



ODISHA POWER TRANSMISSION CORPORATION LIMITED

TECHNICAL SPECIFICATION

FOR

DISTRIBUTION BOARDS

- 1) ACDB**
- 2) DCDB**
- 3) OTHER CONSOLES INCLUDING BMK**

1. General Requirements of AC and DC systems

The electrical auxiliary systems shall be of a quality commensurate with the performance, reliability and availability requirements of the substation.

The electrical station services shall be in accordance with all the relevant standards, shall satisfy the requirements specified herein and shall be designed to operate in the environmental conditions specified in the relevant sections of this Specification.

The electrical station systems shall be required to provide the voltage class indicated in Table-1.1 for operation of various plant equipment, operating mechanisms, plants, and control & communication systems

Nominal Voltage V	Tolerance	Frequency Hz or DC	Phases	Wires	Neutral Connection
430	±10%	50±5%	3	4	Solidly earthed
240	±10%	50±5%	1	2	Solidly earthed
220	187V to 242V	DC	DC	2	Isolated 2 wires
50	±10%	DC	DC	2	+ve earthed

Table 1.1. Voltage classes

The auxiliaries shall be capable of withstanding all over frequency and under voltage conditions without loss of supply to the power circuits or shutdown of any auxiliary system meeting the essential loads of the substation plant and equipment.

Configuration

The basic design of the substation electrical auxiliary services shall be as shown in the schematic drawing (Annexure-A). This drawing is for guidance only and the Contractor may propose an alternative keeping in view the design philosophy stipulated in this section of the Specification. The design philosophy for auxiliary supply systems shall be as follows:

- a) Station auxiliary transformers shall be installed from 33KV bus bars of the substation to provide reliable auxiliary power supplies. At least two auxiliary transformers of a rating sufficient to feed the substation load shall be installed. Where specified, in order to meet the station essential loads a back-up supply from a standby diesel generator set shall be provided. The requirement of diesel generator sets have been indicated in the bill of quantity of relevant schedules.

- b) The Contractor shall estimate loads of the substation and determine the required capacity of station auxiliary transformers and diesel generator set and submit same for the approval of the Project Manager. However, the following capacities of station transformer shall only be used. The contractor shall classify the loads based on the principles defined in the following clauses.

Sl No	Rating of Station Transformer	Substation class
1	2 x 250KVA	132/33KV, 220/33KV, 220/132/33KV
2	2 x 500KVA	400/220KV, 400/220/132KV

- c) Where, it is not possible to install station transformers, the AC supply for station auxiliary systems may be obtained from a single source from the local distribution network having a track record of good power availability. For 400/220kV substations two separate sources shall be used. ***This arrangement shall be with prior approval of OPTCL.***

Load Classes

Essential loads

These are loads whose failure will affect the capability of the station and station plant and equipment. These loads shall include *cooling and other auxiliaries of transformers and reactors, non-interruptible power units, auxiliaries of reactive power compensator, and station services of the relays in the substation.*

Emergency loads

These are loads that must remain in service during complete loss of the ac power supply. These loads shall include the *station battery chargers, disconnecting switch and circuit breaker operating mechanisms, control room air-conditioning and the emergency lighting of the switchyard and control building.* Some emergency loads operate on AC voltage and the others on DC voltage.

Normal loads

These loads, whose failure does not affect capability, shall include but not be limited to *control building and switchyard lighting, control building air-conditioning except in control room, air compressors, normal and fire-fighting water pumps, oil treatment loads, etc.*

Basic design criteria

The failure or the disconnection for maintenance of any motor, feeder, motor control center, or 415V power center or auxiliary transformer shall not affect the power transmission capability of the substation.

To achieve the above criteria, the following facilities shall be incorporated, by the Contractor, in the design of the auxiliary systems:

1. Highly reliable duplicate primary supply sources, with automatic change-over facilities.
2. Duplicate essential loads (e.g. cooling pumps, fans, heat exchangers, etc.). Duplicated loads shall be supplied from two different 415V AC distribution boards (ACDB). Essential loads which are not duplicated shall have duplicated supply circuits with the source having auto change over facility.
3. Provision of a diesel generator set for the essential loads. ***The generator shall start up automatically, in case of loss of all normal and stand by supplies***, to feed the essential loads and emergency loads.
4. In order to limit fault currents, to prevent back feed into the AC bus, and to ensure independence of supply sources, ***parallel operation between station service transformers shall not be permitted at any voltage level***. Also parallel operation shall not be permitted between transformers and diesel generator.
5. System shall be clear and simple to operate to minimize the risk of loss of supply due to human error.
6. The Contractor shall design the LV distribution system to ensure that the voltage supply limits are maintained at all times and that the switchboards and cabling are never overloaded. On larger stations it may be necessary to supply more than one main LVAC switchboard.

415V AC distribution system

General

The 415V secondary distribution system shall comprise 415V power centers serving the different classes of loads either directly or through motor control centers.

Each power center shall consist of two sections, supplied through two station service transformers of adequate capacity. Each transformer and each section of the 415V power center shall be designed to carry the total load of both sections. The two sections shall be interconnected through normally open bus tie breakers and normally closed fuse disconnects. ***An automatic transfer scheme shall be incorporated within each power center. This transfer***

scheme shall automatically disconnect the voltage deficient bus and then re-energize it from the healthy bus.

Restoration of normal supply conditions shall automatically return the power center to the normal operating mode. The 430V power centers shall be of the metal enclosed switchgear type according to the relevant IEC or Indian Standards.

AC distribution board.

The ACDB's shall be in accordance with the relevant IEC or Indian Standards and shall also comply with the following requirements:

- The ACDB shall be located near the supplied loads or inside the control room at a suitable place.
- The circuit breakers of the ACDB shall be individually interlocked to prevent paralleling of two buses from two different sources.
- The 240V loads shall be supplied by 240V panels located in the ACDB room or outside where it is required.

Supply of essential loads

Essential loads shall be fed from ACDB-1 and ACDB-2 respectively. A diesel generator set shall be connected as indicated in schematic drawing (Annexure-A) so as to meet the complete requirement of the essential loads of the substations. ACDB's shall be independently fed from two different sections of the main distribution board.

Supply of emergency loads

The emergency loads shall also be supplied from essential bus ACDB-1, ACDB-2, 220V DCDB-1 and 220V DCDB-2, and 50V DCDB-1 and DCDB-2 as shown in the schematic drawing (Annexure-B). These loads shall be supplied from the two different buses under duplicate supply philosophy. ***Switchyard bay kiosks shall be fed from the two different buses alternatively and interconnected locally with auto changeover switches.*** Power supply to equipment operating Mechanisms shall be fed from the respective bay kiosks.

Supply of normal loads

Normal loads shall be fed through ACDBs connected with two cables to two different sections of the 415V Main ACDB. A manual change-over switch shall be installed in each ACDB, so that the supply is not lost in case of maintenance of one section of the 415V ACDB or for a fault. These ACDB shall also supply the lighting and small single-phase loads through 240V lighting or distribution panels, located in the MCC and all over the substation.

Some loads, such as switchyard lighting and air-conditioning of the control buildings, normal and fire-fighting water pumps, shall be supplied by duplicate feeders so as not to interrupt working in case of maintenance of one of the sections of the power center.

For oil treatment and welding, special service outlets shall be provided in local 415V Main ACDB or distribution boards.

2. LVAC supplies and equipment

General

Switchboards shall be of the free standing design, suitable for mounting directly above the cable trenches laid inside the control room. Cable trench walls shall be flush with the control room floor. Switchboards shall be suitable for terminating all incoming and outgoing cables and will normally be of the bottom rear entry type, generally in accordance with IEC 947 and 439 and of metal clad design arranged for draw out isolation. Switchboards shall be equipped with circuit breakers and molded case or miniature circuit breakers. **The use of fuse switches will not be permitted.**

LVAC scheme

General requirement

The 415V incoming supplies shall be derived from the station auxiliary transformers or in the case of a loss of supplies, from the standby diesel generator where ever applicable. ***The two incoming supplies shall be interlocked to ensure that only one of the two circuit breakers can be closed at any one time. Where a bus section circuit breaker is provided, it shall also be suitably interlocked to prevent the station auxiliary transformer from being back fed.***

Main AC Distribution board (Main ACDB)

The two sections of the main distribution board shall be supplied from separate station auxiliary transformers. The two sections shall have automatic change over facilities in the event of failure of supply from one source. Each section of the board shall feed the following panels:

- AC Distribution Board
- Main lighting distribution board
- Firefighting pump house.
- AC and ventilation plant
- Maintenance equipment and oil treatment plant supplies.

