C.
- Adequate contact pressure shall be ensured by means of two bolts connection with plain and spring washers and locknuts.
- Bimetallic connectors shall be furnished for connections between dissimilar metals.
- All Busbars, Jumpers and connection shall be fully insulated for working voltage with adequate phase/ground clearances. Epoxy cast-resin shrouds for joints shall be provided. All jointing hardware shall have nylon caps. All busbars, links, jumpers etc. shall be sleeved with sleeves of Raychem/DSG make and non-inflammable heat shrinkable type. Busbars, links, live parts etc. shall have nonflammable shrouds.
- No paper/cotton based insulation shall be used any where in the switch gear. Minimum amount of combustible and low smoke generation type insulating material shall be used.
- All buses and connections shall be supported and braced to withstand dynamic electro-magnetic stresses due to maximum short circuit current and also to take care of any thermal expansion.
- Busbars shall be color coded insulated with heat shrinkable PVC sleeves for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switchgear assembly and joints shall have sufficient clearances in order to meet the BIL of 28kV RMS and 75 kVp withstand.

Adequate clearance between 11 KV point and earth and between phase shall be provided to ensure safety as per provision in Indian Electricity Rule 1956 and its amendment thereof and also in accordance with the relevant Indian standard specification and the same shall be capable of withstanding the specified high voltage tests as per IS13118/IEC56 (IEC100) and amendment thereof. If clearance is not adequate at any instant, bus bar shall be with sleeve of system voltage class &

joints with shrouds. Sharp edges and bends either in the bus bars or bus bar connections shall be avoided as far as possible. Wherever such bends or edges are unavoidable, suitable compound or any other insulation shall be supplied to prevent local ionization and consequent flashover.

There shall be a continuous copper/GI earth bus at the bottom of the panel. Earth bus shall be robust and shall be capable of carrying full short circuit current for 1 second. Doors, covers and all non-current carrying metallic parts shall be earthed through flexible copper wires. This also includes instrument casing and cable armour which are also connected to the earth bus. Earth bus must be tested for 40 KA for 1 sec

- **The successful vendor shall submit the calculation in support of selection of busbar conductor size; spacing and short time withstand capability.**

CIRCUIT BRAKER

- Circuit breaker shall be triple pole, single throw, and **SF6 / VCB** type.
- Circuit breaker shall be draw-out type, having **SERVICE, TEST** and **DISCONNECTED** positions with positive indication for each position.
- Circuit breaker of identical rating shall be physically and electrically interchangeable
- Circuit breaker shall have motor wound spring charging facility with Mechanical & Electrical anti- pumping features and shunt trip. In addition facility for manual charging of spring shall be provided. The motor shall be suitable for operation with voltage variation from 85% to 110% of rated voltage. Spring charging motor shall be in a standard enclosure.
- For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.
- Mechanical safety interlock shall be provided to prevent:
The circuit breaker from being racked in or out of the service position when the breaker is closed.
Racking in the circuit breaker unless the control plug is fully engaged.
Closing & opening of the breaker in an intermediate position between 'service' & 'test' and between 'Test' and 'Disconnected' position.
- The circuit breaker cannot be inserted into service position till auxiliary contacts are made. Similarly interlock shall prevent auxiliary contacts from being disconnected, if circuit breaker is in service position.
- Automatic safety shutters shall be provided to fully cover the female primary contacts when the breaker is withdrawn from service position.
- Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator. The

manual trip device shall be located on the front door. Indicators with shrouds will be visible from front door even when breaker is closed.

- Each breaker shall be provided with following:
Auxiliary switch, with 6 NO + 6 NC contacts, mounted on the draw out portion of the switchgear.
Position/cell switch with minimum 3 NO + 1 NC contacts, one each for TEST and SERVICE position.
Auxiliary switch, with 4 NO + 4NC contacts, mounted on the stationary portion of the switchgear and operated mechanically by a sliding lever from the breaker in SERVICE position.
Limit/auxiliary switches shall be convertible type that is facility for changing N.O. contact ton N.C. and vice-versa. Switch contacts shall be rated 10A A.C. and 2A D.C. at opening voltage.
- Circuit breaker shall be draw out type, complete with transfer trucks, self-aligning primary and secondary disconnects, positive guides to ensure proper alignment.
- Each breaker shall be provided with suitable encased rollers.
- The trip coils shall be operated satisfactorily at voltage between 70 % and 110% of rated control supply voltage.
- Each circuit breaker cubicle shall be provided with an earthing facility to earth the incoming or outgoing feeders by the arrangement specified below. Earthing facilities shall be fully interlocked to prevent faulty operation e.g. earthing of live parts.
- Separate earthing truck, which can be inserted in place of circuit breakers, one truck suitable for incoming and the other for outgoing circuits shall be provided.
- Positive earthing of circuit breaker frame shall be maintained when it is in the connected position and in all other positions in which the safety shutters are in open position.

INDICATION

Each breaker shall be equipped with following:

- One heavy duty spring return type TRIP-NORMAL-CLOSE control switch with pistol grip handle.

Three indicating lights in front of compartments:

Green	:Breaker Open
Red	:Breaker Closed
Amber	:Trip

Blue :Spring charged/Low SF6 / VCB

Lamp shall be LED type with series resistor, Lamp and lens shall be replaceable from the front.

CURRENT TRANSFORMER

- Current transformers shall be bar primary, cast resin type. Maximum VA burden shall be of 15 VA and shall be rated for full short circuit current for 1 second. All secondary connections shall be brought out to terminal blocks where Y or D connection will be made.
Class PS for differential & restricted earth fault relaying.
Class 5P20 for other relaying.
Class 1.0 and ISF<5 for metering.
- The current transformers shall be capable of safely withstanding the short circuit, stresses corresponding to the fault level as indicated & shall be able to meet the short-time requirement specified.
- All CT secondary shall be earthed through separate switch link on terminal block. The secondary terminals of the CTS shall have the provision of shorting and disconnecting facilities by links.
- CT terminals & their polarities shall be clearly marked.

POTENTIAL TRANSFORMER

- Potential Transformers shall be cast-resin, draw out type and shall have an accuracy class of 1.0. Potential Transformer mounted on breaker carriage is not acceptable.
- High voltage windings of Potential transformer shall be protected by current limiting fuses. The Potential transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.
- Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.
- The connections from main circuit to PT shall be capable of withstanding short circuit stresses.

RELAYS

- Relays shall be of draw out design with built-in site testing facilities. Small auxiliary relays may be in non-draw out execution and mounted within the cubicle.
- Relays shall be rated for operation on 110 V secondary voltage and 5 A secondary current. Number and rating of relay contacts shall suit the job requirements.

NON-DIRECTIONAL OVERCURRENT AND EARTH FAULT PROTECTION (50, 50N, 51, 51N):-

- The relay should have 3 independent time delayed O/C stages.

The first stage should be programmable to have either a DT characteristics or IDMT characteristics described as follows and shall have a current setting range of $0.1 I_N$ to $5 I_N$ and time setting range of 0 ms to 150 sec. The second and third stage should have a current setting range of $0.1 I_N$ to $40 I_N$.
- The relay should have 3 independent time delayed E/F stages.

Should have a current setting range of $0.005 I_N$ to $8 I_N$ and time setting range of 0 ms to 100 sec. The lower setting is critical to take care of systems, which have low earth fault currents.
- The relay should have front USB port for local communication with Laptop and rear RJ45 ports to communicate on native IEC61850 protocol for future integration. No protocol convertors shall be acceptable.
- Should be able to record atleast 5 oscillographic disturbance records each of minimum 3 seconds
- Should have minimum of 8 programmable LEDs
- Should be able to record 5 fault records and 75 event records
- Current input should be rated for both 1A & 5A.
- Should have two independent setting groups.
- Should have in built MIMIC display
- Should be provided with free software for programming and analyzing the disturbance records supporting comrade format.
- Should be able to measure and record harmonics apart from Current and frequency.
- In built trip circuit supervision is mandatory apart from CT supervision feature.
- All CT & VT Connections should be with ring terminals

METERS

- All meters are digital type of 96x96 mm accuracy class of +-2%.

