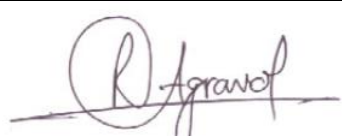


TECHNICAL SPECIFICATIONS
OF
MCC HOUSE
FOR
MUD SYSTEM TEST FACILITY
FOR
BHEL HYDERABAD



SPECIFICATION NO:	OR12687
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CONTROL EQUIPMENT ENGINEERING DIVISION
BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL-462022 (INDIA)

SPECIFICATIONS FOR MCC HOUSE FOR MUD SYSTEM TEST FACILITY

PART - I

This specification covers the requirement for design, manufacturing, testing, & supply of Power Control Room (MCC house) for Mud System Test facility for oil rigs for M/s BHEL Hyderabad. MCC house shall be a fabricated steel housing mainly containing Incomer Feeder & Starters. The MCC house shall be transportable type fabricated steel housing built on oil field skid suitable for outdoor application.

The general requirements of the equipment shall be as per this specification however for any other details, if required, supplier can ask for specific information from BHEL.

PART- I of the specification covers the commercial and other terms & conditions for supply of MCC house as detailed below:-

1.0 Scope of supply / work

Supply of MCC House as per OGA Drg - 17211013364 comprising of MCC panel & other accessories etc. as per Part-II of this specifications.

Details of supply & scope of work has been incorporated in "PART – II TECHNICAL DETAILS & SPECIFICATION OF THE MCC HOUSE"

2.0 DELIVERY SCHEDULE AND COMPLETION :

- 2.1 Delivery period for material shall be within 10 weeks (F.O.R destination) from the date of approval of drawings / documents by BHEL after placement of Purchase Order. Delivery of consignment shall done on F.O.R destination basis at BHEL Bhopal. Freight and transit Insurance shall be in scope of supplier.

3.0 OFFER SUBMISSION :

Offer to be submitted in Two bid system as per BHEL General Terms and Conditions of tender BP200102.

The bids shall be evaluated based upon "Total Cost to BHEL" which will include taxes, duties, freight upto BHEL Bhopal, insurance, loadings due to noncompliance of BHEL commercial terms etc., as applicable as per standard procedure of BHEL.

4.0 PAYMENT TERMS :

BHEL standard conditions for payment terms & payment schedule as per BP200102 shall be applicable.

5.0 SUBMISSION OF DOCUMENTS :**5.1 SUBMISSION OF DOCUMENTS ALONG WITH TECHNICAL BID (PART-1) :**

- a. Complete technical offer in line with requirements of specification. Clause wise comments on all the clauses of the specification.
- b. Structural features with construction details of Power Control Room.
- c. Structural features with construction details of MCC panel.
- d. Signed copy of BHEL drawings for compliance or bidder to submit their offered design meeting BHEL specifications.
- e. List of Commissioning spares to be supplied by supplier with MCC House as part of package.

5.2 DOCUMENTS TO BE SUBMITTED FOR APPROVAL AFTER PLACEMENT OF PO :

Supplier to submit following documents for approval of BHEL within 10 days after receipt of PO. BHEL shall approve or offer comments on the same within 7 days and send it back to supplier for further action.

- i) Outline & layout drawing of House, MCC line up etc.
- ii) Complete Bill of Material
- iii) Component layout drgs.
- iv) Control & Power TB arrangement.
- v) QA Plan
- vi) Detailed test schedule

6.0 ALL CORRESPONDENCE BEARING TENDER / PO NO. TO BE ADDRESSED TO :

Dy. Manager (MM) /MWX
BLOCK IV ANNEXE
BHEL, BHOPAL – 462021
Tel. No.: 0091-755-2505088
Email : rakesh_kum@bhel.in
& copy to : d.kumar@bhel.in

7.0 ACCEPTANCE INSPECTION AT SUPPLIER WORKS :

Inspection shall be carried by BHEL.

- i) Acceptance Inspection & testing shall be carried out at supplier's facility or any other facility where supplier can conduct all the tests.
- ii) Supplier shall notify BHEL at least 15 days in advance the readiness of equipment for testing & inspection. Supplier shall furnish schedule of tests after placement of PO.
- iii) No separate charges for testing and inspection at supplier works according to technical specifications & approved test procedures will be paid. Supplier shall arrange all necessary facilities for testing and inspections free of charge. All expenses for traveling, boarding and lodging for the BHEL inspection staff will be borne by the BHEL.

Supplier shall submit a detailed bounded test report duly signed to BHEL without in any way absolving supplier of its contractual obligations

8.0 LIQUIDATED DAMAGES PENALTY :

Refer BHEL general Terms and conditions BP200102 for penalty in case of delayed supply / execution and same shall be applicable.

9.0 DEFICIENCIES & DEFECTIVE GOODS:

BHEL shall inspect the equipment after receipt of the same at BHEL works. Supplier may depute their representative, at their discretion during Inspection. However, it will be the responsibility of the supplier to inform BHEL in advance if they would like to participate in material inspection and verification process. Should any deficiency or defect noticed in the goods during material receipt inspection same shall be replaced by the Supplier without any extra charge under no charge invoice. Any complaint in regard to the material will be notified to supplier who shall replace same promptly. The rejected/damaged material will have to be accepted back by the supplier who will bear it's to and fro freight also & the supplier will supply the items at site, free of cost and carry out repair/replacement at site without any charge.

10.0 WARRANTY:

Supplier will warranty the products to be free from defects in materials and workmanship and to comply with specification and intended use. The supplier will provide warranty for a period of 18 months from the date of dispatch or 12 months from the date of commissioning at BHEL Hyderabad whichever is earlier. The warranty applies to all supplier manufactured and supplied components. Commissioning is not in scope of supplier.

11.0 COMMISSIONING SPARES :

Supplier will supply 1 lot of commissioning spares with the MCC house as part of package. Commissioning spares to include indication lamps, switches, push buttons, meters, door locks etc. Supplier to provide list of Commissioning spares with Qty along with technical offer.

PART - II

TECHNICAL SPECIFICATION OF MCC HOUSE FOR OUTDOOR APPLICATION FOR MUD SYSTEM TESTING FACILITY

1.0 INTRODUCTION:

This specification covers the requirement for design, manufacturing, testing, & supply of Power Control Room (PCR/MCC house) for Mud System Testing Facility at BHEL Hyderabad. MCC house shall be a fabricated steel housing mainly containing MCC Panel, Socket Board, Internal house lighting, Exhaust Fan etc

MCC or Motor control center shall be comprised of main incomer panel and various starters as per load list. The MCC house shall be transportable type fabricated steel housing built on oil field skid suitable for outdoor application.

All the equipments mounted on the oil field heavy duty skid shall be covered by a suitable housing to protect the equipments from rain, storm etc.

The general requirements of the equipment shall be as per this specification however for any other details, if required, supplier can ask for specific information from BHEL.

The MCC shall be rated for a 415V, 3P-4W, 50Hz system with an available fault current of 36 kA.

2.0 APPLICABLE STANDARDS:

- 2.1 The equipment shall conform to the Indian Electricity Rules 1956 as amended time to time, CEA Regulations 2010 other Regulation and the stipulation of Inspectorate of Factories and other applicable statutory bodies of the state in which the installation exists as regards to Safety earthing and other essential Provisions specified there in, for installation and operation of equipment and plant (nothing in this specification shall be construed to relieve the vendor of this responsibility).
- 2.2 The equipment & accessories covered by this specification shall be designed, manufactured and tested in accordance with the latest relevant standards and codes of practice published by the Bureau of Indian Standards and International standards (relevant IEC & ISO) as furnished below:
- 2.3 Regulation 37 (iii) (a) of CEA – The design shall provide a clear working space of at least one meter in front of all control panels and switch-boards.
- 2.4 The materials shall comply with applicable parts of the following standards:

IS-5	Colors for ready mixed paints & enamels
IS-101	Methods of sampling & test for paints, varnishes & related products.
IS-513	Cold rolled low carbon steel sheets and strips
IS-613	Copper rods & bars for electrical purpose.
IS-694	PVC Insulated cables for working voltages up to & including 450/750V

