

TECHNICAL SPECIFICATION (ELECTRICAL WORK)

A. MEDIUM VOLTAGE DISTRIBUTION BOARDS

1.0 STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standard are not available, relevant British and /or IEC Standard shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standard shall be applicable irrespective of those listed below.

Miniature Air Circuit Breakers for AC Circuits	IS:13947 (1993)
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Degrees of Protection provided by enclosures for low voltage switchgear	IS:2147 (1962)
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Code of Practice for selection, installation and maintenance of switchgear and control gear	IS:10118 (1982)
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2.0 MINIATURE CIRCUIT BREAKERS

- a) The MCB's shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.
- b) The MCB's shall have a rupturing capacity of 10KA at 0.5 p.f.
- c) The MCB's shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection. The MCB time current characteristic shall co-ordinate with H.R.C. fuse/PVC cable characteristic.
- d) Type test certificates from independent authorities shall be submitted with the tender.

3.0 FINAL DISTRIBUTION BOARDS

- a) Final distribution boards shall be flush mounting, totally enclosed, dust and vermin proof and shall comprise of miniature circuit breakers, earth leakage circuit breakers, neutral link etc. as detailed in the schedule of quantities.
- b) The distribution equipment forming a part of the Distribution Board shall comply with the relevant Standards and Codes of the Bureau of Indian

Standards and as per detailed specifications included in this tender document.

- c) The board shall be fabricated from 14 gauge CRCA sheet steel and shall have a hinged lockable spring-loaded cover. All cut-outs and covers shall be provided with synthetic rubber gaskets. The entire construction shall give an IP 54 degree of protection.
- d) The bus bar shall be of electrical grade copper having a maximum current density of 1 sqmm per square mm or AL 0.8 amp per sqmm and PVC insulated throughout the length.
- e) All the internal connections shall be with either solid copper PVC insulated or copper conductor PVC insulated wires of adequate rating.
- f) All the internal connections shall be concealed by providing a hinged protective panel to avoid accidental contact with live points.
- g) All outgoing equipment shall be connected direct to the bus bar on the live side. The equipment shall be mounted on a framework for easy removal and maintenance.
- h) The sheet steelwork shall undergo a rigorous rust proofing process, two coats of filler oxide primer and final powder coated paint finish.
- i) All the circuits shall have an independent neutral insulated wire, one per circuit, and shall be numbered and marked as required by the Client.
- j) A sample of the completed board is to be got approved by the Architects/Client before commencement of supply and erection.

4.0 SHEET STEEL TREATMENT AND PAINTING

- a) Sheet steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, in dilute sulphuric acid and a recognized phosphating process. The steelwork shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- b) All sheet steel shall after metal treatment is given powder coated finish painted with two coats of shade 692 to IS 5 on the outside and white on the inside. Each coat of paint shall be properly stored and the paint thickness shall not be less than 50 microns.

5.0 NAME PLATES AND LABELS

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

B. MEDIUM VOLTAGE SWITCHBOARDS

1.0 STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submit prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Low Voltage switchgear and control gear	IS:13947 (1993)
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Part I : General rules

Part II : Circuit Breakers

Part III : Switch, disconnectors, switch disconnectors and fuse combination units.

Part IV : Contractors and Motor starters

Part V : Control circuit devices and switching elements.

Marking of Switchgear busbars	IS:11353 (1985)
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Degree of Protection of Enclosures for low voltage switchgear	IS:2147 (1962)
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Electrical relays for power system protection	IS:3231 (1986)
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Code of practice for selection, installation and Maintenance of switchgear and control gear	IS:10118 (1982)
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Low voltage switchgear & control gear assemblies.	IS:8623 (1993)
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2.0 MEDIUM VOLTAGE AIR CIRCUIT BREAKERS

2.1 TECHNICAL PARAMETERS

The circuit breaker shall be of the air break type, robust and compact design suitable for indoor mounting and shall comply with the requirement of IS:13947 (1993) Rupturing capacity shall be 31 MVA at 415 Voltas or as per schedule of quantities.

