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12. TECHNICAL  
SPECIFICATIONS FOR  
MEDIUM VOLTAGE PANEL

## TECHNICAL SPECIFICATIONS FOR MEDIUM VOLTAGE PANEL

### 1.0

#### SCOPE OF WORK

- 1.1 This scope shall cover design, manufacture, check test, and supply of medium and low voltage motor/power control Panel boards, MCB distribution boards etc. as described in this specification, as per drawings and schedule of quantities.

### 2.0

#### CODES & STANDARDS

- 2.1 The Panels shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian standards shall be complied with:

Sr.	Item	Relevant IS	Relevant IEC
1	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237	
2	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375	
3	Degree of protection provided by enclosures for Low voltage switch gear and control gear.	IS: 2147	
4	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197	
5	Danger notice plates	IS: 2551	
6	Code of Practice for selection, installation and maintenance of switchgear and control gear.	IS: 10118	
7	Specification for factory built assemblies of switchgear and control gear for voltage up to and including 1000 V AC and 1200 V D.C.	IS: 8623	
8	Miniature circuit breakers.	IS: 8828	
9	Current transformers	IS: 2705	
10	Voltage transformer	IS: 3155	
11	Electrical relay for protection	IS: 3231	
12	Indicating instruments	IS: 1248	
13	Integrating instruments	IS: 722	
14	Control switches and push buttons	IS: 6875	
15	AC motor starters of voltage not exceeding 1000 V	IS: 1822	

The Panels also require approval of the client/consultant at various stage of their manufacture such as design, selection, construction, testing, shipping etc.

Site conditions					
Location Gujarat			Site altitude 81M above mean sea level		
Ambient temperature			Relative humidity		
Maximum 45 ° C			Maximum 85 %		
Minimum 13 ° C			Minimum 25 %		
Design 50 ° C			Design 90 % at 50 ° C		
Seismic factor Zone III as per IS:1893			Rainfall 618mm/year		
Environmental Tropical conditions			Location of Equipment Indoor		
Electrical system data:					
Power supply for Equipment					
Voltage 415 kV ± 5 %			Frequency 50 Hz ± 3 %		
Permissible voltage & variation		combined frequency ± 6 %	System design faults level (Symmetrical)		15 kA for 1 sec. max.
System earthing LV side neutral solidly earthed			Wiring 3 phase, 4 wire on 415V system		
Auxiliary power supply :-----					
Power supply			240V AC, 1-Ph, 50Hz		
Control Supply			-----		
Space heater power supply			240V AC, 1-Ph, 50Hz		
Illumination power supply			240V AC, 1-Ph, 50Hz		
Plug-socket power supply			240V AC, 1-Ph, 50Hz		

All the Panels shall be metal clad, totally enclosed, rigid, floor mounting, air insulated, cubicle type suitable for operation on three phase/single phase, 415 V/240 V, 50 Hz., neutral effectively grounded at transformer and short circuit level as mentioned in the drawings.

All the outdoor panel shall be double door type with IP54 protection class construction.

All the indoor panel shall have IP51 protection class construction.

The painting of all the metal part shall be as per the painting specification defined in the datasheet.

The Panels shall be designed to withstand heaviest condition at site, with maximum expected ambient temperature of 45°C, 90% humidity and salty, dusty weather.

#### CUBICAL TYPE PANELS:

##### 4.1 STRUCTURE

4.1.1 The Panels shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type.

4.1.2 All CRCA sheet steel used in the construction of Panels shall be 2 mm. thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.