AC Distribution Board (ACDB)

This shall comprise two sections each of which shall be supplied through different cables from both sections of the Main Distribution Board. ***Each sections shall be equipped with a backup feed from the standby diesel generator set with automatic change-over facility to generator in the event of loss of supply from the main distribution board.***

The AC distribution board shall supply the following loads:

- Control room supply for panels, computers, etc.
- One section of the 220V battery charger / rectifier.
- One section of the 50V battery charger / rectifier.
- 50% of switchyard Bay Marshalling Kiosks (BMKs).
- Emergency AC lighting system.
- Transformers and reactors (cooling devices and OLTC panels)
- Fire water and civic water pumps
- Spare feeders for future use.

Main Lighting Distribution Board (MLDB)

The main lighting distribution board shall receive incoming supplies from the two sections of the main distribution board. This board shall be further connected to lighting panels through a lighting sub-distribution panel. The panel supplying emergency lighting load and the income from the diesel generator shall be equipped to switch on in the event of failure of supply from the primary source.

3. Construction

Panels

For indoor applications the switchboards shall be of the cubicle pattern, each circuit being self-contained within its own cubicle (compartmentalized type). An access door shall be provided for each cubicle such that access can only be obtained to individual circuits. Circuits shall be segregated one from the other by earthed metal. For outdoor installations, they shall be of multi-box construction.

Sheet steel for fabrication of the panels shall be 2 mm cold rolled sheet steel.

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

Switchboard

Switchboards shall be vermin proof and suitable for use in a tropical climate. All ventilating louvers shall be covered with a fine mesh from inside.

All switchboards shall be provided with a degree of protection of IP 52 as per IEC 947 or equivalent Indian standard. Provision shall be made in all compartments for providing IP 52 degree of protection, when circuit breaker or module trolley has been removed.

Switchboards shall be of uniform height and shall not exceeding 2450 mm.

Switchboards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers.

All switchboards shall be divided into distinct vertical sections, each comprising:

1. A completely enclosed bus bar compartment for horizontal and vertical bus bars. Bus bar chamber shall be completely enclosed with metallic partitions. Bolted covers shall be provided for access to horizontal and vertical bus bars and all joints for repair and maintenance. Access shall be possible without disturbing feeder compartment.
2. Completely enclosed switchgear compartment(s), one for each circuit for housing circuit breaker or motor starter.
3. A compartment or alley shall be there for power and control cables. Cable alley door shall preferably be hinged. Cable alley shall have no exposed live parts, and shall have no communication with bus bar chamber.
4. A compartment for relays and other control devices associated with a circuit breaker.

All access doors shall be provided with facilities for locking in the closed position. It shall be possible to move each circuit breaker or MCCB to the disconnected position without the need to open the cubicle access door. Attempted disconnection of a circuit breaker or MCCB when in the closed position shall not result in tripping of the particular equipment.

4. Cubicle

Cubicles may be arranged vertically in tiers, the number being limited only by the need to ensure that circuits are thermally independent.

It shall be possible to work within each cubicle with the equipment withdrawn whilst the incoming contacts are energized. The minimum requirements for protection shall be:

- Insulating barriers installed between phases within the cubicle.

- An insulating cover to be affixed over the protruding feeder and bus bar connections when the equipment is withdrawn.

Where this is not available, protection shall be provided by automatically operated shutters. It shall be possible to open the shutters intentionally, against spring pressure for testing purpose.

Each phase of the down dropper connections from the bus bars to the equipment isolating contacts shall be separated from the incoming or outgoing connections and from the other phases by barriers.

Cubicles shall be suitable for terminating all types of cables (copper or aluminium conductor design). It shall be possible to terminate any cable whilst adjacent circuits are energized.

5. Bus bar and other equipment housing

All incoming connections, bus bars and feeder connections up to the particular MCCB shall be capable of the short time current rating specified, but connections beyond the MCCB need only be matched to the MCCB characteristic.

The overall height of each tier of cubicles shall be such that the operating handles of all equipment are within the reach of a person standing at ground level. Control switches as specified shall be fitted and suitably labelled to indicate their function.

The equipment shall be complete with cable boxes and glands suitable for XLPE or PVC insulated cables.

The switchboard shall be provided with 240V single phase AC illumination and anti-condensation space heaters and each heater shall be provided with an ON/OFF switch.

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

All equipment associated with a single circuit shall be housed in a separate compartment of the vertical section. The compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. The front of the compartment shall be provided with a hinged single leaf door complete with locking facilities. The main switch shall be operable from outside and will be interlocked with the compartment door such that the latter can be opened only when the switch is off. However, it shall be possible to defeat this interlock and open and close the door with the switch ON. The main switch shall have the facility of being pad-locked in both ON and OFF positions. The switch handle shall clearly indicate the position of main switch.

After isolation of power and control circuit connections it shall be possible to safely carry out maintenance in a compartment with the bus bar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable termination located in cable alley.

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

All single front switchboards shall be provided with removable bolted covers at the rear. The covers shall be ***provided with danger boards riveted on to it.***

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

All 415V switchgear cubicles shall be of single front type, with fully withdrawable circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between **SERVICE, TEST** and **ISOLATED** positions and for withdrawal from the switchboard. Testing of the breaker shall be possible in the **TEST** position.

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

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

All modules shall be fixed type except circuit breaker and motor feeder modules, which shall be draw out type.

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

All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to approval of the Project Manager.

All sheet metalwork shall be painted in accordance with the painting clause specified elsewhere in this Specification. The shade of the paint shall be 692 as per IS 5 (smoke grey).

Earthing

It shall be possible to earth all incoming supplies to the switchboard by means of a fully rated earthing device, either by using the circuit breaker with earthing attachments, a separate earthing truck, or a fixed fully rated earth switch.

Bus bars and dead end feeders may be earthed by means of a voltage checking device and hand applied portable earth switches. These shall normally be applied from the front of the switchboard.

Earthing of current free metallic parts on the body of the switchboard shall be done with soft drawn bare copper bus. Tail connections shall have a minimum cross sectional area of 16 mm² and the main earth bar for the switchboard shall be brought out to two terminals for connection to the station earth grid.

Earthing connections shall be carried out with green wire and the earthing studs shall be identified as such by an earthing symbol.

Clearances and insulation level

Clearances and creepage distances in air shall be those stated in IEC 158 and 947 and be such that the equipment can withstand the dielectric tests specified.

Thermal performance of switchboard and equipment

The complete switchboard shall be capable of carrying rated load current without the temperature rise of any portion exceeding a level of 65 °C. Parts that may be touched by operating personnel shall not exceed a level of 35 °C. In determining the load current performance of tiered cubicles it shall be assumed that all circuits are carrying rated current.

The cross sectional area of the bus bars may be graded according to the current rating, but shall remain capable of the short time current rating stated in the Schedules.

Protection co-ordination

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

6. TECHNICAL SPECIFICATION FOR INDOOR & OUTDOOR TYPE 415/240 V AC POWER DISTRIBUTION SWITCH BOARDS.

SCOPE

The specification covers manufacture, assembly and testing at manufacturer's Works, supply and delivery at site of **Indoor and outdoor type 415/240 volts AC power distribution switch-boards, A.C consoles, Bay Marshalling Kiosk, Receptacle panels** complete in all respects as per system requirement for S/S and switchyards. 20% spare feeders shall be provided in each Distribution Boards.

STANDARDS

The equipment covered by this specification shall unless otherwise specified be built to conform to Indian Electricity Rule 2956 wherever applicable and shall satisfy the requirements of the latest Indian Standard. Permissible temperature rise shall be as per relevant ISS.

SWITCH BOARD DESIGN

The switch board shall be self-supporting, steel cubicle, compartmentalized, fully enclosed with doors for access to the interior. The switch boards shall comprise a non/draw out type panels placed side by side to form a continuous unit with access door for each panel at the rear. Modular type construction for inter-changeability will be preferred.

3 mm CR sheet shall be used for fabrication of the panels/kiosks/distribution boards/receptacle boards meant for outdoor installations.