IS-1248	Direct acting indicating analogue electrical measuring instruments and their accessories.
IS-1359	Electroplated coating Tin specifications
IS-1363 & 64	Specifications for bolt, screws & nut.
IS-1573	Electroplated coating Zinc on Iron & steel
IS-1897	Copper strip for electrical purpose.
IS-1901	Specifications for visual indicator lamps.
IS-2026	Specifications for power transformers.
IS-2062	Steel for general structural purpose.
IS-2071(2)	Methods for HV testing
IS-2102	General Tolerances
IS-2147	Degree of protection provided by enclosures for low voltage switchgear & control gear.
IS-2551	Danger Notice plates.
IS-3043	Code of practice for earthing
IS-3618	Specification for Phosphate treatment of iron & steel for protection against corrosion.
IS-4218	ISO Metric screw threads.
IS-5002	Methods for determination of sample sizes to estimate the average quality of a lot or process.
IS-6875	Control switches for voltages up to & including 1000VAC & 1200VDC.
IS-8084	Specifications for interconnecting Bus-Bar.
IS-8623	LV Switchgear & control gear assemblies. Requirement for type tested & partially type tested assemblies. Particular requirements for Bus-bar trunking systems (Bus-ways).
IS-10118	Code of practice for selection, installation and maintenance of switchgear and control-gear.
IS-10810	Method for test for cables.
IS-11353	Guide for uniform system for marking & identification of conductors and apparatus terminals.
IS-12021	Control Transformers for switchgear & control gear for voltages not exceeding 1000VAC.
IS-13118	High voltage alternating current circuit breakers.
IS-13703	Low voltage fuses for voltages not exceeding 1000VAC.
IS-13871	Powder Coating specifications
IS-13947	Degree of protection of enclosed equipment, LV Switchgear & control-gear -General rules, Switches, Dis-connectors, Switch dis-connectors etc.
ISO-2409	Paints & varnishes - Cross-cut tests.
ISO-9000	Quality Management & Quality assurance standards.
IEC-60947	Standard for switchgear, Contactors, Dis-connectors etc.
Indian Electricity Rules-1956	
CEA 2010 Rules & amended guidelines	

Standards not listed above but are applicable also to be followed.

3.0 VENDOR LIST:

Make of all components shall be as per BOM furnished in Annexure-II of Part-II of the specification.

4.0 GENERAL TECHNICAL SPECIFICATION OF SUB-ASSEMBLIES:

The external 415VAC, 50Hz 3 phase 3 wire supply shall be provided to 3 phase main AC Bus of MCC panel thru Mains feeder.

MCC house shall be used for distribution of power to various loads. External loads shall be connected thru socket board on PCR house thru quick connect plugs and sockets (All socket board plugs and sockets for external connections shall be in **Supplier** scope).

The entire arrangement shall be housed in a fabricated steel shell built above oil field skid constructed of I beam with front portion curved for dragging thru bottom. One door shall be provided with suitable locking / unlocking provision.

The technical requirements of various sub-assemblies is as follows:

5.0 TECHNICAL REQUIREMENT FOR SKID, SHELL & ROOF OF PCR HOUSE:

Please refer reference drgs/sketches for above as under:

1	Drg - 17211013364	GA for PCR house
2	Drg – 17211013393	Construction details of PCR House and skid

Above drawings are for reference purpose, however overall dimensions of the house including various other dimensions given in the drawings are to be maintained by the supplier. Supplier shall prepare detailed drgs for manufacturing of PCR house and shall submit the same to BHEL for approval. BHEL shall not issue any detailed drawings.

5.1 SKID

The entire structure shall be mounted on sturdy Oil Rig Duty Skid suitable for dragging through pipe and flanges at the end, as per drawing **17211013393**. Skid shall be made from the ISMB 250 I-Beams. It shall have a 3 main I-beam and 6 nos. of cross I-beams. Ends of the skid shall be reinforced with 12 mm thick plates and curved at both the ends. Skid shall have 2 lifting pipe of OD approx. 115mm and minimum 6mm of thickness. Pipe shall have flanges on both the ends. Flange OD shall be approx. 165mm and 12mm of thickness. All four lifting ends of the skid shall be properly gusseted. Each end shall have 4 nos. of gussets of minimum 12 mm thick plates. Gussets shall not be projected beyond the main I-beam flanges. Ends of the skid shall be reinforced with 75x40x5 thick channel. Skid shall have a top plate of 6mm thick which shall be suitably welded at the top as well as at the bottom also with the cross members. Skid shall also have earthing pads on the bottom flange of the main I-beams at all four corners. Top welding of plates shall be grind flush. Complete skid shall be water levelled within +/-5mm.

5.2 SHELL (HOUSING)

MCC house structure shall be made from hollow section of size approx. 50x50x3mm as per IS-4923 as shown in drawing **17211013393**. Structure shall be suitably welded on the skid top plate and shall have a grid of above specified section to achieve adequate wall strength from all sides.

LH end of the house shall have 2mm thick folded doors with stainless steel hinges along with canopy and rain protection folded cover. MCC panel shall be adequately anchored with the side wall structure and skid base to avoid and transit damages. A suitably covered cable tray

shall be provided at the top of MCC panels which shall be connected with the roof also. At the back side of the partition between transformers and MCC Panels there shall be adequate cable stiffeners to carry the cables from the cable tray to transformers and socket boards. The socket board partition shall have an exhaust fan to remove the hot air of the transformer area. Two nos. of light pole mounting brackets shall also be provided at the diagonally opposite ends of the house as shown in the drawing. Transformers shall be suitably anchored with the base skid to avoid any transit damages.

Overall structure of the house, like side walls, partition walls, roof and doors etc. shall be straight and free from any kind of buckling, welding marks and deformation. Complete structure of the house shall be leak proof. Lifting joints of skid pipe, all outside welding joints of side wall and roof etc. shall be subjected to DP test with no defect criterion. All the hardware and fittings used in the house shall be of stainless steel. For other details refer attached drawing.

For air circulation wire mesh covered louvers can be provided at both the ends of the house. Suitable meshed louvers to be provided on the end walls at top to provide free air ventilation and circulation. Design of louvers should be such that it should not allow entry of rain water, rodents, reptiles.

5.3 ROOF

Roof of the structure shall be welded type and shall be the integral part of the structure with sufficient strength. Complete structure shall be covered by 3 mm thick sheet from the outside only and shall have partitions as specified in the drawing for socket boards, transformers and MCC panels. Roof shall be covered at the bottom also with 2 mm thick sheet preferably by riveting.

Roof shall be bolted on the structure channel and welded thereafter for proper strength. Design of roof & matching shell portion shall be done in such a way that there is no water ingress in the house during rainy season. Alternatively welded roof construction shall also be acceptable.

5.4 MAIN ENTRANCE DOOR

A main door with double wall construction shall be provided at one of the side wall of the house at location as shown in drawing **17211013393**. Door width shall be 760 mm wide as per the drawing for entry & exit. The doors shall be provided with suitable locking and unlocking arrangement. Proper finish and quality of workmanship is to be ensured, hardware and EPDM door sealing gasket.

5.5 SOCKET BOARD AND CABLE INTERCONNECTIONS IN THE HOUSE

A socket board shall be provided on the front end partition wall of the house as shown in the GA drawing. This socket board shall be provided with power sockets for quick connection with external cables thru mating plugs. **Socket board with all plugs and sockets shall be in Supplier scope. All internal power cabling from Sockets on socket board to respective MCC panel TB shall be done by Supplier and all internal cables shall be in Supplier scope. All internal interconnection cables shall be of flexible copper conductor with PVC/Elastomeric Insulation. All cables to be provided with a PVC Spiral wrap for extra safety.**

The height of the socket board should be limited to 1.8 meter from the floor of the house. The socket board area should be provided with lockable doors and foldable rain water protection canopy at one end of the housing.

Incomer power sockets (3 Phase & Neutral) shall be mounted on minimum 20mm thick Epoxy socket board at the bottom of the socket board area.

Design of socket board shall be such that all sockets shall be removable from front and there shall be no need to access the socket board from inside while removing sockets.