PRESSURE DISCHARGE FLAPS

Pressure discharge flaps shall be provided at the top in all high voltage compartments for the exit of hot gases in the event of internal arc in any of the HV compartments.

ANNUNCIATION

- All necessary visual and audible annunciation shall be provided including indication lamps as per the drawing and to provide indications like Circuit breaker ON,OFF, AUTO-TRIP, TRIP-CIRCUIT HEALTHY, D.C. CONTROL SUPPLY FAILURE, Transformer Faults (winding temperature, OTI, WTI & Buchholz, MOLG alarm & trip) ETC. Separate audible alarms/annunciation shall be provided for Circuit-breakers tripping on fault (auto-trip) and D.C. Control supply failure, these operating on 110 volts D.C.

CONTROL SUPPLY:

- 110 Volts D.C. control supply shall be arranged (A.C. supply from P.T. secondary to be converted to 110 V D.C. with stored energy for two operations in case of power supply not available) by the Vendor for shunt trip coil and the various controls in the switchgears, indicating lamps like circuit-breaker ON/OFF, etc. and alarms operating on DC by providing power pack.
- A.C. supply to be provided for cubicle illumination lamps, panel space heater and alarms operating on A.C.
- No Auxiliary AC supply will be provided by client.

WIRING

- The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.
- Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired upto terminal blocks.
- Wiring shall be done with flexible, 650V grade, FRLS PVC insulated switchboard wires with stranded copper conductors of 2.5 mm² for control and current circuits and 2.5mm² for voltage circuits. All power wiring like space heater supply etc. shall be carried out with min. 4 mm² Cu, conductor, Wiring of trip circuit shall be with fluro-plastic wires.
- Each wire shall be identified, at both ends, with dependant & cross addressing permanent markers bearing wire numbers as per Contractor's Wiring Diagrams. Trip circuit shall have red color ferrule.
- Wire termination shall be made with crimping type ring connectors with insulating sleeves. Wires shall not be spliced between terminals.
- The wires shall run preferably through metallic through adequately supported along its run to prevent sagging due to flexibility or vibration. The control & power wires shall be routed through separate troughs.
- Inter panel wiring at shipping Inter-panel wiring trough shall be furnished for wiring between switchgear cubicles. All wiring required for interlocking between the cubicles of any switchgear shall be furnished and installed. Whenever wires are passing through cutouts or openings they shall be protected by providing suitable

grommet or gasket around the openings . Inter panel wiring at shipping sections shall be through terminal blocks places suitably at intersection points.

- The color of wire shall be taken as follows:
AC System Black
DC System Grey
Earthing System Green
CT & PT Wiring System Red, Yellow, Blue color code.

TERMINAL BLOCKS

- Terminal blocks shall be 660 V grade box-clamp type with marking strips ELMEX 10 mm² or equal. Terminal for C.T. Secondary leads shall be disconnecting link type and shall have provision for shorting. Terminal for P.T. Secondary lead shall also be disconnecting link type.
- Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Multi connection terminal strip to be used if required.
- Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminal.
- Terminal blocks for inter panel/external/Space Heater wiring shall be separate from inter panel wiring.
- The terminal block shall be grouped according to circuit functions and individual terminals in each block shall be serially numbered in accordance with the drawings. Such numbering shall be legible, permanent and indelible.
- The terminal blocks of different voltage classes shall be segregated.
- Similar type of terminal block shall be used for inter panel wiring at shipping sections.

LOW VOLTAGE COMPARTMENT

Low voltage compartment shall be mounted at the front on the top of breaker compartment and shall also have hinged type of door. All wiring shall be routed through PVC ducts and shall be terminated on to stud type terminal with plastic cover. For current transformer terminal shall be disconnecting link type only. The wire shall be of 1.1KV grade and suitable for 2KVrms for 1 minute power frequency high voltage

CABLE TERMINATION

- Switchgear shall be designed for cable entry from the BOTTOM. Sufficient space shall be provided for ease of termination and connection.

- Power cables shall be XLPE insulated, armored, overall PVC sheathed with stranded Aluminium / copper conductor.
- Control cables shall be PVC/XLPE insulated, armored, overall PVC sheathed with stranded copper conductor.
- All provisions and accessories shall be furnished for termination and connection of cables, including removable aluminum gland plates, cables supports etc.
- The gland plates shall be minimum 4mm thick aluminum sheet. The gland plate and supporting arrangement for I/C power cables shall be such as to minimize flow of eddy current.
- Sufficient space (Minimum 750mm) shall be provided between the power cable termination and gland plate. Core Balance C.T.s wherever specified shall be accommodated within this space.

GROUND BUSBAR

- A ground bus, rated to carry maximum fault current, shall extend full length of the switchgear.
- The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to receive 50 x 6 mm G.I. flat.
- Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and draw out P.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.
- C.T. and V.T. secondarily neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.
- Suitable ground terminal, directly connected with the ground bus shall be provided in the cable chamber for grounding connection of cable screen/armor.
- All hinged doors shall be grounded using silver plated and braided copper flexible of adequate size.

NAME PLATES

- Nameplates of approved design shall be furnished at front & back side of each cubicle and at each instruments & device mounted on or inside the cubicle. Name plate shall be 3 mm thick with white letter on black background. The letters of the nameplates shall be engraved. The nameplate shall be held by self-tapping screws. Nameplates size shall be minimum 20x75mm for instrument/device and 40x150mm for panels. Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

SPACE HEATERS AND PLUG SOCKETS

- Each cubicle shall be provided with thermostat controlled space heaters and 10A, 3 pin plug socket. Cubicle heater, Plug/socket circuits shall have Individual MCBs.
- Bus-wires of adequate (minimum 4 sq.mm copper) capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating MCB shall be provided at each cubicle for A.C. supplies.

PAINITING

- All surfaces shall be blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease rust and foreign adhering matter.
- After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and staved after each coat.
- The switchgear shall be finished in light gray (Shade No.631 of IS-5) with three coats of epoxy paint.

ACCESSORIES

The following accessories shall be furnished along with the switchgear:

- Earthing equipment suitable for earthing the bus or outgoing cable.
- Breaker carrier trolley if C.B. is of that design.
- Cubicle door opening key (1 for each panel)
- Withdrawal handle for breaker.
- Commissioning spares (Provide list of spares along with offer)

DRAWINGS & MANUALS

Following Drawings, Data & Manuals shall be submitted in triplicate for approval of Consultant / Client prior to manufacturing.

- Plan, Elevation and Sections with dimensions, Outline dimensional drawings of the switchgear showing general arrangement, space requirements and cable entry points, location of breaker, CT, V.T. busbar chamber, grounding arrangement, weight, recommended clearances, details of operating mechanism and Technical Literature of Breaker and all other associated equipments.
- Foundation plan with proposed fixing arrangement.
- Schematic Diagram with terminal and ferrule number for the cubicle.
- Control wiring diagrams.
- List of equipments with Quantity, Make, Type and brief technical particulars.

- Switchgear layout plan with floor openings, floor fixing arrangement and elevation.
- Characteristic curves for relays of each type.
- Three sets of operation, installation and maintenance manuals shall also be furnished, prior to dispatch of the switchgear.
- Typical reports on circuit breaker/CT/PT.
- Test reports on & complete specifications & OEM address for bought out items.
- Bus bar & circuit breaker sizing calculation along with relevant Test Reports.
- Instruction manuals of switchgear & individual equipment. The manual shall clearly indicate that the installation method, check-up and tests to be carried out before commissioning of the equipment as well as monitoring tests, their interval & maintenance/overhauling procedure & schedule.
- One set of the drawings will be returned to vendor with client/consultant's comments/remarks and required clarifications. The vendor shall incorporate the same and send three sets of revised drawings.

TYPE TEST.

Following minimum type test reports shall be submitted for the evaluation of offers.