- 4.1.3 The Panels shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP: 51. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasketed with foam rubber and/or rubber strips and shall be lockable.
- 4.1.4 All panels and covers shall be properly fitted and secured with the frame and holds in the panel correctly positioned. Fixing screws shall enter into holes, taped into an adequate thickness of metal or provided with bolts and nuts. Self-threading screws shall not be used in the construction of Panels.
- 4.1.5 A base channel of 100 mm. x 50 mm. shall be provided at the bottom. A clearance of 300 mm. between the floor of the Panels and the bottom of the lower most units shall be provided.
- 4.1.6 Panels shall be preferably arranged in multi-tier formation. The Panels shall be of adequate size with a provision of 20% spare space to accommodate possible future additional switchgear. The size of the Panels shall be designed in such a way that the internal space is sufficient for hot air movement and the electrical component does not attain temperature more than 45<sup>0</sup>c. The entire electrical component shall be derated for 50<sup>0</sup>c. The ratings indicated in the drawing are derated for 50<sup>0</sup>c.
- 4.1.7 Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the number, and the size of incoming and outgoing conduits/cables.
- 4.1.8 Alternately, the Panels shall be provided with removable sheet steel plates at top and bottom to drill holes for cable/conduit entry at site.
- 4.1.9 The Panels shall be designed to facilitate easy inspection, maintenance and repair.
- 4.1.10 The Panels shall be sufficiently rigid to support the equipment without distortion under normal and under short circuit condition. They shall be suitably braced for short circuit duty.
- 4.2 PROTECTION CLASS:
- 4.2.1 All the indoor Panels shall have protection class of IP 51 for indoor installation and IP 54 for outdoor installation.
- 4.3. PAINTING:
- 4.3.1 The painting shall be with 2 coats of epoxy primer along with two coats of PU paint [Anti-corrosive paint]. Paint shade shall be confirmed with the client.
- 4.4 CIRCUIT COMPARTMENTS:
- 4.4.1 Each circuit breaker and switch fuse unit shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker/switch fuse unit in 'ON' and 'OFF' position. Safety interlocks shall be provided for air circuit breaker to prevent the breaker from being drawn out when the breaker is in 'ON' position.
- 4.4.2 The door shall not form an integral part of draw out position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.
- 4.5 INSTRUMENT COMPARTMENTS:
- 4.5.1 Separate adequate compartment shall be provided for accommodating instruments, indicating lamps, control contactors/relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker/switch fuse unit, busbar and connections.

4.6 BUS-BARS:

- 4.6.1 The busbar shall be air insulated and made of high quality, high conductivity, high strength Aluminum.
- 4.6.2 The busbar shall be of 3 phases and neutral system with separate neutral and earth bar. The bus bar and interconnection between bus bars and various components shall be of high conductivity Aluminum. The busbar shall be of rectangular cross-section designed to withstand full load current for phase bus bars and half rated current for neutral bus bars and shall be extensible on either side. The busbar size shall be as per drawing. The busbar shall have uniform cross-section throughout the length.
- 4.6.3 The bus bars and interconnections shall be insulated with heat shrinkable PVC sleeve and be colour coded in red, yellow, blue and black to identify the 3 phases and neutral of the system if specified in datasheet. The busbar shall be supported on unbreakable, non-hygroscopic SMC/DMC insulated supports at sufficiently close intervals to prevent bus bars sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 15 KA RMS symmetrical for 1 sec. and a peak short circuit withstand of 31.5 KA minimum.
- 4.6.4 The bus bar shall be housed in a separate compartment. The bus bar shall be isolated with 3 mm. thick Bakelite sheet to avoid any accidental contact. The bus bar shall be arranged such that minimum clearance between the bus bars to be maintained as below:
- |                            |   |                |
|----------------------------|---|----------------|
| Between phases             | : | 25 mm. minimum |
| Between phases and neutral | : | 25 mm.         |
| Between phases and earth   | : | 25 mm.         |
| Between neutral and earth  | : | 20 mm. minimum |
- 4.6.5 All bus bar connections shall be done by drilling holes in bus bars and connecting by chromium plated or tinned plated brass bolts and nuts. Additional cross-section of bus bar shall be provided in all Panels to cover up the holes drilled in the bus bar. Spring and flat washers shall be used for tightening the bolts.
- 4.6.6 All connections between bus bars and circuit breakers/switches and cable terminals shall be through aluminum strips of proper size to carry full rated current. These strips shall be insulated with insulating tapes.