2.2 CONSTRUCTIONAL FEATURES

- a) The Circuit Breaker shall be flush front, metal, clad, horizontal draw-out pattern, three/four pole as required and fully interlocked. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

- b) The Circuit Breaker cradle shall be designed and constructed to permit smooth withdrawal and insertion. The movement shall be free of jerks, easy to operate and positive.
- c) All current carrying parts in the breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts which shall be separate from the main contacts and easily replaceable. In addition, Arc chutes shall be provided for each pole, and these shall be suitable for being lifted out for the inspection of the main and the arcing contacts.
- d) Self aligning cluster type isolating contacts shall be provided for the Circuits Breaker, with automatically operated shutters to screen live cluster contacts when the Breaker is withdrawn from the cubicle. Sliding connections including those for the auxiliary contacts and control wiring shall also be of the self aligning type. The fixed portion of the sliding connections shall have easy access for maintenance purposes.
- e) The cubicle for housing the Breaker shall be free standing dead front pattern, fabricated from the best quality sheet steel.

2.3 OPERATING MECHANISM

- a) The Circuit Breaker shall be trip free with independent manual spring operated or motor would spring operated mechanism as specified and with mechanical ON/OFF indication. The operating mechanism shall be such that the circuit breaker is at all times free to open immediately the trip coil is energized.
- b) The operating handle and mechanical trip push button shall be at the front of and integral with the Circuit Breaker.
- c) The Circuit Breaker shall have the following four distinct and separate positions which shall be indicated on the face of the panel.

"Service" - Both main and secondary isolating contacts closed.

"Test" - Main isolating contacts open and secondary isolating contacts closed.

"Isolated" - Both main and secondary isolating contacts open.

"Maintenance" - Circuit Breaker fully outside the panel ready for maintenance.

2.4 CIRCUIT BREAKER INTERLOCKING

- a) Sequence type strain free interlocks shall be provided to ensure the following.

- b) It shall not be possible for the Breaker to be withdrawn from the cubicle when in the "ON" position. To achieve this, suitable mechanism shall be provided to lock the Breaker in the tripped position before the Breaker is isolated.
- c) It shall not be possible for the Breaker to be switch "ON" until it is either in the fully inserted position or, for testing purposes, it is in the fully isolated position.
- d) It shall not be possible for the Circuit Breaker to be plugged in unless it is in the OFF position.
- e) A safety catch shall be provided to ensure that the movement of the Breaker, as it is withdrawn, is checked before it is completely out of the cubicle, thus preventing its accidental fall due its weight.
- f) Mechanical and electrical anti pumping devices shall be incorporated in the MCCB/ACB's as required.

2.5 CIRCUIT BREAKER AUXILIARY CONTACTS.

The Circuit Breaker shall have minimum 6 No. and 6 N.C. auxiliary contacts rated at 16 amps 415 volts 50 Hz. These contacts shall be approachable from the front. They shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is Drawn out of the cubicle.

2.6 PROTECTIVE DEVICES

- a) The Circuit Breaker shall have protective devices as specified in the Schedule of Quantities. These will in general be.
- b) C.T. operated thermal overload releases with magnetic instantaneous short circuit release. The overload release shall be such at each phase can be individually set depending on the phase unbalanced currents. The released shall have inverse time current characteristics and the magnetic release shall be time delayed with a minimum setting of 25 ms varying upto 300 for discrimination without effecting the breaking current capacity of the ACB.
- c) Over voltage relay
- d) Under/no voltage trip coil or Relay as required.
- e) Over current and earth fault IDMT relays with shunt/series trip coil operation as specified.
- f) The circuit Breaker shall be suitable to accommodate one or more types of protection as specified.

2.7 INSTRUMENT TRANSFORMERS

The Circuit Breaker shall have the required Current Transformers as specified for metering and protection mounted outside the Circuit Breaker compartment

but within the free standing cubicle. The transformers shall comply to the relevant Indian Standards and the Class of Accuracy required for metering and protection. Separate sets of Current transformers shall be provided.

2.8 METERING

The metering required to be provided for each Circuit Breaker shall be as per the Schedule of Quantities. Such metering shall not be provided on the front panel of the Circuit Breaker compartment. A separate compartment shall be provided for the metering and Protective relays as required.

Square pattern flush mounting meters complying with the requirements of the relevant Indian Standards shall only be used.

Selector switches of the three way and OFF pattern complying to the relevant Indian Standards shall be used.

2.9 INDICATING LAMPS

Neon type indicating lamps shall be provided for indication of phases and Breaker position as required in the Schedule of Quantities.