All short circuit duties from test duty 1 to test duty 5 including single phase and double line to ground as per IEC62271-100

- **Short time rating for 3 seconds** as per IEC 62271-100,62271-200
- **Temperature rise test** as per IEC 62271-200
- **Capacitor bank switching** for 400A minimum & cable charging 25 A test as per IEC 62271-100 For test duties 1 to 4
- **Degree of protection test** as per IEC 62271-200
Upto 600 mm cubicle and upto 1250A tested for IP-5X
- **Lightning impulse voltage test** as per IEC 62271-100 , 62271-200
- **Internal arc test** in all the three high voltage compartments 40 kA 1 sec as per IEC 62271-200

INSPECTION & TEST

- 15 days advance notice in writing shall be given to the Consultant/ Client for **Inspection (with photo copy of ready job and internal test reports) and Tests.** All the Routine Tests as per IS:3427 shall be carried out on the Switchgear in presence of Client/ Consultant.

- **All the charges for inspection / testing shall be borne by the contractor including travel & hotel stay for Consultant & Client's engineers.**
- The switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

ROUTINE TEST

- The tests shall include but not necessarily limited to the following for switchgear :
- Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.
- All wiring and current carrying part shall be given appropriate High Voltage test.
- Primary current and voltage shall be applied to all instrument transformers.
- Routine test shall be carried out on all equipment such as circuit breaker, instrument transformers, meters etc.
- One minute power frequency withstand insulation test as per relevant –IS

TEST CERTIFICATE

- Certificate reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner. The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports. Copies of Type test certificate for test on similar switchgear shall be submitted.
- The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. & date of test.

GUARANTEE

- Vendor shall guarantee the design, materials, workmanship and performance of the equipment for a period of twelve months from the date of initial operation or eighteen months after delivery at job site, whichever is earlier.

SPARES

- The bidder shall submit a list of recommended spare parts for two (2) years satisfactory and trouble free operation, including the itemized price of each item of the spare in the appropriate annexure. Self life of consumable spares would be indicated specifically.

DRAWING & DATA SHEET

- The Enclosed Single Line Diagram for High Voltage Breaker panel and Technical Data Sheet forms the part of this specification.

TECHNICAL DATA SHEET FOR EACH COMPARTEMENT

**HIGH VOLTAGE METAL ENCLOSED SWITCHGEAR
(1 # Incoming cum outgoing Breaker)**

1	GENERAL	
A	Ambient temperature	45 deg. C
B	Atmosphere	Corrosive, Humid and Dusty
C	Location	Indoor
2	ELECTRICAL DATA:	
A	Type of breaker & Quantity	SF6 / VCB Circuit Breaker Panel :- 1 # Incoming cum outgoing Breaker
B	Duty	Continuous
C	Voltage	11KV+/- 10%
D	System earthing	Solid earthed
E	Frequency	50Hz. +/- 3%
F	No. of phase	3
G	System fault level	350MVA
H	Fault current	25KA
I	Max. system voltage	12KV
J	Size of Transformer	1 # 2000 KVA CSS
K	Auxiliary supply:	110V D.C. derived from power pack connected on incoming P.T. supply (to be made available by the vendor from P.T. secondary to converter (power pack) & two stored operation availability in case of supply failure).
L	Rated short time current	25KA (1 sec.)rms
M	Making capacity	Vendor to Furnish
N	Cable entry (I/C & O/G)	Bottom
O	Cable size	11Kv, HT, 1#3C x 300 sq.mm XLPE

		aluminium armoured cable (E)
P	Breaker particulars	
	Operating mechanism	Motor charged spring/manual trip & close
	Spring charging motor	230 V AC, 200 W
	Trip/Closing coil	110 V DC, 180 W
	Anti pumping feature	To be provided
	Latching requirement	Trip free
	Emergency trip push button	Required
	Space heater and cubicle lamp	Required
Q	Constructional requirements	
	Thickness of sheet steel for frame, enclosure, doors, covers and partitions	CRCA sheet- 2 /2.5 mm, hinge type door with neoprene rubber gasket
	Degree of protection	IP 54
	Color	Epoxy powder coating –Shade 631 as per IS-5
	Earth bus Size	50 x 6 mm GI
	Foundation frame	ISMC-75, Suitable for breaker with necessary bed plate and foundations bolt
R	Hooter with 8 stage Annunciation window:	To be Provided
S	Panel Accessories	
	Power Pack	For AC to DC
	Toggle switch for space heater and socket	230 V A.C, 10 A
	Socket	3 pin 10 A
	MCB for spring charging motor circuit	6 A, DP MCB
	MCB for ON/OFF	Double pole, 16 A, 110 V D.C. for D.C ckt.
	Local/ Remote selector switch	4 way, 2 position, lockable in any position, angular movement, stay put, lever type handle.

	Auto-Off-Manual switch	18 way, 3 position, lockable in all position, stay put, and wing type handle.
	Breaker control switch (Trip –Neutral-Close)	6 way, 3 position, spring return to neutral, angular movement, pistol grip type handle.
	LED indicating lamp (230V A.C.)	Breaker On - Red color Breaker Off -Green Color Auto trip -Amber color Trip ckt healthy -Amber Color DC Fail indication to be provided Spring charged – Blue color Low SF6 / VCB - Blue color Heater Indication
	Filament Bulb	2/3 W bulb for R, Y, B, Healthy indication
	Limit switch for test and service position	Required
	Ammeter & Voltmeter with Selector switch	To be provided
	Load Manager	To be provided
	Transformer Fault Relay	To be provided
	IDMT relay	To be provided
	Hooter & 8 stage annunciation window	To be provided
	Master Trip relay	To be provided
	Antipumping relay	To be provided
	Master trip Relay	To be provided
	Under voltage relay with by pass facility	To be provided
	Heater with Thermostat & Toggle switch	To be provided
	6 # NO & 6 # NC contact terminal for auxiliary use	To be provided
	Emergency Push button	To be provided

**HIGH VOLTAGE METAL ENCLOSED SWITCHGEAR
(1 # Incoming Breaker & 2 # outgoing Breaker)**

1	GENERAL	
A	Ambient temperature	45 deg. C
B	Atmosphere	Corrosive, Humid and Dusty
C	Location	Indoor
2	ELECTRICAL DATA:	
A	Type of breaker & Quantity	SF6 / VCB Circuit Breaker Panel :- 1 # Incoming Breaker & 2 # outgoing Breaker
B	Duty	Continuous
C	Voltage	11KV+/- 10%
D	System earthing	Solid earthed
E	Frequency	50Hz. +/- 3%
F	No. of phase	3
G	System fault level	350MVA
H	Fault current	25KA
I	Max. system voltage	12KV
J	Size of Transformer	1# 1000 KVA & 2 # 2000 KVA CSS
K	Auxiliary supply:	110V D.C. derived from power pack connected on incoming P.T. supply (to be made available by the vendor from P.T. secondary to converter (power pack) & two stored operation availability in case of supply failure).
L	Rated short time current	25KA (1 sec.)rms
M	Making capacity	Vendor to Furnish
N	Cable entry (I/C & O/G)	Bottom
O	Cable size	Incoming :- 11Kv, HT, 1#3C x 300 sq.mm XLPE aluminium armoured cable (E) Outgoing :- 11Kv, HT, 1#3C x 300 sq.mm XLPE

		aluminium armoured cable (E)
P	Breaker particulars	
	Operating mechanism	Motor charged spring/manual trip & close
	Spring charging motor	230 V AC, 200 W
	Trip/Closing coil	110 V DC, 180 W
	Anti pumping feature	To be provided
	Latching requirement	Trip free
	Emergency trip push button	Required
	Space heater and cubicle lamp	Required
Q	Constructional requirements	
	Thickness of sheet steel for frame, enclosure, doors, covers and partitions	CRCA sheet- 2 /2.5 mm, hinge type door with neoprene rubber gasket
	Degree of protection	IP 54
	Color	Epoxy powder coating –Shade 631 as per IS-5
	Earth bus Size	50 x 6 mm GI
	Foundation frame	ISM-75, Suitable for breaker with necessary bed plate and foundations bolt
R	Hooter with 8 stage Annunciation window:	To be Provided
S	Panel Accessories	
	Power Pack	For AC to DC
	Toggle switch for space heater and socket	230 V A.C, 10 A
	Socket	3 pin 10 A
	MCB for spring charging motor circuit	6 A, DP MCB
	MCB for ON/OFF	Double pole, 16 A, 110 V D.C. for D.C ckt.
	Local/ Remote selector switch	4 way, 2 position, lockable in any position, angular movement, stay put, lever type handle.
	Auto-Off-Manual switch	18 way, 3 position, lockable in all position, stay