3mm Aluminium sheet shall be used as canopy for all panels/kiosks/distribution boards/receptacle boards meant for outdoor installations. The canopy shall be box type instead of an aluminium sheet bolted to the distribution board of CRCA. Proper sloping shall be maintained for easy drainage of water.

2 CR mm sheet shall be used for fabrication of the panels/kiosks/distribution boards/receptacle boards meant for indoor installations.

The complete panels shall not be more than 2450 mm. high with the channel base and 500 mm. depth measured from rear to front faces and of suitable width. The working height shall be limited to maximum 2200 mm. The design shall be such as to permit extension at site on either end. The bottom of the switch board frame shall be suitable for erecting flush on concrete floor by securing it by means of evenly spaced grouting bolts projecting through the base channels. The panels shall be designed to facilitate cable entry from the

bottom and removable plates shall be supplied along with the panels for this purpose which will be drilled at site to fit the cable glands.

The switchboard shall be vermin proof and suitable for use in tropical climate. All ventilating louvers and holes shall be covered with fine wire mesh from inside (for indoor use). All control and power cables will be laid in open distribution trenches running under the A.C. switchboards. The cable will enter the cubicles through entry holes of removable plates provided at the bottom of the cubicles. The cable entry holes required and the position of the foundation bolts.

The switchboards shall be supplied complete with channel base, removable bottom plates grouting bolts, lock nuts, washer, etc. and cable glands as specified hereafter. All unfinished surfaces of the steel panels and frame work shall be free from adhesive matter or greases. A suitable rust resisting primer paint shall be applied on the interior and exterior surface of the steel housing allowed by application of an undercoat to serve as base and binder for the finishing coat. The finishing coat on the exterior of the switchboards shall be polished cellulose enamel or dark batter ship grey, evenly sprayed to present a fine appearance while the interior faces shall be sprayed with a finishing coat of light grey paint to provide contrasting background for the wiring inside the cubicle. The internal illumination for working should be of adequate intensity LED lamps.

A small quantity of finishing paint shall be supplied with the consignment of the Switchboards to enable the employer to restore at site any surface finish which may get damaged during transit.

BUS BARS

The bus bars shall be of E.G. **copper/aluminum alloy, liberally sized** for the specific current ratings (both short circuit and continuous currents). The size of the bus bars shall be such that the **current density is not more than 1A/1.75 A per sq.mm for aluminum alloy and copper respectively at rated capacity**. Necessary precaution shall be taken to avoid bimetallic action where copper conductors shall be connected to the aluminum bus. Means shall be provided for identifying various phases of bus bars. Bus support shall be of arc resistant, non-tracking, low absorption type insulators of high impact strength and high creepage surface. Bus bars shall be spaced with adequate clearance between phases and phases to ground.

The bus and connections shall be so supported as to be capable of safety withstanding stresses due to maximum short circuit current and also take care of any thermal expansion.

The droppers/riser from or to the bus bars should not be twisted but reasonable bend or joint may be allowed. The bidder shall furnish necessary calculations about the adequacy of selected bus support insulator cantilever strength w.r.t. short circuit forces.

AIR CIRCUIT BREAKER FOR INCOMER

A.C. air circuit breaker shall be four pole, non-draw out type, suitable for 1100 volts grade/650 volts grade service, having continuous current carrying capacity of 800/1000 A with breaking capacity of 50 KA at 415 volts. The breaker shall be provided with trip free manually operated mechanism and a push button to trip the breaker electrically.

The breaker shall be provided with mechanical OFF/ON indicators.

The breaker shall be provided with sets of auxiliary contacts for OFF/ON indicating lamps, trip circuit and inter-locking circuit along with 4 sets of spare contacts. The door of the circuit breaker compartment shall be so interlocked that:

- i) The door cannot be opened whilst the breaker is in closed opposition (i.e. 'ON')
- ii) When the door is opened, the breaker shall be locked so that it cannot be closed (i.e. it cannot be made 'ON'). The circuit breaker shall comply with the relevant I.S.S.

The breaker shall be complete with cable glands suitable for entry of 1100 V / 650 V grade aluminum cables as per below table.

Sl No	Rating of Station Transformer	Size of Cable (Aluminium)
1	250KVA	3.5C x 300 sq. mm
2	500KVA	1C x 630 sq. mm for phase & 1C x 300 sq. mm for neutral

Drop out and pick up voltage of the under-voltage release shall be 60% and 85% respectively of the rated voltage.

For incoming circuit 1 no. ACB (as per requirement, it differs from sub-station to sub-station) of suitable capacity according to the system should be design and furnished provided in the panel. The details of main ACDB is as below.

1) Station Transformer capacity: 33/0.433 KV, 250/315/500 KVA depending on the substation. Each substation there will be two station transformers, hence in Main ACDB, there will be two incomers i.e., as source I and source II. There will be a bus coupler in main ACDB for extending the supply as and when required.

All outgoing feeders shall be provided with MCCB of suitable capacity according to the systems are to be provided.

INDICATING LAMPS

Indicating lamps shall be LED type provided with suitable safety resistor, and coloured dust-tight lens. Lamps shall be of very low wattage consumption and heat generated due to continuous burning shall not deteriorate lamp cover. The lamp holders shall preferably be screwed type.

SPACE HEATERS

The A.C. switchboards shall be provided with space heaters rated for 240 volts single phase A.C. Each heater shall be provided with ON/OFF switch. The wattage of the heater shall be such as to keep 10 °C above the ambient temperature during rainy season but the temperature shall not damage the wiring.

CABLE TERMINATION

Switchboards shall be designed to facilitate PVC cable entry from the bottom of the switchboards. Removal plates shall be supplied for this purpose which will be drilled at site to fit the cable glands.

Sufficient space shall be provided to avoid sharp bending and for easy connection.

Cables shall be PVC insulated, armored and PVC sheathed with 2.5mm² copper conductor for control and Aluminum for cables feeder up to 15 A. Rating. Rest of the power cable shall be of aluminum conductor of suitable size as per feeder rating.

Multiway terminal blocks of sturdy construction complete with terminating the internal wiring and outgoing cables.

Power terminals shall be complete with lugs and control terminals shall be clamp type. Screw type terminals with screw directly impinging on conductor shall not be supplied.

Each terminal for 15 A feeders shall be capable for connection of 2 Nos. 2.5 sq. mm copper wires at one end without any damage to the connector or any looseness of connection.

The terminal shall be properly tagged and ferruled in compliance with approved drawings. The terminal blocks shall be readily accessible and those shall be rust proof and of best quality. Terminal block connector built from cells of moulded dielectric and brass-stud inserts shall be provided. The connection stud shall project at least 6 mm. from the lock nut surface. All blocks shall be shrouded of easily removable shrouds moulded of transparent dielectric material of non-breakable type.

WIRING

The wiring shall be complete in all respect so as to ensure proper functioning of control, protection and inter-locking schemes.

All wiring shall be complete up to the terminal blocks at the factory.

Control wiring shall be carried out with flexible, heat resistant, switchboard wires. PVC insulated with 2.5 sq.mm stranded copper conductors. Each wire shall be identified at both ends with wire destinations numbered ferrules in accordance with bidder's wiring diagram. Wires shall not be spliced or tapped between terminal points. Each wire shall be continuous and there shall not be any joint within itself. Individual wire shall be connected only at the connection terminal, blocks, meters, relays, instruments, and other devices used in the switchboards. Red, Yellow, Blue and Black ferrules shall be used for Red, Yellow, Blue phases and Neutral respectively.

Wires shall be neatly bunched and adequately supported so as to prevent sagging and strain on termination.

All spare contacts of the equipment shall be wired up to the terminal block. The wires shall be of 1.1 KV grade. At least 20% spare terminals shall be provided.

- a. Terminal connection shall be such that the conductors may be connected by means of screw or other equivalent means so as to ensure that the necessary contact pressure is maintained permanently.
- b. Terminal shall be such that they cannot turn or be displaced when the connecting screws are tightened and such that the conductor can also not become displaced.
- c. Terminals should be so mounted that the appropriate wire may be connected without impairing the normal performance of the unit.

