NUCLEAR POWER CORPORATION OF INDIA LIMITED

(A Government of India Enterprise)

TARAPUR ATOMIC POWER STATION 1&2

TECHNICAL SPECIFICATION FOR REPLACEMEENT OF EXISTING MCC WITH NEW 415V MCCs AND PMCCs

NPCIL PROPRIETARY

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1.0 SCOPE

1.1 This specification covers the manufacturing, constructional features, inspection and testing at contractors/his sub-contractors works, packing, transportation, and delivery at site of 415V MCC/PMCC with all accessories, complete in all respect as described in this section & enclosed drawings.

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

1.3 Erection and commissioning of panels are in the scope of contractor.

1.4 Spare parts and maintenance tools as described later in the specification shall be supplied.

1.5 Bidder shall consider suitable de-rating factor for breaker and indicate free air rating of breaker and quote accordingly.

1.6 Selection of components required for type-2 coordination is under contractor's scope but is subject to purchaser's approval.

1.7 It is not 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 continuous commercial operation in a manner acceptable to the purchaser who will interpret the meaning of drawing and specification shall be entitled to reject any work or material which in his judgment is not in full accordance therewith.

2.0 CODES AND STANDARDS

2.1 The design, engineering, material, construction, manufacture, inspection, testing and performance of MCCs/PMCCs and associated equipment/accessories shall comply with all currently applicable statutes, standards, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the contractor of his responsibility. Where no standards are available, the supply items shall be of good quality and workmanship and backed by test results. Any supply items which are to be bought out by the contractor shall be procured from the manufacturers approved by the purchaser.

2.2 Equipment shall conform to the latest applicable standards and codes of practice. In case of conflict between the standards and this specification, requirements of this specification shall govern.

2.3 Other national standards are acceptable, if they are established to be equivalent to or superior to the listed standards. The contractor shall provide English version of standards and codes applicable along with his tender.

2.4 Table below lists applicable standards:

Standard	Title
IS:5	Colours of ready mixed paints and enamels
IS:694	PVC insulated unsheathed and sheathed cables/cords with rigid and flexible conductor for rated voltages up to and including 450/750V.
IS:2062	Hot rolled Medium and High tensile structural steel
IS:1573	Specification for electroplated coatings of Zinc on Iron and Steel
IS:613	Copper rods and bars for electrical purpose
IS:732	Code of practice for electrical wiring installation
IS:60947	Specification for low voltage switchgear and control gear
IS:8623	Specification of Low voltage switchgear and control gear assemblies
IS:61439	Low voltage switchgear and control gear assemblies
IS:60898	Electrical accessories- Circuit breakers for over current protection for household and similar installations
IS:3043	Code of practice for earthing
IS:60529	Degrees of protection by enclosures (IP code)
IS:1248	Direct acting analogue electrical measuring instruments and their accessories
IS:2705	Current transformers
IS:16227	Instrument transformers
IS:60255	Electrical relays
IS:8686	Static protective relays
IS:12083	Specification for electrical relays
IS 14570	Electrical measuring transducers for converting AC electrical quantities to analogue or digital signals
IS:12021	Control transformers for switchgear and controlgear for voltages not exceeding 1000V AC
IS:9431	Indoor post insulators of organic material for systems with nominal voltages greater than 1000 V up to and including 300 kV
IS:13703	Low voltage fuses for voltage exceeding 1000 V AC or 1500V DC.
344	IEEE recommended practice for seismic qualification of class-1E equipment for nuclear power generating stations
--	IE rules
PP-P-1819	NPCIL reference document for seismic qualification
ASME section IX	Codes for welding
IS 5082	Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes
IS 513	Cold reduced carbon steel sheet and strip
Standards related to Communication with Purchaser's SCADA if applicable as shown in SLD	
IEC:61850	Communication Networks and Systems in Substations
IEC 62439-3	Industrial communication networks - High availability automation networks - Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)
IEEE 802.3	Ethernet networks
TIA-568-C.2	Balanced Twisted-Pair Telecommunications Cabling and Components
IEC 11801	Information technology – Generic cabling for customer premises
IS 14493/ IEC 61156	Multicore and symmetrical pair/quad cables for digital communications