		put, and wing type handle.
	Breaker control switch (Trip – Neutral-Close)	6 way, 3 position, spring return to neutral, angular movement, pistol grip type handle.
	LED indicating lamp (230V A.C.)	Breaker On - Red color Breaker Off -Green Color Auto trip -Amber color Trip ckt healthy -Amber Color DC Fail indication to be provided Spring charged – Blue color Low SF6 / VCB - Blue color Heater Indication
	Filament Bulb	2/3 W bulb for R, Y, B, Healthy indication
	Limit switch for test and service position	Required
	Ammeter & Voltmeter with Selector switch	To be provided
	Load Manager	To be provided
	Transformer Fault Relay	To be provided
	IDMT relay	To be provided
	Hooter & 8 stage annunciation window	To be provided
	Master Trip relay	To be provided
	Antipumping relay	To be provided
	Master trip Relay	To be provided
	Under voltage relay with by pass facility	To be provided
	Heater with Thermostat & Toggle switch	To be provided
	6 # NO & 6 # NC contact terminal for auxiliary use	To be provided
	Emergency Push button	To be provided

**HIGH VOLTAGE METAL ENCLOSED SWITCHGEAR
(1 # Incoming Breaker & 4 # outgoing Breaker)**

1	GENERAL	
A	Ambient temperature	45 deg. C
B	Atmosphere	Corrosive, Humid and Dusty
C	Location	Indoor
2	ELECTRICAL DATA:	
A	Type of breaker & Quantity	SF6 / VCB Circuit Breaker Panel :- 1 # Incoming Breaker & 4 # outgoing Breaker
B	Duty	Continuous
C	Voltage	11KV+/- 10%
D	System earthing	Solid earthed
E	Frequency	50Hz. +/- 3%
F	No. of phase	3
G	System fault level	350MVA
H	Fault current	25KA
I	Max. system voltage	12KV
J	Size of Transformer	2# 1000 KVA & 2 # 2000 KVA css
K	Auxiliary supply:	110V D.C. derived from power pack connected on incoming P.T. supply (to be made available by the vendor from P.T. secondary to converter (power pack) & two stored operation availability in case of supply failure).
L	Rated short time current	25KA (1 sec.)rms
M	Making capacity	Vendor to Furnish
N	Cable entry (I/C & O/G)	Bottom
O	Cable size	Incoming :- 11Kv, HT, 1#3C x 300 sq.mm XLPE aluminium armoured cable (E) Outgoing :- 11Kv, HT, 1#3C x 300 sq.mm XLPE

		aluminium armoured cable (E)
P	Breaker particulars	
	Operating mechanism	Motor charged spring/manual trip & close
	Spring charging motor	230 V AC, 200 W
	Trip/Closing coil	110 V DC, 180 W
	Anti pumping feature	To be provided
	Latching requirement	Trip free
	Emergency trip push button	Required
	Space heater and cubicle lamp	Required
Q	Constructional requirements	
	Thickness of sheet steel for frame, enclosure, doors, covers and partitions	CRCA sheet- 2 /2.5 mm, hinge type door with neoprene rubber gasket
	Degree of protection	IP 54
	Color	Epoxy powder coating –Shade 631 as per IS-5
	Earth bus Size	50 x 6 mm GI
	Foundation frame	ISM-75, Suitable for breaker with necessary bed plate and foundations bolt
R	Hooter with 8 stage Annunciation window:	To be Provided
S	Panel Accessories	
	Power Pack	For AC to DC
	Toggle switch for space heater and socket	230 V A.C, 10 A
	Socket	3 pin 10 A
	MCB for spring charging motor circuit	6 A, DP MCB
	MCB for ON/OFF	Double pole, 16 A, 110 V D.C. for D.C ckt.
	Local/ Remote selector switch	4 way, 2 position, lockable in any position, angular movement, stay put, lever type handle.
	Auto-Off-Manual switch	18 way, 3 position, lockable in all position, stay

		put, and wing type handle.
	Breaker control switch (Trip – Neutral-Close)	6 way, 3 position, spring return to neutral, angular movement, pistol grip type handle.
	LED indicating lamp (230V A.C.)	Breaker On - Red color Breaker Off -Green Color Auto trip -Amber color Trip ckt healthy -Amber Color DC Fail indication to be provided Spring charged – Blue color Low SF6 / VCB - Blue color Heater Indication
	Filament Bulb	2/3 W bulb for R, Y, B, Healthy indication
	Limit switch for test and service position	Required
	Ammeter & Voltmeter with Selector switch	To be provided
	Load Manager	To be provided
	Transformer Fault Relay	To be provided
	IDMT relay	To be provided
	Hooter & 8 stage annunciation window	To be provided
	Master Trip relay	To be provided
	Antipumping relay	To be provided
	Master trip Relay	To be provided
	Under voltage relay with by pass facility	To be provided
	Heater with Thermostat & Toggle switch	To be provided
	6 # NO & 6 # NC contact terminal for auxiliary use	To be provided
	Emergency Push button	To be provided

IMPORTANT

- The vendor will depute their engineer at site at the time of installation, testing & commissioning for at least three times.
- Minimum 750mm clear space to provided from bottom of gland plate to spreader contact/outgoing/incoming Busbar for Cable termination.

DIESEL GENERATOR SET

SCOPE

- This specification covers the Design, Manufacture and Supply of **500 KVA D.G. Set** with Acoustic Enclosure suitable for Outdoor application.
- This specification also covers the Design, Manufacture and Supply of AMF cum synchronizing panel suitable for **500 KVA DG set** provision for indoor application.
- D.G. Set shall comprise of Engine, alternator, fuel tank, radiator, exhaust piping etc.. as shown in technical data sheet enclosed herewith.
- AMF and synchronizing panel shall comprise of draw out type ACB, Metering (A, V, F, PF, and KW) & protection etc... As shown in technical data sheet enclosed herewith.

CODES & STANDARDS

- All equipments and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian & International Standards
- The equipment shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of practice, Fire Insurance Association and all statutory regulations and safety codes In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

COMPLETENES OF SUPPLY

- It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of Engineering, design and workmanship.
- Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished without any extra charge.

CONSTRUCTION REQUIREMENTS

- Acoustic enclosure shall be powder coated and fabricated out of 16 SWG CRCA MS sheet. The silent canopy shall be of nut bolt type construction. Critical processes of punching is done on CNC machines to maintain dimensional accuracy of holes within 0.1 mm. Powder coating is done after seven-tank surface preparation process of sheet metal. Canopy panel and doors shall have inside lining of FIRE-RETARDANT Glass Wool / Mineral Wool as acoustic material. Four hinged doors shall be provided to canopy, one door shall have glass window for control panel.
- Design approved by ARAI, the nodal agency nominated by CPCB

- Canopy fabricated on machines with dimensional accuracy of 0.1mm.
- Canopy is powder coated after passing through seven tank processes.
- Canopy is lined with acoustic Glass Wool / Mineral Wool, which is non-igniting /Fire Retardant.
- No grouting required on the ground, only a level surface capable of withstanding the DG weight.
- Designed for installation in open-air conditions.
- Lockable doors provided.
- Residential Silencer is provided.
- Externally accessible emergency stop button.
- The exhaust gases shall be taken out through a suitable flexible pipe to prevent any back pressure on the engine.
- The maximum permissible temperature rise above the ambient shall be 10 deg C.

INDICATION

Engine Panel shall have Digital display to indicate following parameter.

- Battery voltage
- Coolant water temperature
- Lube oil pressure
- Engine speed
- Engine running hrs,
- Auxiliary temperature

VENTILATION AND AIR CIRCULATION

- The system is designed to provide air inlet / exhaust acoustic louvers for efficient air circulation and shall have following special features:
- Adequate ventilation is provided to meet air requirement for combustion and heat removal
- The temperature inside the enclosure shall not exceed 5-7 ° c than the ambient temperature near air suction point

THERMAL INSULATION

- The exhaust system and noise suppressor shall be provided with thermal insulation by using fire retardant/non igniting Glass Wool / Mineral Wool to prevent excess heat radiation on the engine and safe for operator.