Details of Plug & Sockets & Interconnecting Cables from MCC to Socket board

SI	Description of Panel	Plug & Socket Rating	Interconnecting cable size
1	Incomer	500A, 415VAC Single pole Heavy duty (Qty 4 Nos for 3 Phase & Neutral)	120sqmm Single core, PVC/ Elastomeric Insulated 1.1 KV grade
2	100HP Star-Delta Starter	125A, 415VAC 4 pin / 5 pin Plug and Socket AC3 duty Industrial Plug & Socket (2 Nos for each starter)	50sqmm single core PVC/ Elastomeric Insulated 1.1 KV grade. Alternatively 3 core cable can also be used.
3	50HP DOL Starter	125A 4 pin / 5 pin Plug and Socket AC3 duty (1 No for each starter)	35sqmm single core PVC/ Elastomeric Insulated 1.1 KV grade. Alternatively 3 core cable can also be used.
4	20HP DOL Starter	32A 4 pin / 5 pin Plug and Socket AC3 duty (1 No for each starter)	10sqmm single core PVC/ Elastomeric Insulated 1.1 KV grade. Alternatively 3 core cable can also be used.
5	10HP DOL Starter	32A 4 pin / 5 pin Plug and Socket AC3 duty (1 No for each starter)	6sqmm single core PVC/ Elastomeric Insulated 1.1 KV grade. Alternatively 3 core cable can also be used.
6	5HP DOL Starter	16A 4 pin / 5 pin Plug and Socket AC3 duty (1 No for each starter)	2.5sqmm single core PVC/ Elastomeric Insulated 1.1 KV grade. Alternatively 3 core cable can also be used.

Makes for Plugs and Sockets : Amphenol USA, EGS-EG USA, Eaton USA, Group Schneider India, BCH India, Righill Electrics India, Hi-Tech Hyderabad

Bidder to submit details of offered plug and sockets with the bid with part Nos and catalogs.

5.6 CABLE TRAY ABOVE MCC PANEL

Suitable cable trays at the top of MCC panel sections to be provided with louvered bolted covers. Cable trays to be bolted at the top of the panel. Partition wall should have suitable cutouts matching with cable trays for both the sections for cable entry in the socket board area.

5.7 PCR HOUSE INTERNAL LIGHT AND EXHAUST FAN

One no. 12 inch heavy duty 1400 RPM steel blade single phase 230VAC exhaust fan to be provided on one of the partition wall above socket board to remove hot air from the house.

Four Nos twin tube 2 x 18W or 2 x 14W 230VAC LED light fittings with polycarbonate transparent cover to be provided inside the house for illumination as shown in GA drawing **17211013364**.

All internal lights and fans should be separately divided into 3 or 4 circuits and a MCB switch box to be provided in the house at suitable location. All wiring from MCB box to individual light & fan circuits should be done with 1.5sqmm PVC insulated copper wire of proper voltage grade as per IS694.

5.8 PCR HOUSE NAME PLATE AND MONOGRAM

Name plate made from stainless steel sheet of suitable size (tentative 700mm*200mm*3mm thick) should be fixed. "BHEL Hyderabad" with BHEL logo & PO number should be written on a proper plate and should be fixed on front side of the house. The writings should be of proper size and good contrasting color so that it is visible from distance. Weight and dimensions should also be mentioned.

BHEL will provide the label printing / engraving details to supplier after placement of PO. It will be responsibility of supplier to collect the drawing from BHEL.

BHEL Monogram shall be fitted at BHEL Bhopal by BHEL.

5.9 SURFACE FINISH & PAINTING OF SKID AND SHELL

MCC house shall be used for outdoor duty in a highly dusty, humid and saline industrial environment with ambient temperature up to 50 Degree Centigrade, hence outside surface preparation & painting of the house must ensure the suitability of the house to withstand such extreme environmental conditions. Painting should be done as per BHEL process Spec-AA0674123 :

- Surface preparation: - Shot/Sand Blast to Sa 2 ½ 35-50 microns.
- Fabricated floor structure and base including skid (Structure of I-Beam), Top plates, bottom plates etc with other items of the base and floor shall be painted with two coats of Epoxy primer & two coats of **BLACK** High Built Coal Tar epoxy paint. DFT-250 micron.
- MCC House structure above skid including columns, side-wall, doors, roofs etc. from both sides shall be coated with: - Inorganic Ethyl Zinc Silicate primer – 1 coat DFT 75 microns. BHEL Spec No AA 56113 for primer to be followed.

- Intermediate coat on visible outer and inner surface of the house including roof, sidewalls and doors etc: – High build intermediate epoxy paint – 1 coat – DFT 75 microns. BHEL Spec No AA 56112 for epoxy paint.
- Finish coat on the outer & inner surface of the house including roof, side walls and doors etc: Full Gloss Polyurethane non-yellowing **WHITE** finishing paint –1 coats – DFT 30 microns. BHEL Spec No AA 56142 for Polyurethane paint.

Total DFT after final coat shall be minimum 150 microns.

6.0 TECHNICAL REQUIREMENTS FOR MCC PANEL LINE-UP

Please refer reference drgs/sketches for above as under:

SL. NO	DRG/SKETCH NO	TITLE
1.	37211013760 sht 1 & 2	GA for MCC Panel

Supplier shall prepare detailed drgs for MCC panel line-up and shall submit the same to BHEL for approval. BHEL shall not issue any detailed drawings for MCC panel.

6.1 GENERAL

The material covered under the scope of supply shall comply with the technical requirements as stipulated in the relevant sections of this specification and other documents referred to therein. In case of any conflicting information this specification shall prevail. Brief technical parameters are given below:

- MCC Enclosure sheet metal
Material : Cold rolled sheet steel
Thickness : Frames & load bearing members – min 2.5 mm,
Doors & covers 2 mm, Partitions – 1.6mm
- Type : Indoor, Single front
- Colour Finish Shade : Powder coated Mat finish to Siemens grey shade No- RAL7032.
- Degree of protection : IP23 for panel
- Cable Entry : Incoming from top, Outgoing from Top
- Cable type : Copper multistrand flexible PVC insulated cables confirming to IS 694 & IS 8134 for wiring inside the panels.
- Cable Sizes : As per Bill of material and schematics. No control cable shall be less than 2.5 sqmm.
- Mounting : Floor, self-standing on MS ISMC channel base.
- Bus Bars :
Material : High conductivity Copper as per IS 1897
Finish: Tin plated 13 microns thick as per IS 1359
Voltage rating : 415 VAC 50 Hz
Current rating : 800 A (free air rating) – Bus A
Current rating : 200 A (free air rating) – Bus B
Current rating : 200 A (free air rating) – Bus C
Bracing : 36 KA
Insulation : Heat Shrinkable sleeves as per phase identification. Tapping not allowed.

Support Insulation : DMC/SMC/FRP type non-hygroscopic support insulation is acceptable.

- j) Clearances Phase to Phase and Phase to ground : Min 20 mm
- k) Minimum Creepage distance : 50 mm
- l) Maximum temperature of Busbars, droppers at continuous rating : 90 deg C at 40 deg C ambient
- m) One minute power frequency voltage : 2.5 KV for power circuit
1.5 KV for control circuit
- n) System Short circuit level Asymmetrical : 36 KA for 1 sec
- o) Make of components : Strictly as per Bill of material. No deviation acceptable.

6.2 MATERIALS AND CONSTRUCTION

6.2.1 GENERAL

It is not the intent to specify completely herein, all details of design and construction of the equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to supplier's guarantee in a manner acceptable to BHEL who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which, in his judgment, is not in full accordance therewith.

Whether called for specifically or not all accessories required for normal operation of equipment are deemed to be considered as a part of the supplier's scope of supply.

6.2.2 APPLICABLE DRAWINGS:

Refer list of enclosures.

6.2.3 SHEET METAL WORK:

The Frame & partition walls of panels shall be fabricated using pressed & shaped cold rolled sheet steel of thickness not less than 2.5 mm. All doors & covers of the MCC panels shall not be of thickness less than 2.0 mm. All panel edges and door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. Cutouts shall be true in shape and devoid of sharp edges. The complete structure shall be rigid, self-supporting, and free from vibrations, twists and bends.

6.2.4 CONSTRUCTIONAL FEATURES :

All panels shall be indoor type, sheet steel enclosed and shall be fully dust vermin proof providing IP 23 degree of protection. All MCC sections should be provided with concealed type hinged doors for the access to equipment. Doors shall be gasketed with all around neoprene rubber gasket. The doors to open minimum 110° providing good accessibility into compartments. Any other cutout on the doors for MCCB rotary handles shall be provided with a neoprene rubber gasket lining for dust free sealing.