3.0 SPECIFICATION OF MAIN EQUIPMENT AND ACCESSORIES

1.0	**General**	
1.1	Type of MCC/PMCC	Metal clad indoor
1.2	Rated voltage	415V
1.3	Number of phases	3-Ø with neutral
1.4	Rated frequency	50Hz
1.5	System neutral earthing	Solidly grounded
1.6	Maximum system voltage	457V
1.7	1-minute power frequency withstand voltage -Power circuits -Control circuits -Circuits connected to CT	 2500V 2000V 2000V
1.8	Reference design ambient temperature :	45°C Maximum Humidity 97% minimum Humidity 60.7%
1.9	Rated impulse withstand voltage -Power circuits -Control circuits	 8kV 4kV
1.10	Maximum temperature with continuous current rating under design ambient temperature -Bus bars -Droppers -Silver faced contacts -Bolted joints -Accessible cubicle outer surface -Operating handle -Cable alley -Breaker contact (silver plated) -Inside modules -Inside modules where numerical relay is housed	 85°C 85°C 105°C 85°C 70°C 55°C 65°C 105°C 60°C 55°C
1.11	Short circuit withstand for bus bars and droppers -1s rating -Dynamic rating	 50kA rms 105kA peak
1.12	Cable entry	Bottom or Top to suit layout
1.13	Bus bar material	Aluminum of grade 63401WP
1.14	Single/Double front	DF for MCC sections and SF for breaker sections
1.15	Fully Draw out/ Semi draw out	Fully draw out for all panels and motor feeder. Bus VT panel are of fixed type. For above 50kW Motor feeders semi draw out type are acceptable only if contractor has manufacturing difficulties for providing large feeders in draw out arrangement
1.16	Degree of protection	IP-52

2.0	**PMCC constructional requirements**	
2.1	Colour shade and finish -Interior -Exterior	 RAL 7032 RAL 7032
2.2	Earth bus bar material and size	Copper suitable to carry 50kA for 1s
2.3	Purchaser's earthing conductor and size	2x50x6mm GS flat
2.4	Electrical clearances -Phase to phase -Phase to earth	 25mm 19mm
3.0	**Breaker particulars**	
3.1	Type	ACB
3.2	Voltage	415V
3.3	Frequency	50Hz
3.4	Phases	3-Ø with neutral link
3.5	Utilization category	B
3.6	Rated breaking capacity -Service short circuit breaking -Ultimate short circuit breaking	 50kA rms 50kA rms
3.7	Rated making current	105kA peak
3.8	Short time withstand current	50kA rms for 1s
3.9	Rated continuous current at ambient temperature	As per design requirement/SLD (600 amps approx.)
3.10	Type of operating mechanism	Electrical or Manual as per SLD
3.11	Protection relays	As per design requirement/SLD
3.12	Minimum number of auxiliary contacts	4NO + 4NC
3.13	Control voltage -For spring changing motor -For tripping -For closing	 230V AC with +10% to -20% 230V AC with +10% to -30% 230V AC with +10% to -20% Or as specified separately
3.14	Emergency manual operations required in addition to electrically operated devices -For spring charging -For tripping -For closing	 Yes Yes Yes
3.15	Rated impulse withstand voltage -Power circuits -Control circuits	 8kV 4kV
4.0	**Current transformers**	
4.1	Type	Cast resin
4.2	Class of insulation	Minimum B
4.3	Winding material	Copper
4.4	Current ratio	As per design/SLD
4.5	Accuracy class	5P10 for protection Cl-1.0 for Metering
4.6	Power frequency withstand voltage	3kV
4.7	Short time rating and dynamic rating	As seen by CT primary & secondary when 50kA(rms) 105kA(peak) is applied to main