NOISE SUPPRESSOR: (SILENCER)

- Absorption type Non resistance Residential Silencer insulated with glass wool shall be provided to suppress exhaust noise from the engine.
- The average sound level, when measured in green field condition (ISO 3744 OR 8528 PT 10) at 1-meter distance from all four sides shall be less than 75-dBA averages or as per CPCB norms.

SURFACE TREATMENT-PAINTING

The enclosure surface shall be suitably treated for degreasing, derusting and phosphating. High quality powder coat treatment/paint shall be used.

FUEL TANK

Fuel tank shall be fabricated out of 14SWG sheet. It is duly painted and fitted with inlet and outlet connections. Fuel tank should be part of D.G. set and all piping and connection should be done as integral part inside the enclosure.

BASE FRAME

Skid mounting type base – frame fabricated from suitable MS Channel suitable machined to ensure perfect alignment of the engine and alternator with rigid construction and necessary rain-force to ensure minimum vibration. The base frame would be provided with lifting facilities and pre-drilled foundation holes suitable for permanent installation on concrete foundation or Anti-Vibration pads.

BATTERIES

Of Exide / prestolite make 4 * 12 Volts, 180 AH Dry and uncharged suitable for the electrical starting of the Engine along with the battery leads.

ARRANGEMENTS

The engine and alternator would be coupled by means of a specially designed flexible coupling and both the units including the Radiator would be mounted on a rigid fabricated base frame to form a compact arrangement.

DRAWINGS & MANUALS

Following Drawings, Data & Manuals shall be submitted in triplicate for approval of Consultant / Client prior to manufacturing.

- Plan, Elevation and Sections with dimensions, Outline dimensional drawings of the D.G. set showing general arrangement, space requirements and cable entry points, location of engine, alternator, grounding arrangement, weight, recommended clearances, details of operating mechanism and Technical Literature of Breaker and all other associated equipments.
- Foundation plan with proposed fixing arrangement.
- Control wiring diagrams.
- List of equipments with Quantity, Make, Type and brief technical particulars.
- D.G. set layout plan with floor fixing arrangement and elevation.
- Three sets of operation, installation and maintenance manuals shall also be furnished, prior to dispatch of the switchgear.

- Typical reports on engine and alternator.
- Test reports on & complete specifications & OEM address for bought out items.
- Instruction manuals of D.G. set & individual equipment. The manual shall clearly indicate that the installation method, check-up and tests to be carried out before commissioning of the equipment as well as monitoring tests, their interval & maintenance/overhauling procedure & schedule.
- One set of the drawings will be returned to vendor with client/consultant's comments/remarks and required clarifications. The vendor shall incorporate the same and send three sets of revised drawings.

INSPECTION & TEST

- 15 days advance notice in writing shall be given to the Consultant/ Client for Inspection and Tests. Assembled D.G. Set testing at works for 30 minutes at full load at free of cost. And 6 hours at site after successful commissioning. (All consumable at site by client).
- **All the charges for inspection / testing shall be borne by the contractor including travel & hotel stay for Consultant & Client's engineers.**
- The D.G. Set shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

ROUTINE TEST

TEST CERTIFICATE

- Certificate reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner. The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports. Copies of Type test certificate for test on similar switchgear shall be submitted.
- The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. & date of test.

GUARANTEE / WARRANTY

- The DG set comprising of Engine & Alternator carries a warranty against Defective material / Faulty workmanship for a period of 18 months from the time of supply, 12 months from the time of installation or 3000 operating hours, whichever occurs first. However, this is extendable to 24 months from the date of installation or 5000 operating hours whichever is earlier.

SPARES

- The bidder shall submit a list of recommended spare parts for two (2) years satisfactory and trouble free operation, including the itemized price of each item of the spare in the appropriate annexure. Self life of consumable spares would be indicated specifically.

IMPORTANT

- Provide C.T. and KWH meter as per the requirement of Electricity board & electrical inspector separately.
- Provide termination box with required space & provide the proper length of Copper Busbars with tinning at the end to connect aluminum Cables.
- The vendor will depute their engineer at site at the time of installation, testing & commissioning for at least three times.
- Minimum 750mm clear space to provided from bottom of gland plate to spreader contact of MCCB/CABLE TERMINATION BOX for Cable termination.

DATA SHEET

- The Enclosed Technical Data Sheet forms the part of this specification.

TECHNICAL DATA SHEET

DIESEL GENERATOR SET

1	GENERAL:	
A	Ambient temperature	50 deg. C
B	Atmosphere	Corrosive, Humid and Dusty
C	Installation	Outdoor
2	ELECTRICAL DATA:	
A	Engine	* *
B	Model	* *
C	Rating In KVA	500 KVA (Prime Rating)
D	Rating In KW	400 KW
E	Voltage	415V+/- 10%
F	Frequency	50 Hz
G	BHP	* *
H	RPM	* *
I	Aspiration	* *
J	No. of Cylinders	* *
K	Governor	* *
L	Starting System	* *
M	Lub Oil Specification	* *
N	Lub Oil Sump Capacity	* *
O	Coolant Capacity (Radiator)	* *

P	Engine Protection	* *
Q	International Standards	ISO 3046 / BS5514 / IS 4722
R	Fuel Tank Capacity	* *
S	Over Load Capacity (%)	* *
T	Fuel Consumption (Ltr. / Hr.) At 100 % Load At 75 % Load At 50 % Load	* * * * * *
U	D.G. Set Efficiency At 100 % Load At 75 % Load At 50 % Load	* * * * * *
V	Exhaust Silencer Type	Residential / Hospital Grade
W	Exhaust Noise Level @ 1mtr.	<75 db
X	Maximum time for ready to take Load	5 Sec.
Y	Dimensions (mm) Length Width Height	* * * * * *
Z	Wight (Kg)	* *

3	ALTERNATOR	
A	Alternator Make	* *
B	Model	* *
C	International Standards	BS 2613 / IS 4722
D	Voltage	415 V
E	Frequency	50 Hz
F	Power Factor	0.8
G	Protection	IP 23
H	Insulation Class	H
I	Type of AVR	* *
J	Alternator Efficiency	
	At 100 %	* *
	At 75 %	* *
K	Dimensions (mm)	
	Length	* *
	Width	* *
	Height	* *
L	Wight (Kg)	* *

AMF CUM SYNCHRONIZING PANEL BOARD

SCOPE

This specification covers the Design, Manufacture and Supply of AMF & auto synchronizing, auto load sharing & auto load management features Panel Boards suitable for 2 nos. 400 KVA D.G. Set. In case of grid power failure, first set will start on auto mode & the second set will start depending on load requirement. If the load on the first set increases beyond the set value of say 80%, the second set will start, synchronize & share the load automatically.

The panel shall be suitable for floor mounting, indoor type, cubicle design, dust & vermin proof.

CODES & STANDARDS:

All equipments and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.

The equipment shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of practice, Fire Insurance Association and all statutory regulations and safety codes In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

CONTROL MONITORING PROTECTION & SYNCHRONIZING:

The panel shall be fitted with Microprocessor Based duly programmed for digital controls comprising of control, monitoring & protection of engine & A.C. Generator, manual & auto start / stop, auto synchronizing. The unit shall have AMF facility.

CONTROL, MONITORING & PROTECTION FOR EACH ENGINE:

CONTROL:

Each engine shall have pre-heating, fuel solenoid control, engine starter control, KVA control & engine auto start / stop (AMF) control facilities in panel.

MONITORING (DIGITAL):

The panel shall have battery voltage monitoring, speed monitoring & counting of engine running hours facilities.

PROTECTION (DIGITAL):

The panel shall have protection against low lub oil pressure, high water temperature, over / under battery voltage, over / under speed.

CONTROL, MONITORING & PROTECTION FOR EACH GENERATOR (ALTERNATOR):

CONTROL:

Each Generator shall have ACB monitoring, dead bus monitoring, ACB closing & tripping facilities in panel.