SAFETY EARTHING

Earthing of current free metallic parts of metallic bodies of the equipment on the switchboard shall be done with soft drawn bare copper bus. Tail connections shall have minimum area of 16 sq. mm. and the main earth connection for earth switchboard shall be brought out of two terminals for connection with the station earthing system.

Earthing terminals should be identified by means of the sign marked on a legible and indelible manner on or adjacent to the terminals.

Earthing lugs shall be provided and all earthing connections shall be carried out with green wires.

SWITCHBOARD LIGHTING

The switchboard illumination by providing LED lamps and space heating arrangement to be provided.

INDICATING INSTRUMENT & ENERGY METERS

All instruments shall be switchboard type, back-connected, suitable for flush mounting. The construction shall conform to appropriate Indian Standard Specifications. The instruments shall be capable of indicating freely without error when operated continuously at any ambient temperature from 0 deg. to 50 deg. C. They shall withstand the effects of shock, vibration and humidity. All circuits of instruments shall be capable of withstanding 20% overload for a period of at least 8 hours. All instruments shall be provided with suitable means of adjusting the accuracy in a laboratory. KWH meters specified shall be of commercial grade accuracy. Ammeter and voltmeter shall be with accuracy of $\pm 1\%$ of full scale value.

RELAYS

The relays shall be suitable for operation within a temperature range of 0 deg. C to 50 deg. C. The contacts of the relays shall be silvered. When open, the contacts shall withstand a voltage of 110% of the normal circuit voltage of the contacts. The relays shall not deteriorate in performance due to ageing of any constituent material.

The relays shall generally comply with the requirements of I.S.S. 3842.

A.C. DISTRIBUTION BOARDSCHEME

Power will be fed to A.C. distribution board through 2 Nos. incoming breakers separately from one no. 250 KVA station service transformer. Normally two feeders will feed power to two sections of A.C.D.B. coupled through a bus coupler breaker. Normally this coupler breaker will be kept upon when both the incomers are kept on. In case of failure of any one of the incomer, this bus-coupler will be made ON. Suitable scheme for electrical interlock and automatic switching on of the bus-coupler in the event of tripping of any of the healthy incomer is to be taken up by the bidder. Suitable annunciation for failure of A.C supply and for any of the incomer is to be provided.

A 415 V single line diagram accommodating the above facilities and to suit the system is to be design and submitted to the Employer for approval. However, exact requirement layout is to be taken up by the contractor depending on the layout, rating and type of equipment for preparation of drawing.

PROTECTION SCHEME FOR INCOMING CIRCUIT BREAKER

Each incoming circuit to the L.T. switchboard shall be protected by a Numerical relay for over current, earth fault, over voltage and under voltage

protection relays. The numerical relay should be SAS compliant i.e. IEC 61850 having time synch port (IRIG-B, SNTP).

The breaker shall also be provided with under-voltage release of tripping out in case of supply failure.

CURRENT TRANSFORMERS

The current transformer to be provided with the incoming/outgoing circuit for metering shall be air-cooled of class 'CM' accuracy. The VA burden should be such as to suit the requirements. C.Ts shall be bar primary type moulded/cast resin type. The current transformer shall be manufactured and tested according to relevant I.S.S.

INSULATION LEVEL

The insulation at any point of the wiring in switchboards shall be suitable for 1100/660 volts grade service.

TEST – TYPE TEST REPORT shall be furnished.

7. DC supply equipment

General scheme

At 400kV and 220kV substations, each DC supply system (50V and 220V DC) shall comprise duplicate batteries and battery chargers, a DC distribution board and control gear. The system shall be arranged such that only one of the station batteries and one of the battery chargers shall be in service at any one time, but should either item of equipment fail or need to be taken out of service for maintenance, then the duplicate item of equipment can be brought into service without disruption of supplies.

Battery chargers shall be provided with an automatic change-over facility that will operate should one of the charger units fail.

At 132kV substations, each DC supply system shall be provided with one battery and one battery charger, DC distribution board and control gear for 220V DC. However the 50V DC system shall be duplicated as in case of 400/220kV substation.

Each battery shall be either of the lead acid and comprise a sufficient number of cells to provide the required rating. The battery charger shall be capable of float charging the battery, from the AC supply voltage specified. A facility shall be provided for boost charging individual battery cells in situ, by means of wander leads.

The batteries shall be located in a battery room and connected to the distribution boards and battery charger located in an adjacent room via a fuse box located in the battery room.

Where the battery size is less than 200 Ah, and the cells are of the totally enclosed type, consideration will be given to housing the battery in a sheet steel cubicle mounted alongside the charger and distribution board so as to form a complete suite of panels.

The 220V DC power supplies system will operate with both battery terminals free of earth whilst that for communication equipment (the 50V DC power supply) will operate with the positive pole permanently earthed. A suitable earth fault detection scheme shall be provided.

The battery rated output shall be that available at the outgoing terminals, after making due allowance for the resistance of inter cell connections. The battery size selected by the Contractor shall be proved by calculation which shall be subject to the approval of the Project Manager. Allowance shall be made for ageing of the battery during its service life.

Earthing of current free metallic parts on the body of the distribution boards shall be done with soft drawn bare copper bus. Tail connections shall have a minimum cross sectional area of 16 mm² and the main earth bar for the distribution shall be brought out to two terminals for connection to the station earth grid.

Earthing connections shall be carried out with green wire and the earthing studs shall be identified as such by an earthing symbol

The distribution board shall be provided with 240V single phase ac illumination and anti-condensation space heaters and each heater shall be provided with an ON/OFF switch.

8. TECHNICAL SPECIFICATION FOR INDOOR TYPE 220 VOLT D.C. SYSTEM POWER DISTRIBUTION SWITCH BOARDS

SCOPE

This specification covers manufacture, assembly and testing at manufacturer's works, supply and delivery of Indoor Type 220 volts D.C. Power Distribution on Switchboards complete in all respects as per system requirement for substation and switchyards. 20% spare feeders shall be provided in each DCDB.

STANDARDS

The equipment covered by this specification shall unless otherwise specified, be built to conform to Indian Electricity Rules 1956 wherever applicable. Permissible temperature rise shall be as per relevant ISS.

Switchboard Design

The switchboards shall be self-supporting steel cubicle compartmentalized fully enclosed with doors for access to the interior. The switchboards shall comprise of non/draw out type panels placed side by side to form a

continuous unit with access door for each panel at the rear. Modular type construction for interchangeability will be preferred.

2mm CRCA sheet shall be used for fabrication of the panels.

The complete panels shall not be more than 2250 mm. high with me channel base and shall be of 600 mm depth, measured from rear to front faces and of suitable width. The working height shall be limited to maximum of 2000 mm.

The design shall be such as to permit extension at site on either end. The bottom of the switchboard frame shall be suitable for erecting flush on concrete floor by securing it by means of evenly spaced grouting bolts projecting through the base channels. The panels shall be designed to facilitate cable entry from the bottom and removable plants shall be supplied along with the panels for this purpose which will be drilled at site to fit the cable glands.

The switchboards shall be vermin proof and suitable for use in tropical climate. All ventilating louvers and oleos shall be covered with fine wire-mesh from inside or inbuilt type. All control and power cables will be paid in open distribution trenches running under the D.C. Switchboards. The cable will enter the cubicles through entry holes of removable plates provided at the bottom of the cubicles. The successful bidder shall furnish foundation drawings for the switchboards showing the cable entry holes required and the position of the foundation bolts.

The switchboards shall be supplied complete with channel base, removable bottom plates, grounding bolts, lock nuts, washers, etc. and cable glands as specified hereafter. All unfinished surfaces of the steel panels and frame work shall be free from adhering matter or grease. A suitable rust resisting primer paint shall be applied on the interior and exterior surface of the steel housing followed by application of an undercoat to serve as base and binder. The finishing coat on the exterior of the switchboards shall be polished cellulose enamel, or dark battleship grey, evenly sprayed to present a fine appearance, while the interior faces shall be approved with a finishing coat of light grey paint to provide a contrasting background for the wiring inside the cubicle.

A small quantity of finishing paint shall be supplied with each consignment or the switchboards to enable the Employer to restore at site any surface finish which may get damaged during transit.