		power circuit to which CT belongs
4.8	CBCT size	Suitable for cable as per design/SLD
5.0	**Voltage transformers**	
5.1	Type	Cast resin, single phase
5.2	Class of insulation	B or better
5.3	Rated voltage -Primary -Secondary	 415/√3V 110/√3V
5.4	Method of connection -Primary -Secondary	 YN0 yn0
5.5	Rated burden	As per design/SLD (100VA)
5.6	Accuracy class	0.5/3.0 (Dual accuracy)
5.7	Rated voltage factor	1.2 continuous, 1.5 for 30S
5.8	1 minute power frequency withstand voltage	3kV rms
6.0	**Meters**	
6.1	Type	Taut band/Digital meter
6.2	Accuracy class	1.5
6.3	Current rating	5A
6.4	Voltage rating	110V
7.0	**Transducers**	
7.1	Type	Dual output type
7.2	Range	4mA-20mA DC
7.3	Overload capacity -Current transducers -Voltage transducers	1.2xIr continuously 10xIr for 0.5s 1.2xVr continuously 2xVr for 0.5s
7.4	Input parameters -Voltage -Current	110V 5A
7.5	Power frequency withstand voltage	2kV rms for 1minute
7.6	Auxiliary supply	220V AC or as given
8.0	**Control /Selector switches**	
8.1	Type	Pistol grip handle switch, black, 3-position spring return to normal type for breaker control switches and Oval handle, black stay-put type for selector switches
9.0	**Indicating Lamps**	
9.1	Type	Cluster LED type lamps, screw type replaceable for each indication
10.0	**MCB**	
10.1	Rated current	16 A As per requirement
10.2	Rated breaking capacity	10kA
10.3	Number of poles and auxiliary contacts	As per control schematics
11.0	**Fuses**	
11.1	Type	HRC cartridge
11.2	Rating	As per design

11.3	Minimum rupturing capacity	80kA
12.0	**Contactors/Starters**	
12.1	Type	As per load list/ design (attached)
12.2	Rated duty of contactor	Continuous
12.3	Utilization category	AC3/AC4
12.4	Impulse withstand voltage	8kV
12.5	Control voltage	110V AC
12.6	Insulation class	E or better
12.7	Auxiliary contacts	2NO+2NC
12.8	Thermal overload relay	As per design
13.0	Relay/Timers	As per one line diagram/Control schematics
14.0	**Under voltage relay (27)**	
14.1	Number of poles	1
14.2	Voltage rating	110V AC
14.3	Setting range	40%-80%
14.4	Auxiliary supply	220V DC or as given
14.5	Number of contacts	2 pairs of self-reset make contacts
14.6	Insulation	2kV for 1 minute
14.7	Operation indicator	Required
15.0	**Common requirements to Numerical relays**	
15.1	Functions	□ Protection □ Metering □ Fast transient recording □ Logical □ Supervision of CT leads and trip circuit □ Communication capability with external programming /diagnostic tools
15.2	Inputs	5A, 110V AC, CBCT
15.3	Output contacts -Type -Making current -Breaking current -Continuous current capability -Mechanical durability	 Potential free 30A for 3s 1A inductive at 250V DC (L/R=40mS) 5A >10000 operations
15.4	Accuracy	±0.2% @In,Vn for measuring ±2% for Protection thresholds ±2ºC for temperature
15.5	Over current capability	100In for 1s 40In for 2s 4In continuous
15.6	Over voltage capability	2Vn continuous 2.6Vn for 10s
5.7	Mounting	Flush
15.8	Auxiliary supply	230V DC +10% to -20% or as given
15.9	Self-testing and diagnostic features	Hard wired watchdog timer feature shall be provided with contacts for external alarm
15.10	Password protection	Multi-level password protection required
15.11	Time Synchronization	Internal clock of the numerical relay shall be able to