All detachable covers shall meet the following requirement:

- a) All detachable covers shall be provided with stainless steel handles.
- b) There shall be an arrangement for holding the detachable cover in position before tightening the screws.

- c) Self-retaining self-aligning screws (suitable for flat type screw driver as well as wrench) shall be tightened to finally secure the cover.

All Hinged Panel doors shall meet the following:

- d) Suitable Latching arrangement for doors shall be provided.
- e) If hinged doors are used in cable alleys, the doors shall open minimum 110°.
- f) Door Latches shall have permanent Polyamide/nickel/chrome plated metallic knobs instead of keys.

All panels shall be provided with indelibly marked aluminum anodized labels with bright background and black letters indicating designation of the MCC section and other items mounted on the door. Incomer & outgoing cable entry shall be from top.

MCC panels shall be of single front design as per GA. Main horizontal bus bars shall be running from the Top and all section Bus bars shall be vertical type. Main Horizontal bus chamber shall be having removable type folded doors with captive screws. Vertical bus sections shall have hinged doors in line with MCC sections from rear side.

All accessible live connections/metals shall be shrouded and it shall be possible to change individual fuses, switches from the front of the panels without danger of contact with live parts. All items should be mounted on the threaded pads or Din channels for easy removal from the panels. Adequate interior cabling space shall be provided.

Each MCC panel shall be provided with at least one earth terminal and should be connected to main ground bus with 2.5sqmm green colour copper conductor PVC wire.

Use of direct rotary handles is called in all MCCBs. Due to operational requirements it is required to mount direct rotary handles on the MCCBs and NOT on doors with extended shaft, hence MCC door interlocking feature is not required

One metal sheet shall be provided between adjacent vertical sections running to the full height of the panel except for the horizontal busbar compartment. Cable alleys shall be provided with suitable hinged doors. It shall be possible to safely carry out maintenance work on cable connections to any one circuit with the busbars and adjacent circuits live. To minimize the chance of fault propagation to adjacent sections, each vertical section shall have side sheets extending the full height and depth of the section.

Wire connections passing from one compartment to other shall pass thru drilled holes with neoprene rubber grommets.

Base channels of the floor-mounted MCC panel line-up shall be welded on the floor of the MCC house. Touch-up painting on the base frame after welding.

All cables above 2.5sqmm after crimping to be provided with heat shrinkable sleeves.

The rotary handle on the MCCBs is to be directly fitted on the MCCBs and a cutout on the door to be made for the same.

Base plate for mounting components inside the individual panels should be at least 3.15mm thick. Proper spacing to be left between the components for wiring and easy removal/maintenance.

PVC insulated cable of specified make to be used for all control and power connections except for Ground connection, which is to be done with 2.5sqmm copper conductor green colour, wire. For 3 phase circuits the cable ends to be provided with respective colour coded heat shrink sleeves (Red for R Phase, Yellow for Y phase and Blue for B phase and Black for Neutral)

Lamps, MCBs, and meters to be door mounted with front projections.

All outgoing connections are to be terminated on the Power & Control TBs in the Cable Alley.

6.2.5 CABLE ALLEY (VERTICAL WIRE WAYS)

A full height vertical cable alley with wide door and hinged shall be provided in each standard vertical section and remain intact even when the MCC sections are removed. Cable routers / supports to be provided for the bunching of all 3 or 4 core out going cables. Sufficient space to be provided for the cabling and connections in the cable alley.

6.2.6 TERMINAL BLOCKS

To minimize exposure to live terminals, terminal blocks shall be mounted within the cable alley and located near the front for accessibility. They shall not be located at the rear. Power terminal blocks shall be provided as per rating called in BOM or next higher rating. TBs for all 63A or higher rating feeders should be stud type.

6.2.7 POWER BUS SYSTEM:

The power bus system shall be supported, braced, and isolated by a bus support molded of a high strength, non-tracking glass-filled polyester material. Bus supports shall have high dielectric qualities, moisture-resistant, non- carbonizing, non-tracking, and have vertical creepages surfaces to prevent faults due to build-up of conductive dirt.

Bus bars shall be suitably rated and to withstand the fault current of 36KA asymmetrical. The bus shall be continuously braced within each section maintaining required electrical clearances & creepages.

The vertical bus shall be continuously braced and sandwiched in a molded bus supports. The vertical bus shall be copper with the tin plating and shall be rated for 400A. Bus connections shall be made only by means of with through-bolts/screws with washers and nuts. Connections shall be provided with lock washers for mechanical locking. No hardware for Bus connection shall be less than M6 size.

Both vertical & horizontal buses shall be of High conductivity copper tin-plated minimum 13 microns thickness. For each vertical section there should be one set of vertical bus bars.

The ground bus bar shall be tin plated copper and located suitably in the panel for easy access. The size of the horizontal ground bus shall be 5mm x 25mm running throughout the panel. All ground wire connections to be made with ring type terminals.

6.2.8 NAMEPLATES:

The MCC master nameplate is to be located on the top of the side of the MCC section. Danger labels to be provided as per standard practices and relevant IS / IE rules.

Each box of MCC section to be provided with anodized aluminum printed labels / other standard legend material as per legend mentioned in BHEL drg with rating of each panel. Letter size shall not be less than 5 mm. Thickness of labels on MCC doors shall be not less than 1 mm. Size of the labels on MCC doors shall not be less than 30 x 120 x 1mm. Each label plate shall contain the details of outgoing power & control sockets. Labels shall be secured using steel self-tapping screws.

6.3 INTERNAL WIRING & TERMINATIONS

6.3.1 Internal wiring

Adequately sized wires as called in BOM shall be used. No wire in the panels shall be less than **1.5sqmm** in conductor size. Only copper flexible PVC insulated cables as per BOM are acceptable. All cables shall have specified colored insulation and shall be numbered as per respective schematics with engraved/ printed plastic ferrules of high quality to have neat appearance. Ferrules shall fit tightly on the wires and shall not fall off when the wire is disconnected from terminal blocks. All terminations on TBs shall be terminated with suitable copper lugs and no bare conductor to be terminated on the TBs and components.

All terminations on CTs & associated meters shall be of ring type, open type terminations on CTs & meters are not acceptable.

6.3.2 Terminations

All terminal blocks shall be 600V grade, rated as per BOM. Terminations should be one piece molded of the specified makes with insulated barriers. Marking on the terminal strips shall be done on both sides of TB.

Moulding materials shall be self extinguishing or resistant to flame propagations, substantially non-hygroscopic and shall not carbonize when tested for tracking. The insulation between any terminal and framework or between adjacent terminals shall withstand a test of 2.5 KV rms for 1 minute for power terminations and 1.5 KV rms for 1 minute for control terminations. The mouldings shall be mechanically robust to withstand handling, while making terminations. Only polyamide material TB to be used as per BOM. For Stud type TBs, epoxy / DMC moulded terminal strips with moulded brass studs to be used.

6.4 PAINTING & FINISH OF MCC PANEL

Complete MCC line up shall be finished with epoxy polyester powder coating with seven (7) tank painting or better process. Painting shade shall be chemical resistant Siemens grey to shade no-RAL7032.

Dry film thickness of the finish coat shall not be less than 60 microns.

7.0 HARDWARE FOR PCR AND MCC PANEL

All bolts, studs, screws, nuts, washers etc shall have standard metric threading and conform to relevant standard as regard shape and tolerance. These shall be marked with the manufacturer's symbol and class of strength. All hardware shall be Zinc electro-plated and passivated. All hardware shall be either of TVS, LPS, LPS Bossard or Forbes Gokak, Neco, or other reputed make.