4.7 ELECTRICAL POWER AND CONTROL WIRING CONNECTION:

- 4.7.1 Terminal for both incoming and outgoing cable connections shall be suitable for 1100 V grade, aluminum/copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solder-less sockets for the cable size as indicated on the appended drawings for the Panels.
- 4.7.2 Power connections for incoming feeders of the main Panels shall be suitable for 1100 V grade aluminum conductor (LT XLPE) cables.
- 4.7.3 Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.
- 4.7.4 Both control and power terminals shall be properly shrouded.
- 4.7.5 10% spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block, so that not more than one outgoing wire is connected per terminal.
- 4.7.6 Terminal strips for power and control shall preferably be separated from each other by suitable barriers of enclosures.

- 4.7.7 Wiring inside the modules for power, control, protection and instruments etc. shall be done with use of 660/1100 V grade, PVC insulated copper conductor cables conforming to IS: 694 and IS: 8130. Power wiring inside the starter module shall be rated for full current rating of respective contactor, but not less than 4.0 sq.mm. cross-section area. For current transformer circuits, 2.5 sq.mm. copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq.mm. copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solderless sockets at the ends before connections are made to the terminals.
- 4.7.8 Control power for the Motor starter module shall be taken from the respective module switchgear outgoing. Control power wiring shall have control fuses, (HRC fuse type) for circuit protection. All indicating lamps shall be protected by HRC fuses.
- 4.7.9 Particular care shall be taken to ensure that the layout of wiring is neat and orderly. Identification ferrules shall be fitted to all the wire termination for ease of identification and to facilitate checking and testing.
- 4.7.10 Spring type washers shall be used for all copper and aluminium connections.
- 4.7.11 Final wiring diagram of the Panels power and control circuit with ferrules numbers shall be submitted along with the Panels as one of the documents against the contract.
- 4.8 TERMINALS:
- 4.8.1 The outgoing terminals and neutral link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformers for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted; only one conductor may be connected in one terminal.
- 4.9 WIRE-WAYS:
- 4.9.1 A horizontal PVC wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.
- 4.10 CABLE COMPARTMENTS:
- 4.10.1 Cable compartments of adequate size shall be provided in the Panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in the cable compartments to support cables. All outgoing and incoming feeder terminals shall be brought out to terminal blocks in the cable compartment.
- 4.11 EARTHING:
- 4.11.1 Copper earth bus of 40 X 6 mm shall be provided in the Panels for the entire length of the panel. The frame work of the Panels shall be connected to this earth bar. Provisions shall be made for connection from this earth bar on both sides of the panels to the main earthing bar coming from the earth pit. Door earthing shall be provided for all the compartments.
- 4.11.2 The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be made for connection from this earth pit on both sides of the Panels.
- 4.11.3 The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be ultimately bonded with the earth bar.

4.12 LABELS:

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

4.13 NAME PLATE:

- 4.13.1 A name plate with the Panel's designation in bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door.
- 4.13.2 Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc. shall suitably be identified by providing stickers.
- 4.13.3 Engraved name plates shall preferably be of 3 ply, (Red-White-Red or Black-White-Black) lamicold sheet. However, black engraved Perspex sheet name plates shall also be acceptable. Engraving shall be done with square groove cutters.
- 4.13.4 Name plate shall be fastened by counter sunk screws and not by adhesives.

4.14 DANGER NOTICE PLATES:

- 4.14.1 The danger notice plate shall be affixed in a permanent manner on operating side of the Panels.
- 4.14.2 The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.
- 4.14.3 The danger notice plates, in general, meet the requirements of local inspecting authorities.
- 4.14.4 Overall dimensions of the danger notice plate shall be 200 mm. wide x 150 mm. high.
- 4.14.5 The danger notice plate shall be made from minimum 1.6 mm. thick mild steel sheet and after due pre-treatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.
- 4.14.6 The letters, the figures, the conventional skull and bones etc. shall be positioned on plate as per recommendation of IS: 2551-1982.
- 4.14.7 The said letters, the figures and the sign of skull and bones shall be painted in signal red colour as per IS: 5-1978.
- 4.14.8 The danger plate shall have rounded corners. Location of fixing holes for the plate shall be decided to suit design of the Panels.
- 4.14.9 The danger notice plate, if possible, be of ISI certification mark. Suitable Voltage rated rubber mates to be provided.