2.10 CONTROL WIRING

All wiring for relays and meters shall be of copper conductor PVC insulated and shall be colour codes and labeled with appropriate plastic ferrules for identification. The minimum size of control wires to be used shall be 2.5 sq.mm.

All control circuits shall be provided with protective H.R.C. fuses. Instrument testing plugs shall be provided for testing the meters.

2.11 EARTHING

The frame of the Circuit Breaker shall be positively earthed when the Circuit Breaker is racked into the cubicle.

2.12 TYPE TEST CERTIFICATES

The Contractor shall submit type test certificates from a recognized test house for the Circuit Breakers offered.

3.0 SWITCH FUSE UNITS

3.1 Switch fuse units, incorporated in switchboards wherever required shall conform in all respects to IS 13947:1993. Switch fuse units shall be suitable for 415 Volts 3 phase 50 HZ AC supply.

Unit housing shall be of robust construction designed to withstand arduous conditions. Sheet steel used shall be given rigorous rust proofing treatment before fabrication and painting. Units shall have double break per phase in order to isolate fuse links when the switch is in OFF position.

Operating mechanism of units shall be crisp and positive in action with quick make and quick-break silver plated contacts. Operating handle shall be suitable for rotary operation unless otherwise specified. Position of handle such as ON and OFF shall be clearly indicated.

All live parts inside the switch fuse unit shall be shrouded to prevent any accidental contact.

All the terminals shall be liberally designed. All units above 100 A shall be provided with integral cable sockets.

All switch units shall be provided with suitable interlocks such that the door of the switchboard panel shall not open unless the switch is in OFF position. Provision for padlocking the switch in OFF position shall also be provided.

Route and type tests as per IS 13947: 1993 shall be conducted at works and test certificates furnished.

4.0 MOULDED CASE CIRCUIT BREAKERS

4.1 Moulded case circuit breakers (MCCB) or fuse free breakers, incorporated in switchboards wherever required, shall conform to IS 13947 : 1993 in all respects. MCCB shall be suitable either for single phase 240 Volts or 3 phase 415 Volts AC 50 HZ supply.

4.2 MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip free type. Operating handle shall have suitable ON, OFF and TRIPPED indicators. Three phase MCCBs shall have a common handle arc simultaneous operation and tripping of all the three phases. Suitable arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermal/magnetic type provided on each pole and connected by a common tripping bar such that tripping of any one pole causes three poles to open simultaneously. Thermal/magnetic tripping device shall have IDMT Characteristics for sustained over loads and short circuits.

4.3 Contact trips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances.

4.4 MCCB's shall be provided with following accessories, if specified in drawings/schedule of quantities:

- a) Under voltage trip
- b) Shunt trip
- c) Alarm switch
- d) Auxiliary switch

MCCBs shall be provided with following interlocking devices for interlocking the door of a switch board.

- e) Handle interlock to prevent unnecessary manipulations of the breaker.

- f) Door interlock to prevent door being opened when the breaker is in ON position.
- g) De-interlocking device to open the door even if the breaker is in ON position.

MCCBs shall have rupturing capacity as specified in drawings/ schedule of quantities.

5.0 METERING, INSTRUMENTTATION AND PROTECTION.

Ratings, type and quantity of meters, instruments and protective devices shall be as per drawings and schedule of quantities.

5.1 CURRENT TRANSFORMERS

C/T shall conform to IS 2705 (part-I, II and III) in all C/Ts used for medium voltage application shall be rated for 1 KV. C/Ts shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 to 1 and for protection class 10. C/Ts shall be capable of withstanding magnetic and thermal stresses due to short circuit faults of 31 MVA on medium voltage. Terminals of C/Ts shall be paired permanently for easy identification of poles. C/Ts shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each C/T shall be provided with rating plate indicating:

- a) Name and make
- b) Serial number
- c) Transformation ratio
- d) Rated burden
- e) Rated voltage
- f) Accuracy class

CTs shall be moulded such that they are easily accessible of inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

5.2 POTENTIAL TRANSFORMER

PTs shall conform to IS 3156 (Part-I, II and III) in all respects.

5.3 MEASURING INSTRUMENTS

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between - 10o C and +50o C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from out side. Direction of deflection shall be from left to right. Selector switches shall be provided for ammeters and volt meters used in three phase system.