8.0 SPECIAL CARE TO BE TAKEN BY SUPPLIER:

- 8.1 Job shall be deployed for outdoor duty, therefore, supplier shall take precaution to ensure all weld joints are leak-proof. Dressing of weld joint is not desired to ensure there is no under cuts, during dressing. Heavy duty neoprene rubber gaskets shall be provided at mating surface of doors cover etc. to avoid water ingress. All welding joint shall be DP tested, and DP report shall be submitted to BHEL.
- 8.2 CRC sheets should be free from waviness.
- 8.3 Welding of CRC sheets with columns to be carried out by welders experienced in sheet metal welding and proper current setting and welding process to be used to ensure no buckling is generated. Proper stiffening and locking to be done before welding of outer sheets. Job with poor aesthetics, denting and buckling on sheet etc. shall not be acceptable and any rework /repair, on account of this shall be in the scope of vendor.
- 8.4 Door shall be straight & true in square-ness and properly aligned and free from any bending, twisting or any deformation. Operation of doors shall be smooth. Fixing shall be straight and in the same line as per drawing. All handles shall be screwed from the rear side and shall be in the same line as per drawing. Good aesthetic shall be maintained.
- 8.5 Care shall be taken during welding of skid top plate to ensure there is no deformation, twisting, ripple formation or buckling. Flatness of surface over entire skid to be maintained at 2-3 mm.
- 8.6 Roof of the Main House shall be straight in length and width and there shall be no bending it's main channel/cross-member fitment and removal of roof from structure should be smooth. Supplier shall ensure that there is no jamming of roof while fitment/lifting over the structure. At the same time any water ingress when water is directed from a water jet is not acceptable. All welding joints at the top of the roof shall undergo DP test and DP report shall be submitted.
- 8.7 Columns of wall shall be perfectly straight and vertical.
- 8.8 Any rivets used shall be of Aluminum / AL alloy to avoid rusting. Al-drops, tower bolts etc. shall be of SS only.
- 8.9 Silicon sealant paste shall be applied on bolted joints of roof, bolted cover and other mating surfaces to avoid water ingress.
- 8.10 Supplier to note that fabrication drawings furnished with this specifications are for guidance only. Supplier may follow their standard construction to meet the service requirement as stipulated in this specifications. In such case where supplier is offering their standard design, full details of design and construction to be provided with the offer.

9.0 QUALITY CHECKS

Supplier shall prepare QA Plan identifying the various stages of manufacturing, quality checks to be performed at each stage and the customer hold points. The document shall also furnish details of method of checking, inspection and acceptance standards / values and get the approval of BHEL. BHEL or their authorized representatives shall have the right to review the inspection reports, quality checks and results of supplier's in-house inspection department which are not customer hold points and the supplier shall comply with the remarks made by BHEL on such reviews with regards to further testing, rectification or rejection etc.

9.1 QUALITY CHECKS FOR SKID AND HOUSE

The following quality check shall be carried out at various stages on the skid to ensure correctness of the job as per requirement :

- i). Overall dimensions (Should be strictly in limits as specified in drg)
- ii) DP test for welding quality
- iii) Squareness
- iv) Flatness (To be within 5 mm for skid)
- v) Paint quality & finish check (Thickness & adhesion).
- vi) Record of critical dimensions as per drgs
- vii) Witnessing lifting of finished MCC House

9.2 QUALITY CHECKS FOR MCC PANEL

The following quality check shall be carried out at various stages on the MCC panel to ensure correctness of the job as per requirement

- i Visual inspection, dimensional checks, verification of BOM and wiring and verification of clearances and creepages.
- ii Mechanical operation tests on switches, MCCBs and other manually operated components.
- iii Painting / Powder coating thickness check.
- iv Checking of setting on MCCBs & OLRs.
- v Power frequency, voltage dry tests and insulation resistance tests using a 500V megger on main circuit and for control and lighting circuits.
- vi Functional tests on all equipment including indications.
- vii Any other relevant test required to verify the system as per this specification.

9.3 TEST REPORT

Supplier to submit a detailed test and acceptance test report to BHEL after completion of testing and inspection.

10.0 LIST OF ENCLOSURES

- i. Annexure - I : Important Notes
- ii. Annexure – II : BOM for MCC
- iii. Drawings as mentioned below:

SL. NO	Drawing No.	TITLE
1.	17211013364	OGA of PCR (MCC House)
2.	17211013393	Construction details of PCR house and Skid
3.	37211013760 Sh-1&2	OGA of MCC panel
4.	37211012454 Sh-1&2	SLD for Power Control Room
5.	37211012455 Sh-1-4	Schematic for Incomer & Starters

ANNEXURE- I

IMPORTANT NOTES :

1. Where ever Catalogue Nos for MCCBs, Contactors & Overload Relays are mentioned in BOM (Annexure-II) for M/s Group Schneider only, same are for bidder reference as a basic design requirement, exact equivalent of other makes as mentioned in BOM shall also be acceptable. However, only one make of Switchgear for all Starters & incomers shall be acceptable meeting the specification requirements to ensure Type-2 Co-ordination for Starters, power circuit discrimination, cascading between upstream and downstream electrical circuits as per relevant IS/IEC standards for LT switchgear selection. In case Bidder is opting to offer equivalent Switchgear (MCCBs, Contactors & Overload Relays) of other makes as mentioned in BOM against the Group Schneider part nos. as given in the BOM, then bidder to furnish complete BOM in line with BHEL specification BOM with full details of part Nos, catalogue as published by respective manufacturer for establishing suitability of the technical bid. In case bidder is furnishing in-complete information then technical bid may not be considered for evaluation. **BOM shall be freezed before opening of price bid of qualified bidders.**
2. The catalog Nos give in BOM are selected from the latest catalogs & documents available from respective manufacturer, however supplier must ensure the correctness of the same before making the offer.
3. All Indication lamps should be of single make in complete panel.

ANNEXURE-II

BILL OF MATERIAL

FOR

MCC PANEL

FOR

MUD SYSTEM TEST FACILITY

A. Details of Panel Construction & Buswork

Qty – 01 set

Sl	Specification description	Details with make/size etc
01	Single front fabricated and powder coated panel structure with doors & partitions as per specifications	Ref Part-II of the specifications for details
02	Cross section Size of main horizontal R, Y, B & N phase main copper bus bar (Tinned & sleeved R,Y,B,N)	10 x 50 mm per phase , 5 x 25 mm for Neutral
04	Cross section size Ground Bus (Tinned)	5 x 25mm
05	Cross section size of Vertical bus for 100 HP starters vertical bus chambers for R, Y & B phase	10 x 40mm
06	Material for bus support	DMC/SMC
07	Make of the bus support	Electro Fibre / Ramanuj / PAC/ Vinayak
08	Width of the horizontal main bus chamber.	As per GA Drg
09	Cross section size of bus tapings from vertical bus droppers to individual starters/feeders above 25HP (tin plated & sleeved R, Y,B)	5 x 20 mm min
10	Cross section of Flexible copper conductor cable for bus tapings from vertical bus for individual starter/feeders upto 25 HP	25 sqmm single core PVC/Rubber Insulated 1.1KV Grade Cable with glass sleeve / glass tapping
11	Door Knobs – Wing type – Material – Polyamide (black). Key operated locks not acceptable.	Make – Darshana, Rittal, Arihant
12	Door Handles – Stainless steel – 10/12mm dia	SS304
13	Other construction details, labels, legends etc	As per Part-II of the spec.

B. Details of Components in MCC PANEL

415VAC, 3P+N, Main Incomer, panel (Box-1)