		synchronize with external time source via IEC:61850 protocol only if applicable as mentioned in SLD
15.12	Local display	□ Relay status □ Measured quantities □ Set Values □ Quantities at the instant of operation
15.13	Disturbance recorder/ Event recorder	□ Event recording data from built-in event recorder shall be available in IEEE/ COMTRADE format for all numerical relays. □ The event recording data shall be downloadable via IEC:61850 protocol from external master station only if applicable as mentioned in SLD.
15.14	Operating temperature	To suit temperature at mounting point
15.15	Degree of protection	IP-52 Front and IP-20 rear
15.16	EMI/EMC requirements	IS:60255, IEC 61000 and other applicable IEC/IS or equivalent standard
15.17	Number of Opto Inputs	As per ESCADA IO list and additional requirement as per the scheme if required subject to minimum of 3 numbers
15.18	Number of Output relays	As per ESCADA IO List and additional requirement as per the scheme if required subject to minimum of 6 numbers
15.19	Other requirements of numerical relay if communication with Purchaser's SCADA is required as per SLD	SCADA is not available, so no provision is required.
16.0	**Numerical relay for PMCC/MCC Incomer**	
16.1	Phase overcurrent & short circuit protection	
16.1.1	Instantaneous protection	Required
16.1.2	IDMT protection	IDMT curves as per IEC/IEEE/ANSI with variable TMS in order to provide time discrimination between upstream and downstream feeders over full range of current setting.
16.1.3	Definite time delay protection	Required
16.2	Earth fault protection	
16.2.1	Number of stages	Minimum two stage
16.2.2	IDMT protection in minimum two stage	IDMT curves as per IEC/IEEE/ANSI with variable TMS in order to provide time discrimination between upstream and downstream feeders over full range of current setting.
16.2.3	Definite time delay protection	Required
16.2.4	Provision to connect external NCT/CBCT	Required
17.0	**Earth fault relay**	
17.1	Setting range	10%-50%
17.2	Time delay	Delay time shall be determined by contractor in order to coordinate between fuse and contactor operation in the event of earth fault which is beyond the breaking

		capacity of contactor
17.3	Input	CBCT
18.0	**MCCBs**	
18.1	Rating	Subject to purchaser's approval
18.2	Voltage	415V
18.3	Number of phases	3-Ø with neutral link
18.4	Service short circuit breaking capacity	50kA(rms)
18.5	Rated making current	105kA(peak)
18.6	Operation	Independent manual closing
18.7	Protection	Over current, Short circuit, Earth fault
19.0	**Over current and short circuit release**	
19.1	Type	Microprocessor based over current/ short circuit release
19.2	No. of poles	Three
19.3	Current rating	5A
19.4	Protective elements	□ Inverse time delay on each phase for over current with variable setting range □ Definite time delay on each phase for over current with variable setting range □ Instantaneous over current protection □ Ground fault protection with time delay
19.5	Contacts for external use	Shall be provided with 2NO contacts
19.6	Standards	IS:60255, IS:60947 and qualified for operating condition

4.0 EQUIPMENT CONSTRUCTION AND DESIGN DETAILS

4.1. Sheet metal work

4.1.1 Panels structural frame shall be fabricated using suitable mild steel structural sections or pressed and shaped cold rolled sheet of thickness not less than 2.5mm.

4.1.2 Frames shall be enclosed by sheet steel of thickness not less than 2mm cold rolled, smoothly finished, leveled and free from flaws. Doors, partitions and covers shall be made of sheet steel of thickness not less than 1.6mm cold rolled. Stiffeners shall be provided wherever necessary. Gland plates shall be made of 2.5mm CRCA or 3mm aluminum for single core cables.

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

4.1.4 Complete structure shall be rigid, self-supporting free from vibration, twists and bends. Cutouts shall be true in shape and devoid of sharp edges.