5.4 AMMETERS

Ammeters shall be of moving iron type. Move part assembly shall be with jewel bearings. Jewel bearings shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks.

Ammeters shall be manufacture and calibrated as per IS 1248. Ammeters shall normally be suitable for 5 A secondary of current transformers. Ammeters shall be capable of carrying substantial over loads during fault conditions.

5.5 VOLTMETERS

Voltmeters shall be moving iron type range of 3 phase 415 volt voltmeters shall be 0-500. Volt meters shall be provided with protection fuse.

5.6 WATT METER

Wattmeter shall be of 3 phase electro dynamic type and shall be provided with a maximum demand indicator if required.

5.7 POWER FACTOR METERS

3 phase power factor meters shall be of electro dynamic type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% readings. Phase angle accuracy shall be $\pm 4^\circ$.

5.8 ENERGY AND REACTIVE POWER METERS

Trajectory meters shall be two element, integrating type, KWH, KVA, KVA hour reactive meters. Meters shall conform to IEC 170 in all respects. Energy meters, KVA, and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy conception of 500 hours corresponding to maximum current at rated voltage and unity power factor. Meters shall be suitable for operation with current and potential transformers available in the panel.

5.9 RELAYS

Protection relays shall be provided with flag type indicators to indicate cause of tripping. Flag indicators shall remain in position till they are reset by hand reset. Relays shall be designed to make or break the normal circuit current with which they are associated. Relay contacts shall be of silver or platinum alloy and shall be designed to withstand repeated operation without damage. Relays shall be of draw out type to facilitate testing and maintenance. Draw out case shall be dust tight. Relays shall be capable of disconnecting faulty section of network without causing interruption to remaining sections. Analysis of setting shall be made considering relay errors, pickup and overshoot errors and shall be submitted to Architect/Client for approval.

5.10 OVER CURRENT RELAYS

Over current relays shall be induction type with inverse definite minimum time lag characteristics. Relays shall be provided with adjustable current and time settings. Setting for current shall be 50 to 200 % in steps of 25%. The IDMT relay shall have time lag (delay) of 0 to 3 seconds. The time setting multiplier shall be adjustable from 0.1 to unity. Over current relays shall be fitted with suitable tripping device with trip coil being suitable for operation on 5 Amps.

5.11 EARTH FAULT RELAY

Same as over current relay excepting the current setting shall be 10% to 40% in steps of 10%.

5.12 UNDER VOLTAGE RELAY

Under voltage relays shall be of induction type and shall have inverse limit operation characteristics with pickup voltage range of 50 to 90% of the rated voltage.

6.0 POWER FACTOR CORRECTION CAPACITORS

Power factor correction capacitors shall conform to IS 2834 in all respects. Approval of insurance association of India shall be obtained if called for. Capacitors shall be suitable for 3 phase 415 volts 50 HZ supply and shall be available in single and three phase units of 5,10,15,20,25 and 50 KVAR sizes. Capacitor shall be usable for indoor use, permissible overloads being as below.

- a) Voltage overloads shall be 10% for continuous operation and 15% for six hours in a 24 hours cycle.
- b) Current overloads shall be 15% for continuous operations and 50% for six hours in a 24 hours cycle.
- c) Over load of 30% continuously and 45% for six hours in a 24 hours cycle.

Capacitors shall be heretically sealed in sturdy corrosion proof sheet steel containers and impregnated with non inflammable synthetic liquid. Every fuse. Capacitors shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 volts or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnates. The capacitors shall withstand power frequency test voltage of 2500 volts AC for one minute. Insulation resistance between capacitors terminals and containers when a test voltage of 500 volts DC is applied shall not be less than 50 meg. ohms.

7.0 MEDIUM VOLTAGE SWITCH BOARDS

7.1 GENERAL

- a) All medium voltage switchboards shall be suitable for operation at three phase/three phase 4 wire, 415 volt, 50 Hz, neutral grounded at transformer system with a short circuit level withstand of 31 MVA at 415 volts or as per schedule of quantities.
- b) The Switch Boards shall comply with the latest edition with upto date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

7.2 SWITCH BOARD CONFIGURATION

- a) The switch Board shall be configured with Air Circuit Breakers, MCCBs and other equipment as called for in the Schedule of Quantities.
- b) The MCCB's shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.
- c) The Switch Boards shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear.