Qty – 01 set

Schematic Drg No-3711012455 Sheet 1 & SLD Drg No 37211012454 Sheet 1-2

S No	Description of item	Qty	Rating	Make	Catalog No	Device Reference / Remarks	Alternate Acceptable Make
01	MCCB 4P, 415 V AC with adjustable thermal overload & short circuit trip unit, 36kA breaking capacity and direct rotary handle on MCCB	01 No	400A	Group Schneider	LV432677+ LV432597	Device reference "MAIN-IN"	GE/ABB / Siemens OR equivalent with direct mounted rotary handle
02	Indication lamps LED type Red, 22.5 mm	01 No	230VAC		XB7EV04MPN	Device reference "R-PH"	GE/Siemens / ABB / L&T / BCH / HPL / Hager OR exact equivalent
03	Indication lamps LED type Yellow, 22.5 mm	01 No	230VAC		XB7EV05MPN	Device reference "Y-PH"	GE/Siemens / ABB / L&T / BCH / HPL / Hager OR exact equivalent
04	Indication lamps LED type Blue, 22.5 mm	01 No	230VAC		XB7EV06MPN	Device reference "B-PH"	GE/Siemens / ABB / L&T / BCH / HPL / Hager OR exact equivalent
05	Indication lamps LED type Green, 22.5 mm	01 No	230VAC		XB7EV03MPN	Device reference "BUS LIVE"	GE/Siemens / ABB / L&T / BCH / HPL / Hager OR exact equivalent
06	MCB 3 Pole 2 A, 10KA breaking capacity	02 Nos	2A, 415VAC		A9N3P02C	Device reference "B1" & "B2"	GE/Siemens / ABB / L&T / BCH / HPL / Hager OR exact equivalent
07	MCB 2 Pole 10 A, 10KA breaking capacity	01 No	10A, 415VAC		A9N2P10C	Device reference "B3"	GE/Siemens / ABB / L&T / BCH / HPL / Hager OR exact equivalent
08	Neutral link	02 Nos	415VAC	GE	NSH holder with copper link	Device reference "NTL-LK1" & NTL-LK2"	Group Schneider /Siemens / ABB / L&T / BCH / HPL / Hager OR exact equivalent
09	Voltmeter selector switch	01 No	6A, 415VAC	Kaycee	--	Device reference "VSS-1"	Siemens, L&T-Salzer, BCH, ABB, Kaycee, Group Schneider or equivalent
10	Voltmeter 0-500VAC direct reading 72 sqmm	01 No	0-500VAC	AE	--	Device reference "V1"	Rishabh / Meco or equivalent
11	CT for ammeter (Bar primary) 500:5A 10VA, Epoxy potted / Polyester resin cast	01 No	500:5A, 10VA	AE	--	Device reference "CT1"	Kappa, Rishabh, Meco, Quantam, GPD or equivalent
12	Ammeter moving iron 0-90 deg 72 sqmm	01 No	0-500A, FSD 5A	AE	--	Device reference "A1"	Rishabh / Meco or equivalent
13	Cable for Control wiring (1.5sqmm single core 1.1KV grade tinned copper flexible conductor FRLS PVC insulated) as per IS694.	As reqd	1.5 sqmm, 1.1KV Gr cable	Finolex	--	Grey or White	Lapp cables / KEI / Havells / RR / RJ or equivalent

14	Cable for Control wiring (2.5sqmm single core 1.1KV grade tinned copper flexible conductor FRLS PVC insulated) as per IS694 for MCB tappings from Bus & Neutral links	As reqd	2.5 sqmm, 1.1KV Gr cable		--	Grey or White	Lapp cables / KEI / Havells / RR / RJ or equivalent
15	Power cable for power wiring ; outgoing from MCCB to socket board (150 sqmm single core 1.1KV grade copper flexible conductor PVC cable as per IS694	As reqd	150 sqmm 1.1kv Gr PVC		--	Black or Grey	Lapp cables / KEI / Havells / RR / RJ or equivalent
16	Cable terminals & accessories	As reqd	Size as per termination requirement	Dowells	--	--	Hex / Jainson / 3D / Lapp or equivalent
17	Control TB C/DIN Channel mounted Polyamide KUT series of Elmex or equivalent	As reqd	41A, 800V	Elmex	KUT6 for 0.5-6sqmm	--	Wago / Connectwell / Phoenix or equivalent



5 HP / 3.75 KW DOL Starter with HOA – BOM for Type-2 Co-ordination Starter

Qty – 1 Set

(Box – 2)

Schematic Drg No-3711012455 Sheet 2

S No	Description of item	Qty	Rating	Make	Catalog No	Device Reference / Remarks	Alternate Acceptable Make
01	MCCB with magnetic trip unit, 3P, 415 V AC, 36kA breaking capacity Motor Protection MCCB with MA trip Unit	01 No	12.5A MA trip unit	Group Schneider	NSX100-MA LV429743	Device reference "CB"	Siemens / ABB OR equivalent with direct mount rotary handle on MCCB
02	Direct rotary handle for MCCB mounted on MCCB	01 No	--		LV429337	For CB	
03	3 Pole main contactor with 230VAC coil & 4NO+2NC contacts	01 No	40A	Group Schneider	LC1D40AM7 LADN31	Device reference "C"	Should be of same make as for SI No 01 for Type-2 co-ordination requirement.
04	Overload Relay with direct mounting	01 No	7 - 10A		LRD-14	Device reference "OLR"	
05	MI Ammeter 90 deg scale direct reading, 72 x72 mm	01 No	0-15/90A	AE	--	Device reference "A"	Rishabh, Meco or equivalent
06	Neutral link	01 No	415VAC	GE	NSH holder with copper link	Device reference "NTL LK"	Group Schneider /Siemens / ABB / L&T / BCH / HPL / Hager OR equivalent
07	2 Position 1 pole On- Off-switch with bezel "OFF - ON"	01 No	5A, 415VAC	Group Schneider	XB5AJ21N	Device reference "SW"	Siemens, L&T, BCH, ABB, Kaycee or equivalent
08	Pushbutton Green 22.5mm dia Flush type with 1 NO contact for START	01 No	230VAC, 1 NO	Group Schneider	XB5AA31N	Device reference "PB1"	Siemens, L&T, BCH & ABB or equivalent
09	Pushbutton Red 22.5mm dia Flush Type with 1 NC contact for STOP	01 No	230VAC, 1 NC	Group Schneider	XB5AA42N	Device reference "PB2"	Siemens, L&T, BCH & ABB or equivalent
10	O/L lamp LED type – Yellow, size 22.5 mm	01 No	230 VAC	Group Schneider	XB7EV05MPN	Device reference "O/L"	Siemens, L&T, BCH & ABB, HPL, Hager or equivalent
11	ON lamp LED type – Red, Size 22.5mm	01 No	230 VAC	Group Schneider	XB7EV04MPN	Device reference "ON"	Siemens, L&T, BCH & ABB, HPL, Hager or equivalent

12	Cable for Control wiring (1.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	1.5 sqmm, 1.1KV Gr	Finolex Cables	-	Grey or White	Havells / KEI / RR / RJ / Lapp or equivalent
13	Cable for Ground wiring (2.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	2.5 sqmm, 1.1KV Gr		-	Green	
14	Cable for Power wiring for starter out going connections to TB (4 sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694.	As reqd	4 sqmm 1.1KV Gr		-	Grey or White or black	
15	Cable for Incomer connections from Bus to MCCB 25sqmm single core 1.1KV grade PVC insulated Flexible copper conductor cable as per IS694	As reqd	25sqmm 1.1KV Gr		--	Grey or White or black	
16	Lugs to be used for above incomer bus tapping cable of 25sqmm size	As reqd	-	Dowells	--	--	Hex, Jainson, 3D, Lapp or equivalent
17	Cable terminals & accessories	As reqd	Size as per termination requirement		--		
18	Control TB C/DIN Channel mounted Polyamide.	As reqd	800V 41A- KUT6	Elmex	KUT 6	Grey Colour	Wago, Connectwell, Phoenix or equivalent
19	Power TB for 415VAC outgoing connections C/DIN Channel mounted Polyamide	As reqd	800V 41A- KUT6		KUT 6	Red, Yellow, Blue coloured for respective Phases	
20	Ground TB C/DIN Channel mounted Polyamide.	As reqd	-		ET10	Yellow-Green dual coloured	

**10 HP / 7.5 KW DOL Starter with HOA – BOM for Type-2 Co-ordination Starter****Qty – 3 Set****(Box – 10,11,12)****Schematic Drg No-3711012455 Sheet 2**