BUS BARS

The bus bar shall be of E.G. copper/aluminum alloy, liberally sized for the specified current rating (both short circuit and continuous currents). The size of bus bars shall be such that the current density is not more than (1A/1.75A) per sq. mm. for aluminum alloy and copper respectively at rated capacity. Necessary precaution shall be taken to avoid bimetallic action where copper conductors shall be connected to the aluminum bus. Means shall be provided for identifying the positive and negative bus bars. Bus supports shall be of

arc resistant, non-tracking, low absorption type insulators of high impact strength and high creep age surface.

The bus and connections shall be so supported as to be capable of safety withstanding stresses due to maximum short circuit current and also take care of any thermal expansion.

The droppers/risers from or to the bus bars should not be twisted but reasonable bend or joint may be allowed.

MCCB/MCB

All incomer feeders will be provided with DC MCCB and all outgoing feeders with DC MCB conforming to latest IS : standards as per system requirements.

FUSE

Fuses shall be HRC link type of renowned make conforming to latest issue of ISS 2208. Re-wireable fuses shall not be supplied.

Fuse shall be complete with fuse bases and fittings of such design as to permit easy replacement of the fuse elements.

Link shall also be easily replaceable. Visible indication shall be provides on blowing of the fuse.

INDICATING LAMPS

Indicating lamps shall be LED type provided with suitable safety resistor and coloured dust-tight lens. Lamps shall be of very low wattage consumption and heat generated due to continuous burning shall not deteriorate lamp cover.

CABLE TERMINATION

Switch boards shall be designed to facilitate PVC cable entry from the bottom of the switchboard. Removable places shall be supplied for this purpose which will be drilled at site to fit the cable glands.

Sufficient space shall be provided to avoid sharp bending and for easy connection

Cables shall be PVC insulated, armored and PVC sheathed with 2.5mm² stranded copper conductor for control and for feeders up to 15 As. rating. Rest of the power cable shall be of aluminum conductor of suitable size as per feeder rating.

Multi-way terminal blocks of sturdy construction complete with screws, nuts. Washers and marking strips shall be furnished for terminating the internal wiring and outgoing cables.

Power terminal shall be complete with lugs and control terminals shall be clamp type. *Screw type terminals with screw directly impinging on conductor shall not be supplied.* Connectors built from cells of moulded dielectric and brass stud inserts shall be provided for terminating the internal wiring and outgoing cables.

Each terminal for 25 A, feeders shall be capable for connection of 6mm² stranded copper wires at one end without any damage to the connector or any looseness of connection. The terminals shall be properly tagged and ferruled in compliance with approved drawings. The terminal blocks shall be readily accessible and those shall be rust proof and of best quality.

WIRING

The wiring shall be complete in all respect so as to ensure proper functioning of control, protection and interlocking scheme.

All wiring shall be complete up to the terminal blocks at the factory. The insulation grade of wire to be used for internal wiring if the switch board shall be 1100 volts grade. Wiring shall be carried out with flexible heat resistant, switchboard wires PVC insulated with 2.5 sq.mm stranded copper conductors.

Earth wire shall be identified at both ends with ferrules showing wire designations in accordance with bidder's wiring diagram. Wires shall not be spliced or tapped between terminal points.

Each wire shall be continuous and there shall not be any joint within itself. Individual wire shall be connected only at the connection terminals, blocks, meters, relays, instruments and other devices used in the switchboards. Red ferrules with positive marking shall be used for positive terminals and white ferrule with negative marking shall be used for negative terminals for D.C. wiring.

Wires shall be neatly bunched and adequately supported so as to prevent sagging and strain on termination. All spare contacts of the equipment shall be wired up to the terminal block.

SAFETY EARTHING

Earthing of current free metallic parts of metallic bodies of the equipment on the switchboards shall be done with soft drawn bare copper bus Tail connections shall have minimum area of 26 sq. mm. and the main earth connection for each switchboards shall be brought out to two terminals for connection with the station earthing system.

Earth terminals should be identified by means of the sign marked in a legible and indelible manner on or adjacent to the terminals. Earth lugs shall be provided and all earthing connections shall be carried out with green wires.

SWITCH BOARD LIGHTING

The interior of each panel switchboard shall be illuminated by LED lamps connected to 230 volts. Single phase A.C. supply and shall be controlled by a door-operated switch. All A.C. wiring shall be carried out with black wires. The incoming A.C. supply to the D.C. boards shall be provided with H.R.C. fuse and link of proper rating.

INDICATING INSTRUMENTS

All instruments shall be of switchboard type, back-connected suitable for flush mounting. The construction shall conform to the appropriate Indian Standard Specifications. The instruments shall be capable of indicating freely without error when operated continuously at any ambient temperature from 0 deg. C to 50 deg. C. Those shall withstand the effects of shock, vibration and humidity. All circuits of instruments shall be capable of withstanding 20% overload for a period of at least 8 hours.

COMPLETENESS OF SUPPLY

The switchboards offered by the bidder shall be complete in all respects. Any materials necessary which may not have been specifically mentioned but which is usual or necessary for satisfactory and trouble-free operation and maintenance of the switchboards shall be supplied without any extra charge to the employer.

SPARES

The item wise price for the spares recommended for three years operation and maintenance of each switchboard shall be quoted.

INTER CHANGEABILITY

All similar materials and removable parts shall be interchangeable with each other.

All switches, contactors, etc. shall be easily removable as a complete unit from the switchboards and shall be capable of being put in similar position in other switchboards for performing identical functions.

The spares called for in respective sections shall be identical with like parts provided in the main equipment in all respects and shall be capable of replacing the main equipment wherever required to carry out identical functions.

ACCEPTABILITY OF DIFFERENT EQUIPMENTS & AUXILIARIES

All equipment, cables, wires and accessories offered shall be of best quality and of renowned make for successful and trouble free operation of the switchboards.

Equipment/accessories of sub-standard quality shall not be accepted by the Employer.

TESTS

The following tests are to be carried out.

- i) Checking continuity of the wiring.
- ii) Insulation resistance of all wiring circuit with all equipment mounted on the board, before and after application of H.V.
- iii) One minute power frequency voltage withstand test. All equipment and wiring shall withstand a power frequency voltage of 2 KV applied between any circuit and earth.
- iv) Routine test of all equipment, switches and devices according to relevant I.S.S.
- v) Type test reports shall be furnished.

CLEARANCE

The apparatus forming part of the panel shall have requisite clearances and these shall be maintained during normal service conditions. When arranging the apparatus within the panels, the clearances for them shall be complied with taking into account the relevant service condition. In addition, abnormal conditions such as in short circuit shall not permanently reduce the distances between bus bars.

NAME PLATE OF D.C. SWITCHBOARDS

Each panel shall be provided with name plates, marked in a durable manner and located in a place such that they are visible and legible when the panel is installed. The following information should be given on the name plate.

- i. The manufacturer's name and /or 'trade mark' & identification number.
- ii. Rated operational voltage.
- iii. Purchase order number and date.
- iv. Weight.

9. D.C. SYSTEM

The 220 volts D.C. supply will be available from the lead acid station storage battery banks associated with battery charging equipment.

In the 220 KV system the D.C. supply will be available from two sources. So the system should be designed with provision for a bus coupler.

The battery shall normally float under trickle charge conditions with the charger which continuously supplies the D.C. load to the load bus in D.C. switchboard and trickle charging current to the battery. The charger will be connected to the load bus of DCDB through double pole MCCB (DC). These two double pole MCCB (DC) should be mechanically interlocked so that only one switch can be closed at a time. An emergency D.C. lighting system would be provided in each sub-station to operate a separate lighting system with D.C. power in case of total failure of A.C. supply.

The D.C. lighting system would be completely independent from the normal A.C. lighting system. For this purpose, provision shall be made in the panel for mains failure AC contactors with contacts rated for 32 A which makes through DC lighting system in the event of main failure. The two MCCBs required for D.C. lighting feeders shall be taken from the D.C. panel Board.

D.C. fail alarm both audible and visual shall be provided in case of total failure of D.C. supply at the load bus as per drawing. 220 volts D.C. supply scheme is enclosed in Annexure-C for guidance and understanding of D.C. system. As the entire D.C. system is to be designed by the contractor depending on the rating and type of equipment being supplied, the necessary modification in the schematic diagram has to be taken up by the contractor and got approved from the Engineer.