7.3 EQUIPMENT SPECIFICATIONS

All equipment used to configure the Switch Board shall comply to the relevant Standards and codes of the Bureau of Indian Standards and to the detailed technical specifications as included in this tender documents.

7.4 CONSTRUCTIONAL FEATURES.

- a) The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.
- b) The Switch Board shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proofs to provide a degree of protection of IP 54. All doors and covers shall also be fully gasketed with synthetic rubber and shall be lockable.
- c) The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.

- d) All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.
- e) Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switch Boards.

7.5 SWITCHBOARD DIMENSIONAL LIMITATIONS

- a) A base channel 75mmX5mm thick shall be provided at the bottom.
- b) A minimum of 200mm blank space between the floor of switch board and bottom most unit shall be provided.
- c) The overall height of the Switch Board shall be limited to 2300 mm.
- d) The height of the operating handle, push buttons etc. shall be restricted between 300mm and 2000mm from finished floor level.

7.6 SWITCH BOARD COMPARTMENTALISATION

The Switch Board shall be divided into distinct separate compartments comprising.

- a) A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical busbars.
- b) Each circuit breaker and MCCB shall be housed in separate compartments enclosed on all sides.
- c) Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker/switch fuse unit in "on" and "off" position.
- d) For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connections.
- e) A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.
- f) Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.
- g) Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top.
- h) Adequate and proper support shall be provided in cable compartments to support cables.

7.7 SWITCH BOARD BUS BARS

- a) The Bus Bar and interconnections shall be of electrolytic Copper and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. The maximum current density for copper shall be 1.6 amps per sq.mm. and suitable to withstand the stresses of a 31 MVA fault level or at 415 volts for 1 second or as per schedule of quantities.
- b) The bus bars and interconnections shall be insulated with insulation tape/fiber glass.
- c) The bus bars shall be extensible on either side of the Switch Board.
- d) The Bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.
- e) All bus bars shall be color coded.
- f) All bus bar connections in Switch Boards shall be bolted with brass bolts and nuts. Additional cross section of bus bars shall be provided wherever holes are drilled in the bus bars.

7.8 SWITCH BOARD INTERCONNECTIONS

- a) All connections between the bus bars/breakers/cable terminations shall be through solid copper strips of adequate size to carry full rated current and PVC/fiber glass insulated.
- b) For unit ratings up to 100 amps PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of all such interconnections shall be crimped.

7.9 DRAWOUT FEATURES

Air Circuit Breakers shall be provided in fully draw out cubicles. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self aligning and self isolating contacts. The fixed and moving contacts shall be easily accessible for operation and maintenance. Mechanical interlocks shall be provided on the draw out cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

7.10 INSTRUMENT ACCOMODATION

- a) Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switch Board.

- b) For MCCB's instruments and indicating lamps can be provided on the compartment doors.
- c) The current transformers for metering and for protection shall be mounted on the solid copper/aluminum bus bars with proper supports.

7.11 WIRING

All wiring for relays and meters shall be with PVC insulated copper conductor wires. The wiring shall be coded and labelled with approved ferrules for identification. The minimum size of copper conductor control wires shall be 1.5 sq.mm.

7.12 CABLE TERMINATIONS

- a) Knockout holes of appropriate size and number shall be provided in the Switch Board in conformity with the location of incoming and outgoing conduits/cables.
- b) The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear of the panel.
- c) The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.
- d) The Switch Boards shall be complete with tinned brass cable sockets, tinned brass compression glands, gland plates, supporting clamps and brackets etc for termination of 1100 volt grade aluminum conductor PVC/PVCA cables

7.13 SPACE HEATERS

The Switch Board shall have in each panel thermostatically controlled space heaters with a controlling 15 amp 230 volt switch socket outlet to eliminate condensation.

7.14 EARTHING

A main earth bar of G.I./copper as required shall be provided throughout the full length of the Switch Board with a provision to make connections to the sub-station earths on both sides.

8.0 SHEET STEEL TREATMENT AND PAINTING

- a) Sheet steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, decaling in dilute sulphuric acid and a recognized phosphating process. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.
- b) All sheet steel shall after metal treatment be spray or powder painted with two coats of shade 693 to IS 5 on the outside and white on the inside. Each coat of

paint shall be properly stored and the paint thickness shall not be less than 50 microns.