S No	Description of item	Qty	Rating	Make	Catalog No	Device Reference / Remarks	Alternate Acceptable Make
01	MCCB with magnetic trip unit, 3P, 415 V AC, 36kA breaking capacity Motor Protection MCCB with MA trip Unit	01 No	25A MA trip unit	Group Schneider	NSX100-MA LV429742	Device reference "CB"	Siemens / ABB OR equivalent with direct mount rotary handle on MCCB
02	Direct rotary handle for MCCB mounted on MCCB	01 No	--		LV429337	For CB	
03	3 Pole main contactor with 230VAC coil & 4NO+2NC contacts	01 No	40A	Group Schneider	LC1D40AM7 LADN31	Device reference "C"	Should be of same make as for SI No 01 for Type-2 co-ordination requirement.
04	Overload Relay with direct mounting	01 No	12 - 18A		LRD-21	Device reference "OLR"	
05	MI Ammeter 90 deg scale direct reading, 72 x72 mm	01 No	0-15/90A	AE	--	Device reference "A"	Rishabh, Meco or equivalent
06	Neutral link	01 No	415VAC	GE	NSH holder with copper link	Device reference "NTL LK"	Group Schneider /Siemens / ABB / L&T / BCH / HPL / Hager OR equivalent
07	2 Position 1 pole On- Off-switch with bezel "OFF - ON"	01 No	5A, 415VAC	Group Schneider	XB5AJ21N	Device reference "SW"	Siemens, L&T, BCH, ABB, Kaycee or equivalent
08	Pushbutton Green 22.5mm dia Flush type with 1 NO contact for START	01 No	230VAC, 1 NO	Group Schneider	XB5AA31N	Device reference "PB1"	Siemens, L&T, BCH & ABB or equivalent
09	Pushbutton Red 22.5mm dia Flush Type with 1 NC contact for STOP	01 No	230VAC, 1 NC	Group Schneider	XB5AA42N	Device reference "PB2"	Siemens, L&T, BCH & ABB or equivalent
10	O/L lamp LED type – Yellow, size 22.5 mm	01 No	230 VAC	Group Schneider	XB7EV05MPN	Device reference "O/L"	Siemens, L&T, BCH & ABB, HPL, Hagger or equivalent
11	ON lamp LED type – Red, Size 22.5mm	01 No	230 VAC	Group Schneider	XB7EV04MPN	Device reference "ON"	Siemens, L&T, BCH & ABB, HPL, Hagger or equivalent

12	Cable for Control wiring (1.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	1.5 sqmm, 1.1KV Gr	Finolex Cables	-	Grey or White	Havells / KEI / RR / RJ / Lapp or equivalent
13	Cable for Ground wiring (2.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	2.5 sqmm, 1.1KV Gr		-	Green	
14	Cable for Power wiring for starter out going connections to TB (6 sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694.	As reqd	6 sqmm 1.1KV Gr		-	Grey or White or black	
15	Cable for Incomer connections from Bus to MCCB 25sqmm single core 1.1KV grade PVC insulated Flexible copper conductor cable as per IS694	As reqd	25sqmm 1.1KV Gr		--	Grey or White or black	
16	Lugs to be used for above incomer bus tapping cable of 25sqmm size	As reqd	-	Dowells	--	--	Hex, Jainson, 3D, Lapp or equivalent
17	Cable terminals & accessories	As reqd	Size as per termination requirement		--		
18	Control TB C/DIN Channel mounted Polyamide.	As reqd	800V 41A- KUT6	Elmex	KUT 6	Grey Colour	Wago, Connectwell, Phoenix or equivalent
19	Power TB for 415VAC outgoing connections C/DIN Channel mounted Polyamide	As reqd	800V 57A- KUT10		KUT 10	Red, Yellow, Blue coloured for respective Phases	
20	Ground TB C/DIN Channel mounted Polyamide.	As reqd	-		ET10	Yellow-Green dual coloured	



20 HP / 15 KW DOL Starter with HOA – BOM for Type-2 Co-ordination Starter

Qty – 3 Set

(Box –5,6,9)

Schematic Drg No-3711012455 Sheet 3

S No	Description of item	Qty	Rating	Make	Catalog No	Device Reference / Remarks	Alternate Acceptable Make
01	MCCB with magnetic trip unit, 3P, 415 V AC, 36kA breaking capacity Motor Protection MCCB with MA trip Unit	01 No	50A MA trip unit	Group Schneider	NSX100-MA LV429741	Device reference "CB"	Siemens / ABB OR equivalent with direct mount rotary handle on MCCB
02	Direct rotary handle for MCCB mounted on MCCB	01 No	--		LV429337	For CB	
03	3 Pole main contactor with 230VAC coil & 4NO+2NC contacts	01 No	80A	Group Schneider	LC1D80M7 LADN31	Device reference "C"	Should be of same make as for SI No 01 for Type-2 co-ordination requirement.
04	Overload Relay with direct mounting	01 No	23 - 32A		LRD-3353	Device reference "OLR"	
05	MI Ammeter 90 deg scale direct reading, 72 x72 mm, CT operated 50:5A	01 No	0-50/300A FSD 5A CT operated	AE	--	Device reference "A"	Rishabh, Meco or equivalent
06	CT for ammeter (Bar primary) 50:5A 10VA, Epoxy potted / Polyester resin cast	01 No	50:5A, 10VA	AE	--	Device reference "CT"	Kappa, Rishabh, Meco, Quantam, GPD or equivalent
07	Neutral link	01 Nos	415VAC	GE	NSH holder with copper link	Device reference "NTL LK"	Group Schneider /Siemens / ABB / L&T / BCH / HPL / Hager OR equivalent
08	2 Position 1 pole On- Off- switch with bezel "OFF - ON"	01 No	5A, 415VAC	Group Schneider	XB5AJ21N	Device reference "SW"	Siemens, L&T, BCH, ABB, Kaycee or equivalent
09	Pushbutton Green 22.5mm dia Flush type with 1 NO contact for START	01 No	230VAC, 1 NO	Group Schneider	XB5AA31N	Device reference "PB1"	Siemens, L&T, BCH & ABB or equivalent
10	Pushbutton Red 22.5mm dia Flush Type with 1 NC contact for STOP	01 No	230VAC, 1 NC	Group Schneider	XB5AA42N	Device reference "PB2"	Siemens, L&T, BCH & ABB or equivalent
11	O/L lamp LED type – Yellow, size 22.5 mm	01 No	230 VAC	Group Schneider	XB7EV05MPN	Device reference "O/L"	Siemens, L&T, BCH & ABB, HPL, Hager or equivalent
12	ON lamp LED type – Red, Size 22.5mm	01 No	230 VAC	Group Schneider	XB7EV04MPN	Device reference "ON"	Siemens, L&T, BCH & ABB, HPL, Hager or equivalent

13	Cable for Control wiring (1.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	1.5 sqmm, 1.1KV Gr	Finolex Cables	-	Grey or White	Havells / KEI / RR / RJ / Lapp or equivalent
14	Cable for Ground wiring (2.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	2.5 sqmm, 1.1KV Gr		-	Green	
15	Cable for Power wiring for starter outgoing connections to TB (10 sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694.	As reqd	10 sqmm 1.1KV Gr		-	Grey or White or black	
16	Cable for Incomer connections from Bus to MCCB 25sqmm single core 1.1KV grade PVC insulated Flexible copper conductor cable as per IS694	As reqd	25sqmm 1.1KV Gr		--	Grey or White or black	
17	Lugs to be used for above incomer bus tapping cable of 25sqmm size	As reqd	-	Dowells	--	--	Hex, Jainsen, 3D, Lapp or equivalent
18	Cable terminals & accessories	As reqd	Size as per termination requirement		--		
19	Control TB C/DIN Channel mounted Polyamide.	As reqd	800V 41A- KUT6	Elmex	KUT 6	Grey Colour	Wago, Connectwell, Phoenix or equivalent
20	Power TB for 415VAC outgoing connections C/DIN Channel mounted Polyamide	As reqd	800V 57A- KUT10		KUT 10	Red, Yellow, Blue coloured for respective Phases	
21	Ground TB C/DIN Channel mounted Polyamide.	As reqd	-		ET10	Yellow-Green dual coloured	



50 HP / 37 KW DOL Starter with HOA – BOM for Type-2 Co-ordination Starter

Qty – 2 Set

(Box – 3,7)