10. BAY MARSHALLING KIOSK:

Same as ACDB but outdoor type. The purposes of these boards are to be installed in the switch yard at different locations. There shall be two incomer as source I and source II. There shall be adequate AC outlets, both 3 phase with neutral and single phase, which will be taken to all the equipment and equipment marshalling boxes. **At least 20% extra outlets are to be provided besides the requirement to meet during exigencies.** All the inlet and out lets shall be provided with MCB's. The board shall have two doors one at front and the other at the rear end. Since these boards are to be installed outside in the switch yard sufficient care as per the relevant standards are to be taken care from weathering effect. At the front end, all AC inlets and out lets are to be provided and at the rear end, terminal blocks are to be provided in column wise for DC control /AC control purpose. The minimum quantity of terminal blocks of rating 35 A shall be 150 nos for substations upto 220KV & 200 nos for 400KV substations, with duly marked the numbers on terminals. At the front side also adequate capacity (current rating) as per the rating of MCB, terminal blocks to be provided for inlet and out let points of AC supply.

Proper engineering to be made and to be submitted for approval to OPTCL before manufacturing and supply. The components and wirings to be used shall be of as per IS standard and of reputed make. The BMK incoming supply scheme is enclosed at Annexure-B.

10. AC CONSOLES:

Same as ACDB but outdoor type suitable for use in switchyard illumination control. Adequate nos of MCBs for incoming and outlets are to be provided in the console to take care of the switch yard illumination system. No of such boards will be as per requirement. Care should be taken as these boards are of outdoor type. 20 % extra outlets should be provided to meet the exigencies.

11. RECEPTACLE AC SUPPLY PANEL:

Receptacle panels both indoor and outdoor types are to be provided to meet the emergency requirement of AC supply. For example welding purpose, testing purpose etc. Both three phase and single phase outlets should be provided. One no receptacle panel outdoor type shall be provided near the transformer for oil filtration purpose. The rating of the inlet and outlet MCCBs, shall be 250 A.

12. DETAILS OF DISTRIBUTION BOARDS:

1) MAIN ACDB:

1.	Type	Indoor
2.	Mounting	Floor mounted.
3.	Thickness/ Material of steel sheet	2mm. CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	100 x 10 mm Aluminium for Phase 80 x 10 for Aluminium Neutral
5.	Earth bus bar	40 x 4 copper running through the Panel
6.	Incomer & Bus coupler: Four pole air circuit breaker (Device No. 52), draw out type, Microprocessor controlled, power operated mechanism complete with all accessories as specified. The ACB should have the required number of NO & NC aux switch contacts (or through Aux contactors) for interlock, indication & SAS signal. The trip & close coils shall be of 220V DC. The current rating of the ACB should be as per the rating of the Station transformer mentioned below.	
	250KVA	800A, 50KA, 4P ACB
	500KVA	1000A, 50KA 4P ACB
7.	Circuit breaker control switch with spring return to normal /Push Buttons for local control.	
8.	Current transformer for relaying (-/5A).	
9.	Voltage transformer (415V/ $\sqrt{3}$ /110V/ $\sqrt{3}$)	
10.	Numerical type Relay (-/5A) with 16 DI & 16 DO for protection from over current, earth fault, under voltage, over voltage etc. The relay	

	should also have the directional & instantaneous feature. The relay should be IEC 61850 compliant.																				
11.	HRC control fuse.																				
12.	Auxiliary relays (Master trip-86)																				
13.	Led type Indicating lamps (for ACB ON/OFF, TC Healthy, Auto Trip, Spring charge, R/Y/B Healthy)																				
14.	Auxiliary contactors / Time delay relays etc																				
15.	Auto/Manual and Local/Remote switches																				
16.	<p>The Scheme shall be such that the Incomer breaker shall trip automatically when the power supply fails and should close automatically when the power supply restores with a time lag. When the ACB trips on fault, the auto close command is barred. The incomer breaker shall have the option to be operated from SCADA i.e. Remote or Auto/Manual (Local).</p> <p>Logic applicable for Incomers and Bus coupler</p> <table><tr><td></td><td>Incomer-1</td><td>Incomer-2</td><td>Bus-coupler</td></tr><tr><td></td><td>ON</td><td>ON</td><td>OFF</td></tr><tr><td></td><td>ON</td><td>OFF</td><td>ON</td></tr><tr><td></td><td>OFF</td><td>ON</td><td>ON</td></tr></table>						Incomer-1	Incomer-2	Bus-coupler		ON	ON	OFF		ON	OFF	ON		OFF	ON	ON
	Incomer-1	Incomer-2	Bus-coupler																		
	ON	ON	OFF																		
	ON	OFF	ON																		
	OFF	ON	ON																		
17.	Any other material for successful implementation of scheme.																				
18.	Outgoing Feeders per section of Bus bar																				
	Sl	O/G MCCB	132KV SS	220KV SS	400KV SS																
	1	400A	Nil	1	2																
	2	250A	4	3	3																
	3	100A	4	4	7																
19	<p>Mandatory SAS inputs</p> <p>1. ACB ON/OFF status – Source-1, 2 & B/C</p> <p>2. Voltage – Source-1 & 2</p> <p>3. Current – Source-1 & 2</p> <p>4. O/C relay operated for each ACB</p> <p>5. E/F relay operated for each ACB</p> <p>6. Any other protection configured</p>																				

2) ACDB

1.	Type	Indoor
2.	Mounting	Floor mounted.
3.	Thickness/ Material of steel sheet	2mm. CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	50 x 10 mm Aluminium for Phase 50 x 10 for Aluminium Neutral
5.	Earth bus bar	40 x 4 copper
6.	Incomer & Bus coupler: Motorized MCCB (4P) The MCCB should have the required number of NO & NC aux switch contacts (or	

	through Aux contactors) for interlock, indication & SAS signal. The current rating of the MCCB is mentioned below.				
7.	Substation Class		MCCB Rating		
	132KV		250A		
	220KV		400A		
	400KV		400A		
8.	The DG set Incomers shall also be of same rating as above.				
9.	Push Buttons for local control.				
10.	HRC control fuse.				
11.	LED Type Indicating lamps (for MCCB ON/OFF, Auto Trip, Spring charge, R/Y/B Healthy)				
12.	Auxiliary contactors / Time delay Relays etc				
13.	Auto/Manual and Local/Remote switches				
14.	The incomers shall trip automatically when the power supply fails and the DG should start automatically with a time lag. Similarly, the DG set should stop automatically when the power supply to the ACDB is restored and the incomers shall close automatically. The DG incomer shall also have the appropriate numerical protection relay. Logic applicable for Incomers, DG set incomers and Bus coupler				
	Incomer-1	Incomer-2	DG-1	DG-2	Bus Coupler
	ON	ON	OFF	OFF	OFF
	ON	OFF	OFF	OFF	ON
	OFF	ON	OFF	OFF	ON
	OFF	OFF	ON	OFF	ON
	OFF	OFF	OFF	ON	ON
15.	Any other material for successful implementation of scheme.				
16.	Outgoing Feeders per section of Busbar				
	S/S Class	100A, 4P MCCB	63A, 4P MCCB	32A, 4P MCCB	
	132KV	1	15	10	
	220KV	3	15	10	
	400KV	5	15	10	
17.	Mandatory SAS inputs 1. MCCB ON/OFF status – Source-1, 2 & B/C, DG-1 & DG-2				

3) MAIN LIGHTING DB:

1.	Type	Indoor
2.	Mounting	Floor mounted.
3.	Thickness/ Material of steel sheet	2mm. CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar (Bus-1 & 2)	50 x 8 mm Aluminium for Phase 25 x 8 for Aluminium Neutral
5.	Earth bus bar	25 x 4 copper

6.	Incomer & Bus coupler: 250A MCCB (4P)		
7.	HRC control fuse.		
8.	LED Type Indicating lamps (for R/Y/B Healthy)		
9.	The incomers & bus coupler shall be interlocked mechanically as per the below logic.		
	I/C-1	I/C-2	B/C
	ON	ON	OFF
	ON	OFF	ON
	OFF	ON	ON
10.	Outgoing Feeders per Bus section		
	4P 63A MCCB with neutral link -4 nos		
	4P 32A MCCB with Neutral Link- 2 nos		

4) INDOOR RECEPTACLE DB:

1.	Type	Indoor
2.	Mounting	Wall mounted.
3.	Thickness/ Material of steel sheet	2mm. CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	25 x 4 mm Aluminium for Phase & neutral
5.	Earth bus bar	25 x 3 copper
6.	Incomer- 63A, 4P MCB – 1 no	
7.	Outgoing : 4P MCB 32A- 2 nos DP MCB 32A- 4 Nos	
8.	R, Y, B, Healthy Indication	

5) EMERGENCY LIGHTING DB:

1.	Type	Outdoor in switchyard
2.	Mounting	Wall/structure mounted.
3.	Thickness/ Material of steel sheet	3mm. CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	25 x 4 mm Aluminium for Phase & neutral
5.	Earth bus bar	25 x 3 copper
6.	Incomer- 63A, 4P MCB – 1 no	
7.	Outgoing : 4P MCB 32A- 4 nos DP MCB 16A- 8 Nos	
8.	This DB will supply power to 20% of each voltage level switchyard lights	

6) 220 V DC Indoor Lighting DB:

1.	Type	Indoor
2.	Mounting	Wall mounted.
3.	Thickness/ Material of steel sheet	2mm. CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	20 x 3 mm Copper for +ive & -ive
5.	Earth bus bar	20 x 3 copper
6.	Incomer- 32A DC DP MCB – 1 no	
7.	Outgoing : DP MCB 16A- 5 nos	
8.	AC Aux Contactor and Auto Manual Switch	
9.	Logic: The DC lights should switch ON automatically in the event of failure of AC supply.	

7) 220 V DCDB (SET):

1.	Type	Indoor	
2.	Mounting	Floor Mounted	
3.	Thickness/ Material of steel sheet	2mm CR steel sheet & gland plate is 3mm CR steel sheet	
4.	Bus Bar	20 x 4 mm Copper +ive & -ive	
5.	Earth bus bar	20 x 3 copper	
6.	Incomer & Bus coupler: 63A DC DP MCB		
7.	Outgoing for each section: <u>DP MCB 32A</u> - (Twice the No of Yard Kisoks & 20% spare or 8 nos minimum) DP MCB 16A- Aux supply such as Smoke & heat detection system, Main ACDB, Network Panel, GPS etc & 20% spare <i>Where there is no switchyard kiosk, the no of outgoing feeders are more, depending on twice the number of panels & the aux requirement.</i>		
8.	Each section having Earth fault relay (Earth leakage), under and over voltage relay, DC Ammeter and Voltmeter compatible with SAS.		
9.	The incomers & bus coupler shall be interlocked mechanically as per the below logic.		
	I/C-1	I/C-2	B/C
	ON	ON	OFF
	ON	OFF	ON
	OFF	ON	ON
10.	Mandatory SAS Inputs required 1. Incomer & B/C MCCB Status 2. DC Voltage- Source-1 & 2 3. DC current- Source-1 & 2		

8) 48 V DCDB:

1.	Type	Indoor	
2.	Mounting	Floor mounted.	
3.	Thickness/ Material of steel sheet	2mm CR steel sheet & gland plate is 3mm CR steel sheet	
4.	Bus Bar	20 x 4 mm Copper +ive & -ive	
5.	Earth bus bar	20 x 3 copper	
6.	Incomer & Bus coupler: 63A DC DP MCB		
7.	Outgoing for each section: DP MCB 32A- 8 nos		
8.	Aux contactor & Auto Manual Switch		
9.	The incomers & bus coupler shall be interlocked mechanically as per the below logic.		
	I/C-1	I/C-2	B/C
	ON	ON	OFF
	ON	OFF	ON
	OFF	ON	ON
10.	Each section having Earth fault relay (Earth leakage), under and over voltage relay, DC Ammeter and Voltmeter compatible with SAS.		
11.	Mandatory SAS Inputs required 1. Incomer & B/C MCCB Status 2. DC Voltage- Source-1 & 2 3. DC current- Source-1 & 2		

9) BMK (Suitable for Outdoor type)

1.	Type	Outdoor
2.	Mounting	Floor Mounted
3.	Thickness/ Material of steel sheet	3mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	20 x 5 mm Aluminium for phase & neutral
5.	Earth bus bar	25 x 3 copper
6.	Incomers: 63A AC FP MCB with neutral Link	
7.	Outgoings:	
	400KV	32A 4P MCB- 20 Nos 16A DP MCB- 7 Nos
	220KV, 132KV, 33KV	32A 4P MCB- 13 Nos 16A DP MCB- 7 Nos
8.	Power & Aux contactor, delay timer & Auto Manual Switch	
9.	The incomers & bus coupler shall be interlocked as per the below logic.	
	I/C-1	I/C-2
	ON	OFF
	OFF	ON

10.	Terminal Block of Elmex/ any renowned Make suitable for 35 A rated (rear side)- 150 Nos for upto 220KV Substations - 200 Nos for 400KV Substations	
11.	No of BMKs to used for the switchyard as per below	
	Voltage Level	BMKs to be used for no of Bays
	400KV	3 for one dia
	220KV	1 for Two Bays
	132KV	1 for Three Bays
	33KV	1 for four bays
	GIS substations	As per requirement. To be finalized during drawing approval.

10) OUTDOOR RECEPTACLE DB: (Transformer filtration purpose)

1.	Type	Outdoor
2.	Mounting	Plinth Mounted
3.	Thickness/ Material of steel sheet	3mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	50 x 10 mm Aluminium for phase & neutral
5.	Earth bus bar	25 x 3 copper
6.	Incomer: 250A AC 4P MCCB	
7.	Outgoings: 250A 4P MCCB- 1 nos	
8.	R, Y, B healthy indication	

11) OUTDOOR RECEPTACLE BOARD (Welding)

1.	Type	Outdoor
2.	Mounting	Plinth Mounted
3.	Thickness/ Material of steel sheet	3mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	25 x 10 mm Aluminium for phase & neutral
5.	Earth bus bar	25 x 3 copper
6.	Incomer: 63A AC 4P MCB	
7.	Outgoings: 32A 4P MCB- 2 nos 16A DP MCB- 2 nos	
8.	R, Y, B healthy indication	

12) OUTDOOR KIOSK FOR SWITCHYARD LIGHTING

1.	Type	Outdoor
2.	Mounting	Plinth Mounted
3.	Thickness/ Material of steel sheet	3mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	25 x 10 mm Aluminium for phase & neutral
5.	Earth bus bar	25 x 3 copper
6.	Incomer: As per load calculation of the switchyard lights (4P MCB)	
7.	Outgoings: 4P/DP MCB rating-As per the no of lights per cable route	
8.	R, Y, B healthy indication	
9.	A 24Hr Timer shall be used for switching the lights through the use of an Auto Manual switch.	

13) OUTDOOR KIOSK FOR STREET LIGHTING

1.	Type	Outdoor
2.	Mounting	Plinth Mounted
3.	Thickness/ Material of steel sheet	3mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	25 x 10 mm Aluminium for phase & neutral
5.	Earth bus bar	25 x 3 copper
6.	Incomer: As per load calculation of the street lights (4P MCB)	
7.	Outgoings: 4P/DP MCB rating-As per the no of lights per cable route	
8.	R, Y, B healthy indication	
9.	A 24Hr Timer shall be used for switching the lights through the use of an Auto Manual switch.	

14) OUTDOOR KIOSK FOR COLONY SUPPLY

1.	Type	Outdoor
2.	Mounting	Plinth Mounted
3.	Thickness/ Material of steel sheet	3mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	25 x 10 mm Aluminium for phase & neutral
5.	Earth bus bar	25 x 3 copper
6.	Incomer: 100A 4P MCB	
7.	Outgoings: 63A 4P MCB- 6 nos 16A DP MCB-2 nos	
8.	R, Y, B healthy indication	

15) OUTDOOR KIOSK FOR STATION TRANSFORMERS

1.	Type	Outdoor
2.	Mounting	Plinth Mounted
3.	Thickness/ Material of steel sheet	3mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	2 x 50 x 10 mm Aluminium for phase & neutral
5.	Earth bus bar	25 x 5 copper
6.	Incomer: 800A/1000A isolator switch(TPN)	
7.	Outgoings: 800A/1000A isolator switch(TPN)	
8.	R, Y, B healthy indication	

16) CT / PT / CVT Console box

1.	Type	Outdoor
2.	Mounting	Wall/Structure Mounted
3.	Thickness/ Material of steel sheet	3mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Terminal Blocks	Disconnecting type, stud with nuts. No of TBs shall be as per requirement & 20% spare.
5.	Earth bus bar	25 x 3 copper
6.	Necessary fabrication shall be done without disturbing the original members of the structure.	