9.0 NAME PLATES AND LABELS

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

10.0 INSTALLATION

The foundations prepared as per the manufacturers drawings shall be leveled, checked for accuracy and the Switch Board installed. All bus bar connections shall be checked with a feeler gauge after installation. The cable end boxes shall be sealed to prevent entry of moisture. The main earth bar shall be connected to the sub-station earths. A 15 mm thick rubber matting of approved make on a 100 mm high timber platform shall be provided in front of and along the full length of the Switch Board. The width of the matting shall be 1000 mm. The rubber mat shall withstand 15 KV for 1 minute and leakage current shall not exceed 160 mm.sq. meter. After installation the Switch Board shall be tested as required prior to commissioning.

ANNEXURE – I
List of Approved Makes

S. No	Equipment/Material	Approved Manufacturer Name
1.	Numeric Type Protection Relays	Siemens L&T ABB Schneider
2.	LT Panels & Distribution Boards	Adlec Control System Advance Panels & Switchgear Ambit Switchgear Pvt. Ltd. SPC Electrotech Madhu Electricals
3.	Air Circuit Breakers / Moulded Case Circuit Breaker / MPCB / Contactors	Siemens Schneider Electric L&T ABB
4.	Final Distribution Boards / MCB/RCCB	Siemens Schneider Electric ABB L&T Hager Legrand
5.	Control Transformer / Potential Transformers (Epoxy Cast Resin)	Automatic Electric Gilbert & Maxwell Precise Pragati Matrix Kappa
6.	Indicating Lamps LED type and Push Button	Schneider Electric Siemens ESBEE Teknik Vaishno Kaycee
7.	Digital Meters	Siemens Schneider Electric L&T Automatic Electric
8.	LT Cables	Polycab KEI Batra Henlay Skytone RPG Cables RR Kabel
9.	Termination kits	3M Raychem
10.	Double Compression Cable Glands with earthing links	Dowells Comet

S. No	Equipment/Material	Approved Manufacturer Name
11.	Bimetallic Cable Lugs	Dowels Comet Cosmos
12.	PVC Insulated HFFR Wires	Polycab KEI Batra Henlay Finolex Bonton
13.	Terminal Blocks	Connect well Elmex Wago
14.	Industrial Socket outlets	BCH Neptune Balls Crompton Greaves Clipsal Legrand
15.	Cable Trays & Raceways	Ricco MEM Profab MK Indeana Engineering
16.	Accessories for Supporting system	Hilti Fisher
17.	Fire Sealant & Paints	3M Hilti Promat
18.	Insulating Mats	DL Miller & Co. Premier Polyfilm Ltd RMG Polyvinyl India Ltd Jyoti
19.	Earthing Protection System	Erico Dehn Obo Betterman L&T
20.	Capacitors, Harmonic Filters & APFC Relay	Epcos Matrix Schneider Electric Neptune L&T
21.	Metal Conduit & Accessories	BEC AKG
22.	Accessories for Metal Conduits	Sharma Sales Super Sales

S. No	Equipment/Material	Approved Manufacturer Name
23.	PVC / PVC FRLS Conduit & Accessories	BEC AKG Polypack Precision
24.	Switch & Sockets (Range as per approved sample only)	Crabtree Wipro Northwest Schneider ABB Lumina Legrand Arteor
25.	LED Light Fixtures, Drivers & Accessories (Range as per approved sample only)	Philips Wipro OPPLE Legero
26.	Dimmers	Crestron Lutron
27.	Occupancy & Day Light Sensors	Philips Wipro Legrand
28.	Ceiling Fan / Exhaust Fan	Havells Crompton Greaves Bajaj Usha
29.	External light fixtures with controls and accessories	Philips Wipro Ligman Keselec Bajaj
30.	Telephone Tag Blocks & Connectors	Krone TVS Network Cables
31.	Cat 6 e cables	Amp Molex Schneider Systimax Fusion Polymer
31.	Telephone cables	Delton Cables Finolex Polycab Skytone

S. No	Equipment/Material	Approved Manufacturer Name
33.	UPS	Eaton Emerson APC ABB
34.	Batteries SMF	Exide Amar Raja Global (Rocket) Panasonic