4.1.5 Perimeter of all doors and removable covers shall have EPDM gaskets all around.

4.1.6 Floor mounted panels shall be provided with a metal base frame. The metal base frame size shall be matched to suit the floor cutouts provided. Panel of base frame shall be made up of ISMC-100 to take care of local internal flooding.

4.1.7 Base frames of floor mounted panels shall be welded to the embedded parts provided on the floor. The top portion of base frame should be in perfect level. Contractor to take care of any imperfections in the embedded parts provided. In case embedded plates provided are not matching / not provided by the PUCHASER, CONTRACTOR shall provide required anchor fasteners of approved make and type without any extra cost to PURCHASER. Panels shall be bolted to the base frame. Welding requirement on factory built panels for mounting purposes is not acceptable.

4.1.8 Checkered Plate shall be provided to cover the unused portion of floor cutouts and spaces in the base frame not covered with panels to form a uniform flat surface.

4.2. Constructional features

4.2.1 The equipment shall be metal enclosed, indoor, floor mounted modular type. Protective relays associated with the feeder shall be housed in same vertical section.

4.2.2 Panels shall be easily extendable on both sides by the addition of vertical sections after removing the end covers.

4.2.3 Incomer circuit breakers and outgoing feeder modules shall be of fully withdrawable type. Cable entry shall be top or bottom as per purchaser’s requirement and approved drawings.

4.2.4 Panels shall have a uniform height.

4.2.5 MCC modules shall be of double front type.

4.2.6 CT and PT shall be located in such a way that they can be easily accessible for maintenance.

4.2.7 Panels shall be provided with labels on the front and rear indicating the MCC/PMCC designation.

4.2.8 Manufacturer shall maintain the same MCC/PMCC cell number for identical loads with same tag number in case of twin stations. There are some common loads which are fed from either of the units having tag number starting with ‘0’. In such cases the corresponding MCC cell number shall be used for other common loads fed from another unit. If there are no corresponding common loads on the other unit that module should be kept as spare/empty.

4.2.9 Panels shall have a horizontal bus bars running horizontally with vertical droppers for connecting to modules. Neutral bus bars shall be extended along bus bars and there shall be provision to extend the neutral to individual feeder module.

4.2.10 It shall be possible to draw out modules without having to unscrew or unbolt connections. Modules should perfectly align themselves on withdrawal and subsequent insertion. The draw out contacts shall be of copper/copper alloy which are silver plated. The design shall prevent any arcing. The arrangement shall be suitable to withstand peak short circuit current.

4.2.11 Suitable shutters shall be provided to prevent anyone from coming into contact with live bus bars while drawing out modules or carrying out permissible maintenance on live MCC/PMCC.

4.2.12 Contractor shall satisfy purchaser that the cable alley, bus bar arrangements and gland plates provided are suitable for terminating purchaser's cable as given in purchaser's SLD/ other document. Cable alley shall be provided with suitable hinged doors. It shall be possible to carry out maintenance work on cable connection to any one circuit with bus and adjacent circuits alive.

4.2.13 Control and selector switches, push button, indicating instruments, lamps and protective relays shall be mounted on the front door of the respective compartment.

4.2.14 Individual compartment doors shall be provided with suitable cut out necessary to permit operation of circuit breaker/ isolating switches from the front without opening the door.

4.2.15 Adjacent panels shall be separated by a metal sheet. Each module shall be covered on all sides. The front of the compartment/module shall be provided with a hinged door.

4.2.16 The withdrawable chassis shall move on suitable guide and on suitably plated steel or stainless steel rollers/balls to facilitate easy withdrawal.

4.2.17 Marshalling panels shall be provided for all MCCs/PMCCs to enable convenient termination of purchaser's external control cables. This arrangement and numbering of terminals is subject to purchaser's approval. Adequate number of spare terminals shall be provided. Terminal blocks shall be segregated according to voltage grading.