MONITORING (DIGITAL):

The panel shall have monitoring facilities like voltage (R,Y,B,RY,YB,BR), Ampere (R,Y,B), frequency, KWh, KW on R,Y,B & total KW, KVA on R,Y,B & total KVA, PF & KVA.

PROTECTION (DIGITAL):

The panel shall have adjustable protection facilities like under voltage trip (27), over voltage trip (59), under frequency trip (81U), over frequency trip (81O), Reverse power trip (32) with IDMT characteristic, 3 pole over current trip (51) with IDMT characteristic, loss of excitation (40) & synchronizing check relay to trip the generator.

SYNCHRONIZING:**AUTO SYNCHRONIZING (DIGITAL):**

The panel shall have auto sequencing, phase, frequency & voltage match, adjustable frequency matching window, adjustable phase angle window, adjustable voltage matching window, adjustable stability & phase gain, voltage match, internal dead bus & rely sensing control, manual voltage & speed adjustment & display of synchronizing while parameters i.e. phase angle, voltage difference & frequency difference.

MANUAL SYNCHRONIZING:

The microprocessor unit shall have in built manual digital synchronoscope.

LOAD SHARING & LOAD CONTROL (DIGITAL):

The panel shall have adjustable governor speed set, built in paralleling relay, KW load control, load sharing, KVA load control, adjustable droop for manual synchronizing, adjustable load pulse sensitive, adjustable low & high power limit & load depended start/stop with auto synchronizing.

MAINS CONTROL:

The unit shall also have facility to monitor the mains (grid) power for auto start/stop facility (AMF) to start the D.G. set on failure of mains power.

ELECTRICAL (MAINS):

The unit shall have adjustable protection facilities like under voltage trip (27), over voltage trip (59), under frequency trip (81U), over frequency trip (81C) to monitor mains supply & trip mains breaker.

ANNUNCIATIONS / INDICATIONS:

The fault annunciation for each engine & electrical fault shall be displayed in the LCD window of microprocessor unit.

AIR CIRCUIT BREAKER:

The panel shall have 2 # 630 Amp, 3P, electrically operated draw out type, Microprocessor base ACB, Inbuilt Adjustable over load, Short circuit, Earth fault with Closing coil, u/v release, shunt trip release, suitable rating neutral contactor, set of PVC sleeved aluminum bus-bar with resin supports & set of CTs (5P10) for metering & protection.

24 V DC BATTERY CHARGER:

The Battery charger unit shall have DC Ammeter, DC voltmeter, selector switch, transformer / rectifier & trickle / boost / off selector switch.

Battery charger shall charge the battery continuously when normal power is on , so that whenever power fails battery are always charged condition.

PUSH BUTTON AND SELECTOR SWITCH FOR EACH D.G. SET:

The panel shall have set of push buttons for emergency trip, D.G. ACB close, D.G. ACB trip, Engine start / stop.

The panel shall have set of selector switches for auto / test / manual / off, D.G. selector switch, speed raise, speed lower, voltage raise & voltage lower.

INCOMING & OUTGOING:

Terminal for incoming & Outgoing cable connections shall be suitable for cable size & quantity mentioned in drawings / single line diagram.

MISCELLANEOUS:

The panel shall have set of control fuses, control rely & auxiliary connectors, indicating & rating name plates, mounting base channel, set of control cable connectors & one no audio alarm hooter.

MAKE OF MATERIALS: AS PER DRAWINGS / SLD

GENERAL SPECIFICATIONS:

All the Panels shall be metal clad, totally enclosed, rigid, floor/wall mounting, air insulated, cubicle type suitable for operation on three phase/single phase, 415 V/230 V/240 V, 50 Hz., neutral effectively grounded at transformer and short circuit level as mentioned in the drawings. The painting of all the metal part shall be with seven-tank process followed by powder coating as per the standard.

CONSTRUCTION STRUCTURE:

The Panel shall be of compartmentalized design so that circuit arc/flash products do not create secondary faults and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor/wall mounting type. All CRCA sheet steel used in the construction of Panels shall be 14/16 SWG Thick and shall be folded and braced as necessary to provide a rigid support for all components. Joint of any kind in sheet steel

shall be seam welded, all welding slag ground off and welding pits wiped smooth with plumber metal. The Panels shall be totally enclosed, completely dust and vermin proof. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasket with foam rubber and /or rubber strips and shall be lockable. All Panels and covers shall be properly fitted and screwed with the frame and holds in the panel correctly positioned. Fixing screws shall enter into holes, taped into an adequate thickness of metal or provided with bolts and nuts. Self threading screws shall not be used in the construction of Panels. A base channel of 75 mm.x 40 mm. X 6 mm. Thick shall be provided at the bottom. A clearance of 300mm. between the floor of the Panels and the bottom of the units shall be provided.

Panels shall be preferably arranged in multi-tier formation. The Panels shall be adequate size with a provision of 20% spare space to accommodate possible future additional switchgear. The size of the Panels shall be designed in such a way that the internal space is sufficient for hot air movement and the electrical components do not attain temperature more than 50 Deg C. If necessary, openings shall be provided for neutral ventilation, but the said openings shall be screened with fine weld mesh. The entire electrical component shall be derated for 50 Deg. C. Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the number, and the size of incoming and outgoing conduits/cables. Alternately, the Panels shall be provided with removable sheet steel plates at top and bottom to drill holes for cable/conduit entry at site. The panels shall be designed to facilitate easy inspection, maintenance and repair. The Panels shall be sufficient rigid to support the equipment without distortion under normal and under short circuit condition. They shall be suitable braced for short circuit duty.

PROTECTION CLASS:

All the indoor Panels shall protection class of IP: 42

All the outdoor Panels shall protection class of IP: 54

PAINTING:

The painting shall be seven tank process followed by powder coating.

CIRCUIT COMPARTMENTS:

Each circuit breaker and switch fuse unit shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker in 'ON' and 'OFF' position. The door shall not form an integral part of draw out position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.

INSTRUMENT COMPARTMENTS:

Separate adequate compartment shall be provided for accommodating instruments, indicating lamps, control contractors/relays and control fuses etc. These components shall be accessible for testing and maintenance

BUSBAR:

The busbar shall be air insulated and made of high quality, high conductivity, high strength (Copper / Aluminum) as per drawing. The busbar shall be of 3 phase and neutral system with separate neutral and earth bar. The size of neutral busbar in all main panels or lighting panels and feeders for LDB shall be equal / half to phase busbar as required. The busbar and interconnection between busbar and various components shall be of high conductivity Copper

/ Aluminum. The busbar shall be of rectangular cross-section designed to with stand full load current for phase busbar and half rated current for neutral busbar in case of MCC panels only and shall be extensible on either side. The busbar size shall be provided by vendor. The busbar shall have uniform cross-section throughout the length. The busbars and interconnections shall be insulated with epoxy coated bur sleeves. The busbar shall be supported on bus insulators of SMD/DMC type at sufficiently close intervals to prevent busbars sag and shall effectively withstand electronic stresses in the event of short circuit. The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm. Thick bakelite sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearance between the busbars is maintained as below:

Between phases	:	25 mm. minimum
Between phase and neutral	:	25 mm.
Between phase and earth	:	25mm.
Between neutral and earth	:	20mm. Minimum

All busbar connections shall be done by drilling holes in busbars and connecting by chromium plated or tinned plated brass bolts and nuts. Additional core-section of busbar shall be provided in all Panels to cover up the holes drilled in the busbar. Spring and flat washers shall be used for tightening the bolts. All connections between busbars and circuit breakers/switches and cables terminals shall be through Copper strips of proper size to carry full rated current. These strips shall be insulated with insulating tapes. Busbar shall be calculated on 50 deg C. ambient temp. And 85 deg.C. for continuous and short time rating. Busbar surrounding air temp. Shall be considered 70 deg. C. for busbar calculation. All joints shall have non-flammable insulation shrouds for secondary insulation purpose.

For Aluminium busbar 0.8 Current density to be considered.

For Copper Busbar 1.2 current density to be considered.