Schematic Drg No-3711012455 Sheet 3

S No	Description of item	Qty	Rating	Make	Catalog No	Device Reference / Remarks	Alternate Acceptable Make
01	MCCB with magnetic trip unit, 3P, 415 V AC, 36kA breaking capacity Motor Protection MCCB with MA trip Unit	01 No	100A MA trip unit	Group Schneider	NSX100-MA LV429740	Device reference "CB"	Siemens / ABB OR equivalent with direct mount rotary handle on MCCB
02	Direct rotary handle for MCCB mounted on MCCB	01 No	--		LV429337	For CB	
03	3 Pole main contactor with 230VAC coil & 4NO+2NC contacts	01 No	80A	Group Schneider	LC1D80M7 LADN31	Device reference "C"	Should be of same make as for SI No 01 for Type-2 co-ordination requirement.
04	Overload Relay with direct mounting	01 No	63 – 80A		LRD-3363	Device reference "OLR"	
05	MI Ammeter 90 deg scale direct reading, 72 x72 mm, CT operated 75:5A	01 No	0-75/450A FSD 5A CT operated	AE	--	Device reference "A"	Rishabh, Meco or equivalent
06	CT for ammeter (Bar primary) 75:5A 10VA, Epoxy potted / Polyester resin cast	01 No	75:5A, 10VA	AE	--	Device reference "CT"	Kappa, Rishabh, Meco, Quantam, GPD or equivalent
07	Neutral link	01 Nos	415VAC	GE	NSH holder with copper link	Device reference "NTL LK"	Group Schneider /Siemens / ABB / L&T / BCH / HPL / Hager OR equivalent
08	2 Position 1 pole On- Off- switch with bezel "OFF - ON"	01 No	5A, 415VAC	Group Schneider	XB5AJ21N	Device reference "SW"	Siemens, L&T, BCH, ABB, Kaycee or equivalent
09	Pushbutton Green 22.5mm dia Flush type with 1 NO contact for START	01 No	230VAC, 1 NO	Group Schneider	XB5AA31N	Device reference "PB1"	Siemens, L&T, BCH & ABB or equivalent
10	Pushbutton Red 22.5mm dia Flush Type with 1 NC contact for STOP	01 No	230VAC, 1 NC	Group Schneider	XB5AA42N	Device reference "PB2"	Siemens, L&T, BCH & ABB or equivalent
11	O/L lamp LED type – Yellow, size 22.5 mm	01 No	230 VAC	Group Schneider	XB7EV05MPN	Device reference "O/L"	Siemens, L&T, BCH & ABB, HPL, Hagger or equivalent
12	ON lamp LED type – Red, Size 22.5mm	01 No	230 VAC	Group Schneider	XB7EV04MPN	Device reference "ON"	Siemens, L&T, BCH & ABB, HPL, Hagger or equivalent

13	Cable for Control wiring (1.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	1.5 sqmm, 1.1KV Gr	Finolex Cables	-	Grey or White	Havells / KEI / RR / RJ / Lapp or equivalent
14	Cable for Ground wiring (2.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	2.5 sqmm, 1.1KV Gr		-	Green	
15	Cable for Power wiring for starter outgoing connections to TB (35 sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694.	As reqd	35 sqmm 1.1KV Gr		-	Grey or White or black	
16	Incomer connections from Bus to MCCB 5 X 25 mm Tin plate copper bus with PVC sleeve	As reqd	5 x 25mm tin plated copper bus		--		
17	Lugs to be used for above cables	As reqd	-	Dowells	--	--	Hex, Jainsen, 3D, Lapp or equivalent
18	Cable terminals & accessories	As reqd	Size as per termination requirement		--		
19	Control TB C/DIN Channel mounted Polyamide.	As reqd	800V 41A- KUT6	Elmex	KUT 6	Grey Colour	Wago, Connectwell, Phoenix or equivalent
20	Ground TB C/DIN Channel mounted Polyamide.	As reqd	-		ET10	Yellow-Green dual coloured	
21	Power TB for 415VAC starter outgoing connections Stud type	1 No	100A	Electro Fiber,	Electro fiber Cat No EFTB-03/TP	For Power circuit termination	Ramanuj, PAC, Vinayak or equivalent



**100 HP/ 75KW Star-Delta Starter with LOR IS – BOM for Type 2 Co-ordination Starter
(Box – 4,8) Schematic Drg No-3711012455 Sheet 4**

Qty – 02 Sets

S No	Description of item	Qty	Rating	Make	Catalog No	Device Reference / Remarks	Alternate Make Acceptable
01	MCCB with magnetic trip unit, 3P, 415 V AC, 36kA breaking capacity	01 No	150A	Group Schneider	NSX160MA LV430830	Device reference "CB"	Siemens / ABB OR equivalent with direct mount rotary handle on MCCB
02	Direct rotary handle for MCCB mounted on MCCB	01 No	--		LV429337	For CB	
03	3 Pole main contactor with 230VAC coil & 3NO+1NC contacts	01 No	150A		LC1D150M7 LAD8N20	Device reference "MC"	Should be of same make as for SI No 01 for Type-2 co-ordination requirement and other compatibility reasons
04	3 Pole main contactor with 230VAC coil & 4NO+2NC contacts	02 Nos	150A		LC1D150M7 LADN31	Device reference "DC" & "NC"	
05	Mechanical interlock for Contactors	01 No			LA9D11502	To be used with NC & DC contactors	
06	Overload Relay with direct mounting on MC contactor	01 No	90/150A		LR9D5369	Device reference "OLR"	
07	Star Delta Timer with 1 NO + 1 NC Contacts, To be mounted on MC and plunger operated	01 No	--		LADS2	Device reference "TM"	
08	MI Ammeter 90 deg scale direct reading, 72 x72 mm, CT operated 150:5A	01 No	0-150/900A FSD 5A CT operated	AE	--	Device reference "A"	Rishabh, Meco or equivalent
09	CT for ammeter (Bar primary) 150:5A 10VA, Epoxy potted / Polyester resin cast	01 No	150:5A, 10VA	AE	--	Device reference "CT"	Kappa, Rishabh, Meco, Quantam, GPD or equivalent
10	Neutral link	01 Nos	415VAC	GE	NSH holder with copper link	Device reference "NTL LK"	Group Schneider /Siemens / ABB / L&T / BCH / HPL / Hager OR equivalent
11	2 Position 1 pole On- Off- switch with bezel "OFF - ON"	01 No	5A, 415VAC	Group Schneider	XB5AJ21N	Device reference "SW"	Siemens, L&T, BCH, ABB, Kaycee or equivalent
12	Pushbutton Green 22.5mm dia Flush type with 1 NO contact for START	01 No	230VAC, 1 NO	Group Schneider	XB5AA31N	Device reference "PB1"	Siemens, L&T, BCH & ABB or equivalent
13	Pushbutton Red 22.5mm dia Flush Type with 1 NC contact for STOP	01 No	230VAC, 1 NC	Group Schneider	XB5AA42N	Device reference "PB2"	Siemens, L&T, BCH & ABB or equivalent
14	O/L lamp LED type – Yellow, size 22.5 mm	01 No	230 VAC	Group Schneider	XB7EV05MPN	Device reference "O/L"	Siemens, L&T, BCH & ABB, HPL, Hagger or equivalent

15	ON lamp LED type – Red, Size 22.5mm	01 No	230 VAC	Group Schneider	XB7EV04MPN	Device reference “ON”	Siemens, L&T, BCH & ABB, HPL, Hagger or equivalent
16	Cable for Control wiring (1.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	1.5 sqmm, 1.1KV Gr	Finolex Cables	-	Grey or White	Havells / KEI / RR / RJ / Lapp or equivalent
17	Cable for Ground wiring (2.5sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694	As reqd	2.5 sqmm, 1.1KV Gr		-	Green	
18	Cable for Power wiring for starter contactor connections to TB (35 sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS694.	As reqd	35 sqmm 1.1KV Gr		-	Grey or White or black	
19	Cable for Power wiring for MCCB to OLR connections (50 sqmm single core 1.1KV grade copper flexible conductor FRLS PVC insulated) as per IS-694.	As reqd	50 sqmm 1.1KV Gr		-	Grey or White or black	
20	Incomer connections from Bus to MCCB 5 X 25 mm Tin plate copper bus with PVC sleeve	As reqd	5 x 25mm tin plated copper bus		--		
21	Lugs to be used for above cables	As reqd	-	Dowells	--	--	Hex, Jainson, 3D, Lapp or equivalent
22	Cable terminals & accessories	As reqd	Size as per termination requirement		--		
23	Control TB C/DIN Channel mounted Polyamide.	As reqd	800V 41A- KUT6	Elmex	KUT 6	Grey Colour	Wago, Connectwell, Phoenix or equivalent
24	Ground TB C/DIN Channel mounted Polyamide.	As reqd	-		ET10	Yellow-Green dual coloured	
25	Power TB for 415VAC starter outgoing connections Stud type	1 No	100A	Electro Fiber,	Electro fiber Cat No EFTB-03/TP	For Power circuit termination	Ramanuj, PAC, Vinayak or equivalent