17) ACDB for yard Kiosk

1.	Type	Indoor
2.	Mounting	Wall Mounted
3.	Thickness/ Material of steel sheet	2mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar	25 x 10 mm Aluminium for phase & neutral
5.	Earth bus bar	25 x 3 copper
6.	Incomer: 32A AC 4P MCB	
7.	Outgoing: 20A 4P MCB- 4 Nos 10A DP MCB- 3 Nos	

18) DCDB FOR YARD KIOSK:

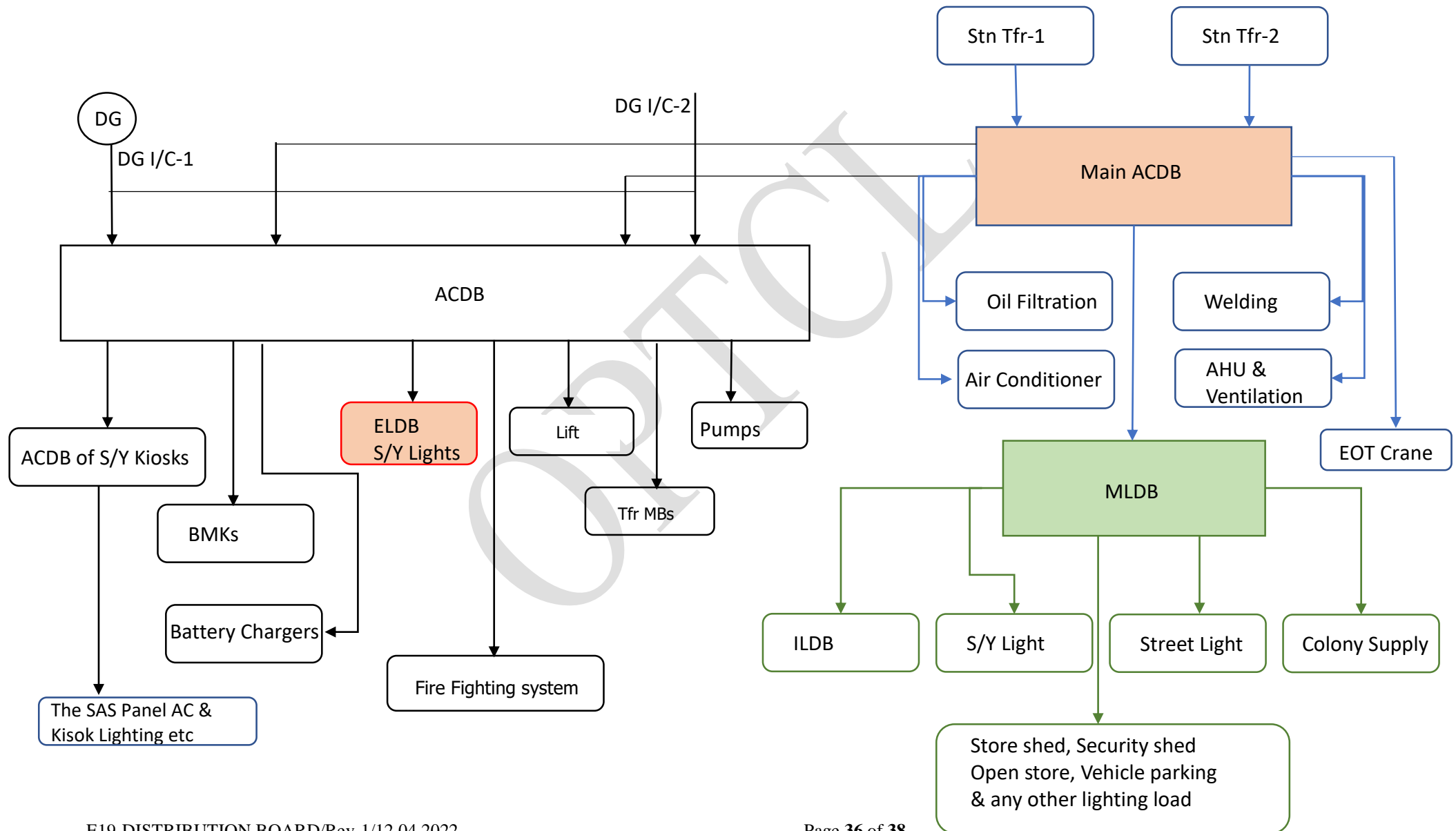
1.	Type	Indoor
2.	Mounting	Wall/Floor mounted.
3.	Thickness/ Material of steel sheet	2mm CR steel sheet & gland plate is 3mm CR steel sheet
4.	Bus Bar (Source-1 & 2)	10 x 4 mm Copper +ive & -ive
5.	Earth bus bar	10 x 3 copper
6.	Incomers: 32A DC DP MCB	
7.	Outgoing for each section: DP MCB 16A- Twice the no of Panels	

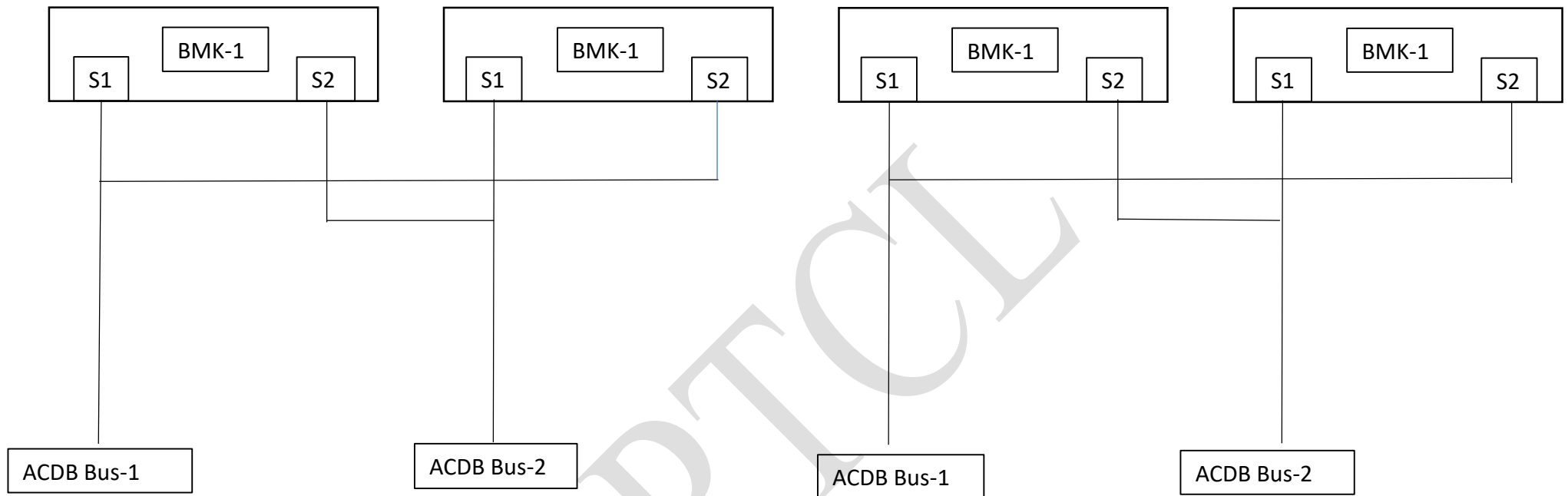
19) DCDB FOR SWITCHYARD:

8.	Type	Outdoor
9.	Mounting	Plinth mounted.
10.	Thickness/ Material of steel sheet	3mm CR steel sheet & gland plate is 3mm CR steel sheet
11.	Bus Bar (Source-1 & 2)	10 x 4 mm Copper +ive & -ive
12.	Earth bus bar	10 x 3 copper
13.	Incomers: 32A DC DP MCB	
14.	Outgoing for each section: DP MCB 16A- As per requirement	

Note: The outgoing feeders mentioned against each of the Panels / Kiosks / console boxes / receptacle boards / distribution boards are only the minimum requirements. The actual number of outgoing feeders may increase depending on the requirement for the substation.

Annexure-A





BMK Typical connection

Annexure-C