ELECTRICAL POWER AND CONTROL WIRING CONNECTION:

Terminal for both incoming and outgoing cable connections shall be suitable for 1100 V grade aluminum /copper conductor PVC insulated and PVC sheathed, armoured cable and shall be suitable for connections of solder less sockets for the cable size as indicated on the appended drawings for the Panels. Power connections for incoming feeders of the main Panels shall be suitable fro 1100 V grade aluminum conductor (PVC) cables. Both control and power terminals shall be properly shrouded. Clip on type terminals shall be provided up to 10 sq.mm conductor and above 10 sq.mm bolt type terminals shall be used. 10 % spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block, so that not more than one outgoing wire is connected per terminal. Terminal strips for power and control shall preferably by separate from each other by suitable barriers. Wiring inside the modules for power, control, protection and instruments etc. shall be done with use of 660/100 V grade,PVC insulated copper conductor wires conforming to IS : 694 & 8130 Power wiring inside the starter module shall be rated for full current rating of respective contactor, but not less than 4.0 sq.mm cross-section area. For current transformer circuits, 2.5 sq.mm. Copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq.mm copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals. Control power supply to modules through the control transformer only. Control power wiring shall have MCB for circuit protection. All indicating lamps shall be protected by MCB. Particular care shall be taken to ensure that the layout of wiring is neat

and orderly. Identification ferrules shall be fitted to all the wire termination for ease of identification and to facilitate checking and testing. Spring type washers shall be used for all copper and aluminum connections. Final wiring diagram of the Panels power and control circuit with ferrules numbers shall be submitted along with the Panels as one of the documents against the contract.

TERMINALS:

The outgoing terminals and neutral link shall be brought out to a cable alley suitable located and accessible from the panel front. The current transformers for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted and only one conductor may be connected in one terminal.

WIRESWAYS:

A horizontal/vertical/AI. Wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.

CABLE COMPARTMENTS:

Cable compartment of minimum 300 to 400 mm size shall be provided in the panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in the cable compartments to support cables. All outgoing and incoming feeder terminals shall be brought out to terminal blocks in the cable compartment.

EARTHING:

GI earth bars of 50 mm x 6 mm shall be provided in the Panels for the entire length of the panel. The framework of the Panels shall be connected to this earth bar. Provisions shall be made for connection from this earth bar to the main earthing bar coming from the earth pit on both sides of the Panels. The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The Armor shall be properly connected with earthing clamp, and the clamp shall be ultimately bonded with the earth bar.

LABELS:

Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

NAME PLATE:

A name plate with the Panel's designation in bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door. Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc, shall suitably be identified by providing stickers.

DANGER NOTICE PLATES:

The danger notice plate shall be affixed in a permanent manner on opening side of all the Panels.

INTERNAL COMPONENTS:

The Panels shall be equipped complete with all types of required number of ACBs, MCCBs, MCBs, contactors, relays, fuses, meters, instruments, indicating lamps, push buttons, fittings, busbars, cable connectors etc. and all the necessary internal connections/wiring as required

and as indicated on relevant drawings. Components necessary for the proper and complete functioning of the Panels but not indicated on the drawings shall be supplied and installed on the Panels. All parts of the Panels carrying current including the components, connections, joints and instruments shall be capable of carrying their specifies rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at the part of the Panels.

COMPONENTS

GENERAL:

The type, size and rating of the components shall be as indicated on the relevant drawings. While selection of the capacity of the components resulting from the prevailing conditions like ambient temperature shall be allowed for the thermal and magnetic trip rating shall be compensated for the ambient temperature. The rating indicated on the drawing is ratings anticipated at prevailing site conditions.

AIR CIRCUIT BREAKERS

- The ACB shall conform to IEC 60947-1&2 / IS 13947-2 standard.
- ACB shall have a rated operational voltage of 415V AC, rated insulation voltage of 1000 volts AC, rated impulse voltage of 12kV.
- ACB shall be of 3pole or 4pole (as per BOQ), air break, molded case design for longer life along with less maintenance requirement
- All ACBs shall preferably be of single frame size up to 3200A to optimize requirement for spares management.

- The ACB shall not require any derating at 50 deg.C.
- The ACB should be with microprocessor based release having Adujstable O/L, Adujstable short circuit, Adjutable Inst.short circuit and Adjustable E/F protection with individual fault LED indication.
- ACB shall have $I_{cs} = I_{cu} = I_{cw} = 50kA$ for 1 sec or as per mentioned in drawing ratings up to 3200 A
- Minimum mechanical life shall be 20000 operations.
- The operating mechanism of ACB shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 70ms, and of fast opening type with break time of breaker should be <30ms to ensure higher life of distribution cables.
- All air circuit breakers shall be fully tropicalized as standard & suitable for terminating copper or aluminium bus bars. Both fixed & draw-out circuit breakers shall have single pole-pitch. ACBs upto 3200A shall be provided with top vertical and bottom vertical terminal adapters on both sides for proper cable connections/basbar connection/bus duct connections for better heat dissipation. Terminal orientation for top and bottom side shall preferably be possible to be changed from vertical to horizontal or vice versa on site as per cable/busbar/bus duct entry.
- Circuit breaker trip unit shall have a display for measurement of current and voltage. It shall be possible to view last 5 trip cause on trip unit.


- Separately powered, individual fault trip indication LEDs (For overload, short circuit, earth fault and trip unit failure) shall be available on the trip unit which shall function even if the display fails.
- The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.
- It shall be possible to view the percentage loading of three phases at once on trip unit via LEDs or LCD display to help the user in identifying the current load balancing of the network. This will help in preventing the deterioration of loads affected by load balancing by identification of the balancing related issue.
- All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over-load faults with provisions for settings neutral unprotected, neutral protection at $0.5I_n$ and neutral protection at $1.0 I_n$ to ensure precise neutral protection.

The ACBs shall have following features:

230 V A.C. closing and shunt trip coil. Draw out type with “service”, “test”, “isolated” and “maintenance” position. Safety shutter of Fiber glass/polycarbonate sheet of 2mm thickness shall be provided. Mechanically trip free plus anti pumping feature is to be provided. Electrical trip free plus anti pumping shall be provided with relay ONLY and not by contractors. Electrical/Mechanical operation counter shall be provided. Door interlock with defeat features to be provided. ACB shall be lockable in isolation position. The circuit Breaker shall be air break, horizontal draw – out feature shall show 3 positions viz., SERVICE, TEST & ISOLATED. These positions along with ‘OPEN’ & ‘CLOSE’ positions shall be visibly marked. The operating mechanism shall be independent, manual / electric motor operated spring charged stored energy type. The mechanism shall ensure quick break, quick make action & the ACB shall be TRIP – FREE in operation. Electrically operated ACB shall be provided with AC closing coil. The ACB shall have 6 NO + 6 NC auxiliary contacts rated at 10A, 240V, AC ‘RED’ & ‘GREEN’ indicating lamps shall be provided on the cubicle. The ACB door shall not have any lamps or instruments. All such accessories shall be mounted on a separate compartment. The ACB shall have proper interlocks such that it cannot be ‘plugged in or out’ from the SERVICE position if the breaker is in ON condition. It shall not be possible to operate as a circuit breaker unless it is properly engaged in any of the three positions. The ACB shall have series CT operated over – current & short circuit releases with facilities to mount the under voltage & shunt trip releases or will have IDMT relays as specified.