4.15 INTERNAL COMPONENTS:

- 4.15.1 The Panels shall be equipped complete with all types of required number of auto transformer starters, switch fuse units, contactors, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, bus bars, cable boxes, cable glands etc. and all the necessary internal connections/wiring as required and as indicated on relevant drawings. Components necessary for the proper and complete functioning of the Panels but not indicated on the drawings shall be supplied and installed on the Panels.

- 4.15.2 All parts of the Panels carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at the part of the Panels.
- 4.15.3 All units of the same rating and specifications shall be fully interchangeable.

#### COMPONENTS

##### 4.16 GENERAL:

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

##### 4.17 MINIATURE CIRCUIT BREAKERS:

- 4.17.1 Miniature Circuit breakers shall be current limiting type conformed with British standard BS: 3871 (Part I) 1965 and IS: 8825. The housing of MCBs shall be heat resistant and having a high impact strength. The fault current of MCBs shall not be less than 9000 A at 230 V. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical 'ON' and 'OFF' indications.
- 4.17.2 The circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit.
- 4.17.3 The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCBs shall be provided with magnetic fluid plunger release for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCBs shall be tested and certified as per Indian Standards, prior to installation.

##### 4.18 FUSE:

- 4.18.1 Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS: 2000-1962 and having high rupturing capacity of not less than 35 MVA at 415 V. The back-up fuse rating for each motor/equipment shall be so chosen that the fuse does not operate on starting of motors/equipment. HRC fuses shall be of the make as specified in Make of Material.

##### 4.19 AIR CIRCUIT BREAKER:

###### 4.19.1 Construction:

The ACBs shall have following features:

1. Motorized with 230 V A.C. motor.
2. 230 V A.C closing and shunt trip coil
3. Draw out type with "service", "test", "isolated" and "maintenance" position.
4. Safety shutter of Fibre glass/polycarbonate sheet of 2mm thickness shall be provided
5. Mechanically trip free plus anti-pumping feature is to be provided.
6. Electrical trip free plus anti pumping shall be provided with relay ONLY and not by contactors.



7. Electrical/Mechanical operation counter shall be provided.
8. Door interlock with defeat features to be provided.
9. ACB shall be lockable in isolation position.

4.19.2 Release:

1. Thermal Magnetic release shall be direct acting type, tripping ACB mechanically.
2. Short circuit, overload and earth fault protection shall be provided.
3. Vendor to suggest release type for feeders of supply range characteristic and accuracy.

4.19.3 ACB Performance:

1. ACB performance inside panels at ambient 50 Degree.
2. Ith Symmetrical breaking, 35KA
3. Making capacity peak 87.5 KA
4. Short time rating, 1sec. 35KA

4.20 CONTACTORS:

4.20.1 The contractors shall meet with the requirements of IS: 2959 and BS: 775.

The contractors shall have minimum making and breaking capacity in accordance with utilisation category AC3 and shall be suitable for minimum Class II intermittent duty.

If the contractor forms part of a distribution board then a separate enclosure is not required, but the installation of the contractor shall be such that it is not possible to make an accidental contact with live parts.

4.21 CURRENT TRANSFORMER:

4.21.1 Where ammeters are called for C.T.s shall be provided for current measuring. Each phase shall be provided with separate current transformer of accuracy Class I and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS: 2705 - 1964 as amended upto date.

4.22 PUSH BUTTONS:

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

4.23 INDICATING LAMPS:

4.23.1 Indicating lamps shall be transformer operated low voltage rated and shall be supplied complete with translucent covers to diffuse the lamp light.