4.2.18 Generally, all equipment pertaining to a module/breaker shall be housed in the same module/vertical section.

4.2.19 All identical equipment and corresponding parts of the same size shall be fully interchangeable

4.3 Earthing

4.3.1 An earthing bus of tinned copper shall be provided throughout the length of the panel and in each vertical section. It shall be bolted to the framework. All non-current carrying metal parts of the switchgear shall be effectively connected to the earth bus. Hinged doors shall be earthed through flexible wire.

4.3.2 Suitable terminals at each end of the earth bus bar shall be provided to suit purchaser's earthing conductor at two places.

4.3.3 Looping of earth connections that would result in loss of earth connection to other devices when the loop is broken shall not be permitted.

4.4 Panel wiring and termination

4.4.1 Each panel shall be supplied completely wired internally ready for purchaser's external cable connections. In case the boards are supplied in shipping sections the entire inter board wiring between shipping sections at site will be done by the contractor.

4.4.2 Internal control wiring diagram and external cable connection diagram for each board shall be furnished by contractor.

4.4.3 All control wiring shall be carried out with 650V grade, HR FR PVC insulated, single core, stranded flexible copper conductor wires. The minimum size of the stranded copper conductor used for board wiring shall be as follows:
All control circuits 1.5mm^2
CT circuits 2.5mm^2
Main control supply from purchaser 10mm^2
Space heater and lighting supply 4mm^2

4.4.4 Panel wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters, troughs shall be used for this purpose.

4.4.5 Wire terminations shall be made with solder less crimping type of tinned copper lugs. Insulated sleeves shall be provided at all the wire terminations. Core identification plastic ferrules, marked to correspond with contractor's board wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is disconnected from terminal blocks.

4.4.6 Following colour coding scheme shall be followed:

220V DC/as specified	:	Grey
240V AC	:	White
Neutrals	:	Black
All earthing	:	Green
24V DC	:	Brown
R,Y,B phases including CT,PT	:	Red, Yellow and Blue

4.4.7 In case wires of same colour are used, coloured ferules/markings shall be adopted at terminations to suit the above colour code.

4.4.8 Terminal blocks for control wiring shall be 650V grade, rated 10A, one piece moulded complete with insulated barriers. Stud type terminals, washer, nuts and lock nuts of copper and identification strips shall be provided.

4.4.9 The insulation between any terminal and framework or between adjacent terminals shall withstand a 2kV rms, for 60s.

4.4.10 At least 10% spare terminals shall be provided in each cubicle and these spare terminals shall be uniformly distributed on all terminal blocks. Spacing between strips of terminal blocks shall be adequate for laying and terminating purchaser's cables.

4.4.11 Each terminal of terminal block shall have not more than one incoming and one outgoing wire termination.

4.4.12 Terminal block for CT and VT secondary leads shall be provided with test link and isolating facilities. CT secondary leads shall be provided with shorting links and earthing facilities.

4.4.13 The panels shall be provided with necessary arrangement for receiving, distributing and isolating DC and AC supplies required for control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch & fuse. Selection of the main and sub-circuit fuse rating shall be such as to ensure selective clearance of sub-circuit faults

4.5. Equipment mounting

4.5.1 All equipment in the front side shall be flush mounted. Equipment mounted inside the cubicles shall be so located that fuses, terminals and adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly done.

4.5.2 Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment.

4.5.3 Indicating instruments and meters shall be at a suitable height so that the lettering on the dials can be easily read.

4.5.4 Control switches, push buttons and relay resetting knobs shall be conveniently located for ease of operation.

4.6. Cable and bus bar termination

4.6.1 Terminals for power cables in the MCC/PMCC panel shall be suitable for stranded copper conductor or aluminium conductor. Indicative cable sizes are given in the SLD/load list. Final cable sizes will be given to the successful bidder during drawing approval.