MOULDED CASE CIRCUIT BREAKER:

- MCCB shall conform to the latest standard to IEC 60947-1 & 2.
- The breaking capacity performance certificates shall be available for category A to the above mentioned standards for outgoing side MCCB.
- MCCB shall have a rated operational voltage (U_e) of 415V, insulation voltage (U_i) of 690 V (AC 50/60 Hz) & impulse voltage (U_{imp}) of not less than 8kV
- **The MCCBs shall have a rated service breaking capacity (I_{cs}) equal to the ultimate breaking capacity (I_{cu}) at 415V and as per system fault levels (refer SLD).**

- Incoming side MCCB or 800A and above rating MCCBs - shall be microprocessor based, category B type (drawout design in main panel and fixed type in sub panels) having I_{cw} (1sec) not less than 15kA. Microprocessor trip unit shall measure current and voltage data with last 5 trip records.
- Mechanical life shall be 10000 operations
- The limiting capacity of a circuit breaker is expressed by two curves which are a function of the prospective short-circuit current (the current which would flow if no protection devices were installed): The thermal stress (A^2s), i.e. the energy dissipated by MCCB during fault should be as low as possible.
- For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries (ON/OFF/Trip Contact, Shunt, Under Voltage etc.). All poles shall operate simultaneously for circuit breaker opening, closing and tripping. MCCBs shall be actuated by a toggle or rotary-handle that clearly indicates the three distinctive positions: ON, OFF and TRIPPED. MCCB shall clearly indicate the suitability for isolation in the name plate identified by the symbol . MCCBs shall be equipped with a “push to trip” button in front to test operation and simultaneous opening of all poles together.
- MCCBs shall be designed to prevent access to live parts when the cover is removed , means main current path of the circuit breaker should be isolated from auxiliary section i.e. MCCB shall offer class –II front face as per IEC standards 61140 and 60664-1
- The electrical life of MCCBs shall be 8,000 operations up to 250A & 4000 operations up to 630A
- All MCCBs provided shall be of single frame size upto 250A to reduce the requirement of spares management.
- All MCCBs shall have cross bolted type termination where bus bars or cable lugs can be terminated by crossing the bolt between the lugs/bus bars and MCCB connections, to enhance safety and reliability of the terminations. In case spreaders/rear connectors are used in between MCCB and bus bar/lugs then the spreaders shall be cross bolted with the MCCB connectors.
- Rotary handle shall ensure IP40 for direct type and IP 55 for extended Rotary handle or as per single line diagram.
- Thermal magnetic trip units shall have variable overload settings from 0.7 to 1 Ir and fixed short circuit settings
- Microprocessor trip units shall have variable overload settings from 0.5 to 1 Ir and variable short circuit settings from 2 to 10Ir
- In case of 4 pole microprocessor based MCCBs neutral shall be protected & adjustable as a Neutral unprotected / Neutral protected at 0.5 In/ Neutral protected at In.

- MCCB's should be provided with auxiliary contacts for signaling different functions, as: open/ closed position, fault signal and shunt trip coil for remote/emergency tripping of MCCB.
- Where ever it is required based on electrical distribution network need, MCCB shall have Earth Fault Protection as a provision. MCCB Earth Fault Protection should have following settings and features:
 - Selection of Ir MCCB rating
 - Earth fault sensitivity selection from 20% – 60% In.
 - The time delay selection in case of Earth Fault from 0.5 to 3 Sec/ instantaneous.
 - There shall be a separate fault differentiation indication (LED) for Over current and Earth fault. Indication for over current and earth fault tripping shall be extended to the panel door via indication lamps
 - Separate LED shall be there to show healthiness of earth fault protection system
 - EF protection module shall be suitable for 3P 4W system. It shall take the input from neutral for correct earth fault protection.
 - Earth fault module shall have auxiliary contacts for earth fault signaling.
- Type of releases for MCCBs shall be with as per drawings with O/L, Short time delay S/C, Inst.S/C and E/F protection.
- Outgoing MCCBs shall be 3Pole type with adjustable O/L & fixed S/C.
- MCCBs supplied shall be of Current Limiting type only.
- MCCB should be with extended rotary handle, spreader contact, terminal extension links and phase barriers.

The moulded case circuit breaker (MCCB) shall be air break type and having quick make-quick break with trip free operating mechanism. Housing of the MCCB shall be of heat resistance and flame retardant insulating material. Operating handle of the MCCB shall be in front and clearly indicate ON/OFF/TRIP positions. The electrical contacts of the circuit breaker shall be of high conducting non deteriorating silver alloy contacts. The MCCB shall be provided with thermal/magnetic type bi-metal overload release and electro magnetic short circuit protection device. All the releases shall operate on common trip busbar so that in case of operation of any one of the releases in any of the three phases, it will cut off all the three phases and thereby single phasing of the system is avoided. The MCCB wherever called for in the appended drawings shall provide an earth fault relay. The MCCB shall provide two sets of extra auxiliary contacts with connections for additional controls at future date. The electrical parameters of the MCCB shall be as per the description given in the appended drawings. Draw out type MCCB shall be provided for the feeder indicated in the single line diagram. The MCCB shall be provided with 230 V A.C. motor for closing and tripping/switching off for the feeders if indicated in single line diagram.

FUSE:

Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with latest IS and having high rupturing capacity of not less than 15KA at 415 V. The back-up fuse rating for each motor/equipment.

HRC fuses shall be of the make as specified in Make of Material.

MINIATURE CIRCUIT BREAKER:

Miniature Circuit breakers shall be current limiting type conformed with latest standards. The housing of MCBs shall be heat resistant and having high impact strength. The fault current of MCBs shall be provided with trip free manual operating mechanism with mechanical 'ON' and 'OFF' indications. The circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit. The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCBs shall be provided with magnetic fluid plunger release for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCBs shall be tested and certified as per Indian Standards, prior to installation.

CONTACTORS:

The contactors shall meet with the requirements of latest IS. The contactors shall have minimum making and breaking capacity in accordance with utilization category AC3 and shall be suitable for minimum Class II intermittent duty. If the contractor forms part of a distribution board then a separate enclosure is not required, but the installation of the contactor shall be such that it is not possible to make an accidental contact with live parts.

VOLTMETER:

Voltmeter shall be digital. The dial of the meter shall be square in shape of 96 x 96 mm. The voltmeter selector switch shall be arranged to provide line to line voltage reading and line neutral voltage.

AMMETER:

Ammeter shall be digital. The dial of the ammeter shall be square in 96 x 96 mm. Separate current transformer shall be provided for all ammeters.

CURRENT TRANSFORMER:

Where ammeters are called for C.T.s shall be provided for current measuring. Each phase shall be provided with separate current transformer of accuracy Class I and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with latest IS.

PUSH BUTTONS:

The push button unit shall comprise of the contact element, a fixing holder, and a push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. continuous current rating. The actuator shall of standard type and color as per its usage for ON, OFF and TRIP. Wiring for Remote ON, OFF push button is to be required.

INDICATING LAMPS:

Indicating lamps assembly shall be screw type with built in resistor having non fading color lens. LED type lamps are required. Wiring for Remote ON, OFF, TRIP indicating lamp is required.

Color shade for the indicating lamps shall be as below:

- ON indicating lamp : Red
- OFF indicating lamp : Green
- TRIP indicating lamp : Amber
- PHASE indicating lamp : Red, Yellow and Blue

TRIP circuit healthy lamp : Milky

DRAWINGS

Prior to fabrication of the Panels, the supplier/contractor shall submit for consultant's approval the shop/vendor drawings consisting of G.A. drawings, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuit rating of all the electrical components used, busbar size, internal wiring size, Panels dimension, color, mounting details etc. in 6 sets.. The contractor shall also submit manufacturer's catalogues of the electrical components installed in the Panel dimension, color, mounting details etc. in 6 sets. One set of the drawings will be returned to vendor with client/consultant's comments/remarks and required clarifications. The vendor shall incorporate the same and send three sets of revised drawings.

INSPECTION & TEST

15 days advance notice in writing shall be given to the Consultant/ Client for Inspection (**with photo copy of ready job and internal test reports**) and Tests. All the Routine Tests as per IS shall be carried out on the Panels in presence of Client/ Consultant. All the charges for inspection / testing shall be borne by the supplier.

The switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

TEST CERTIFICATE

Certificate reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner. The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports. Copies of Type test certificate for test on similar switchgear shall be submitted. The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. & date of test.

COMMISSIONING

The vendor will depute their engineer at site at the time of installation, testing & commissioning for at least three times.

GUARANTEE

Vendor shall guarantee the design, materials, workmanship and performance of the equipment for a period of twelve months from the date of initial operation or eighteen months after delivery at job site, whichever is earlier.

IMPORTANT

- The vendor will depute their engineer at site at the time of installation, testing & commissioning for at least three times.
- Minimum 750mm clear space to provided from bottom of gland plate to spreader contact terminal of ACB/MCCB/MCB/terminal for outgoing/incoming Cable termination.