Colour shade for the indicating lamps shall be as below – the LED shall be 22.5 mm and self coloured:

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

4.24 DIGITAL MULTI FUNCTION METER

- 4.24.1 The load manager shall be digital type with RS485 port. It should measure KW, KVA, KVAR, V, I, PF etc.
- 5.0 DRAWING & INFORMATION
- 5.1 Prior to fabrication of the Panels the supplier/contractor shall submit for consultant's approval the shop/vendor drawing consisting of G.A. drawing, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuiting rating of all the electrical components used, busbar size, internal wiring size, Panels dimension, colour, mounting details etc.. The contractor shall submit manufacturer's catalogues of the electrical components installed in the Panels.
- 6.0 INSPECTION & TESTING
- 6.1 At all reasonable times during production and prior to transport of the Panels to site, the supplier/contractor shall arrange and provide all the facilities at their plant for inspection.
- 6.2 Testing of Panels shall be carried out at factory and at site as specified in Indian standards in the presence of consultant. The test results shall be recorded on a prescribed form. The test certificate for the test carried out at factory and at site shall be submitted in duplicate to the consultant for approvals.
- 7.0 METHOD OF MEASUREMENT
- 7.1 All the items will be measured as mentioned in Bill of quantity.
- 8.0 TRANSPORT, DELIVERY & STORAGE
- 8.1 The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of site or site store. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.
- 9.0 GUARANTEE & WARRENTY
- 9.1 The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier.
- 10.0 SPARES
- 10.1 The bidder shall quote for minimum spares required for **two years** safe operation of transformer along with the offer separately.
- 11.0 ATTACHMENTS
- 11.1
- Data Sheet

NOTE: VENDOR MUST HAVE CPRI APPROVED LICENSE FOR ELECTRICAL PANEL MANUFACTURING.

TECHNICAL DATA SHEET FOR MEDIUM VOLTAGE DISTRIBUTION BOARD

SR. NO.	PARTICULARS	DESCRIPTION
1.0	SITE CONDITION	
1.1	Type	Indoor
1.2	Mounting	Floor, Indoor
1.3	Ambient Temperature	50° C.
1.4	Atmosphere	Corrosive, Humid & Dusty
2.0	OPERATIVE CONDITION	
2.1	Voltage	415 V $\pm$ 10 %
2.2	No. Of Phase	3
2.3	System	3 $\emptyset$ , 4 WIRE
2.4	Frequency	50 HZ, + 3 % / - 6 %.
2.5	Fault Level	18 MVA
2.6	Fault Current	As per SLD
3.0	CONTROL SYSTEM	
3.1	Voltage	230 V A.C.
	For Indication	230 V A.C.
	For Metering	230 V A.C.
	For Protection	230 V A.C.
3.2	Control Supply Through Control Transformer	230 V A.C. only
3.3	Control Wiring	2.5 MM <sup>2</sup> FRLS Cu. Wire
		4.0 MM <sup>2</sup> FRLS cu. Wire for CT ckt.
4.0	BUSBAR	
4.1	Phase Bus bar	
A.	Material	Copper
B.	Support	SMC/DMC
C.	Insulation	Epoxy Moulded ( Resin )
D.	Insulating Barriers	Fibre Glass / Poly Carbonate Of Minimum 1.5 Mm Thick And To Be Of Fr4 Class
E.	Current Density	1.0 Amp. / mm <sup>2</sup>
4.2	Neutral Bus bar Material	Copper
4.3	Earth Bus bar Material	GI
5.0	Source changeover System	Not Required
6.0	PAINTING	
6.1	Sheet Should Be 7 Tank Processed, Oven Baked At 310°C. With Powder coating.	
6.2	Type Of Primer	EPOXY PRIMER
6.3	Type Of Paint	RAL 7032
6.4	Shade	Shall be confirmed with client
	Exterior	Shall be confirmed with client
6.5	Interior	IP 51
6.6	Degree Of Protection	35 ° C. above ambient
	Max. Temperature Rise Inside The Panel (°C.)	
7.0	CONTROL WIRING	
7.1	Wire Size	According to Load
8.0	HARDWARE ( ZINC PLATED )	YES
9.0	SPACE HEATER	230 V A.C. With thermostat control
10.0	POCKET FOR DRAWINGS AT DOOR	YES
11.0	Illumination and switched power plug	YES