4.6.2 Control cables are generally terminated on terminal blocks in the marshalling panel. Few control connections may be made to the module/vertical section directly depending on the approved drawings.

4.6.3 Proper supporting arrangement for purchaser's cables shall be made inside the panels. Gland plates shall be undrilled.

4.6.4 The incomer of PMCC is connected with auxiliary transformer through direct bus bar connection. The contractor shall supply suitable braided copper flexible, neoprene rubber bellow with associated hard ware for above connection. Braided copper shall have same continuous and short circuit current rating as that of PMCC. The copper flexible shall be of tinned type.

4.7. Bus bars

4.7.1 All panels shall be provided with high conductivity aluminium bus bars. Horizontal bus bars shall be of uniform cross section throughout length of the panel. Vertical bus bars shall be uniformly sized for all vertical sections and shall be suitable for connecting all combinations of loads.

4.7.2 Horizontal bus bars shall be located in an independent air insulated enclosure and segregated from all other compartments of the cubicle.

4.7.3 The bus bar support insulators, bushings shall be of Class-B or better materials.

4.7.4 The current carrying capacity of the neutral bus shall be rated not less than 50% of the phase bus bars. The neutral bus bar shall have same capacity to withstand fault currents.

4.7.5 Aluminum Bus bar joints shall be tinned and complete with high tensile bolts, washers and nuts.

4.8. Air circuit breakers

4.8.1 Circuit breakers shall be three-pole air break horizontal draw out type and shall have fault making and breaking capacities as specified. Circuit breakers shall be mounted along with its operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimize misalignment of the breaker.

4.8.2 Circuit breakers shall be provided in single tier arrangement only.

4.8.3 There shall be `Service', `Test' and ‘Fully withdrawn’ positions for the breakers. In `Test' position the circuit breaker shall be capable of being tested for operation without energizing the power circuits. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the `Service', position.

4.8.4 All circuit breakers shall be provided with 4NO + 4NC potential free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker.

4.8.5 Separate limit switches each having required number of contacts shall be provided for both `Service' & `Test' position of the breaker.

4.8.6 All contacts shall be rated for making continuously carrying and breaking 10A at 240V AC and 1A (Inductive) at 220V DC. Suitable mechanical indications shall be provided on all circuit breakers to show `Open'. `Close', `Service', `Test' and `Spring-charged' positions.

4.8.7 Breakers shall be provided with two trip coils. Breakers shall be provided with mechanically operated red trip push button, shrouded to prevent accidental operation.

4.8.8 All circuit breakers shall be provided with the interlocks as given in indicative control schematics and approved drawings. Further the following may be noted:

4.8.8.1 Movement of a circuit breaker between service and test positions shall not be possible unless it is in open position.

4.8.8.2 Attempted withdrawal of a closed circuit breaker shall not trip the circuit breaker. Such withdrawal should not be possible.

4.8.8.3 Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn. It shall however, be possible to open the shutters intentionally, against spring pressure for testing purpose.

4.8.8.4 A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

4.8.8.5 Circuit breakers shall be provided with electrical anti-pumping and trip free feature, even if mechanical anti pumping feature is provided.

4.8.8.6 The Circuit breakers shall be provided with power operated/ manual spring charge mechanism.

4.8.8.7 Closing of circuit breaker shall automatically initiate recharging of spring ready for next closing stroke.

4.8.8.8. The circuit breaker shall not close until spring is fully charged.

4.8.8.9 Circuit breakers shall be designed to enable a continuous sequence of closing and opening operations as long as power is available and at least one operation on power supply failure.

4.8.8.10 Breakers shall be provided with emergency manual charging facility.

4.8.8.11 The trip coil shall operate satisfactorily under all values of supply voltage between 70%-110% of rated control voltage. Close coil shall operate satisfactory under all values of supply voltage between 80%-110% of rated control voltage.

4.9 Transducers

4.9.1 Voltage/current transducers as indicated in schematic drawings shall be provided.

4.9.2 Galvanic isolation shall be provided between the input and output.

4.9.3 Control power supply provided by purchaser shall be used.

4.10 Current transformers

4.10.1 Current transformer shall be of resin cast dry type with Class-B or better insulation.

4.10.2 It is contractor’s responsibility to co-ordinate the current transformer burden with the requirement of relays/instruments and leads associated.

4.10.3 All current transformers shall be earthed through a separate link on the terminal block to permit easy measurement of the current transformer insulation measurement.

4.11 Voltage transformers

4.11.1 Voltage transformer shall be of resin cast dry type with Class-B or better insulation.

4.11.2 Voltage transformer shall be fixed type complete with suitable rated primary and secondary fuses. Primary fuses shall have rupturing capacity equal to the 80kA at 440V. Fuses shall be provided in all sub circuits.

4.12 Indicating instruments

4.12.1 Instruments shall have accuracy class of 1.5 or better. For analog meters the design of the scales shall be such that it can read a resolution corresponding to 50% of the accuracy class index. Digital indicating meters are also acceptable.

4.12.2 Instrument dials shall be white with black numerals and lettering. Knife edge pointers and parallax free dials shall be provided. Instruments shall be provided with non-reflecting glass.

4.12.3 All voltage circuits of meters shall be provided with fuses. Indicating instrument shall be provided as per the single line diagrams & data sheets.

4.13 Switches

4.13.1 Switches shall be of rotary type, heavy duty, double break, hand operated, air break, quick make, quick break type conforming to applicable standards. Switch ratings and number of poles shall be as per requirement.

4.13.2 The switches shall be capable of withstanding the mechanical stresses caused by the peak short circuit current of value equal to the cut off current of the associated fuse/MCCB. The utilization category for switches shall be selected in commensuration with its application.

4.13.3 Lockable type switches which can be locked in both local and remote position shall be provided for local/remote switches.

4.13.4 The connections between switch and fuse shall be insulated and all live connections shall be shrouded.

4.13.5 The circuit breaker test control switches shall be of 3-position, spring return to neutral type. The control spring shall be strong and robust enough to prevent inadvertent operation due to light touch.

4.13.6 Instrument selector switches shall be stay put type. Ammeter selector switch shall be of make before break type so as to prevent inadvertent open circuit of CT secondary.

4.13.7 Contact of the switches shall be spring assisted and contact faces shall be of silver/silver alloy. Spring shall not be used as current carrying part. The contact combination shall be as indicated in enclosed drawings. The contact rating shall meet the requirement of the circuit for which it is used.

4.14 Miniature circuit breakers (MCBs)

4.14.1 MCBs shall be hand operated, air break, quick make, quick break confirming to applicable standards.

4.14.2 MCB shall be provided with overload and short circuit protective device for protection under overload and short circuit conditions. All MCBs shall have current limiting features. The let through I^2t shall be limited to a value less than I^2t of one-half cycle wave of the symmetrical prospective current without any fusible elements when operating within its current range.

4.15 Fuses

4.15.1 All fuses shall be of the HRC cartridge plug in type with required rupturing capacity of 80kA at 440V.

4.15.2 Fuses shall be provided with visible indication to show that they have operated.

4.16 Relays

4.16.1 Protective relays used in incomer breaker and motor protection relays as mentioned below shall be of numerical type with following general specification:

4.16.2 The sampling rate of CT/PT inputs shall be adequate to process the inputs with required accuracy. The system shall use nonvolatile memory unit and shall not require any loading of software after it is inspected at factory. The response time for instantaneous type protection shall be less than 30 milli second. Time delayed and IDMT protection shall be suitable for coordinating with downstream protection system.

4.16.3 Relay facia shall have LED displays with functional keys to program the relay for relay setting and configuration.

4.16.4 All numerical relays shall have self-diagnostic facilities to indicate the failure or unhealthiness of various modules. Display shall be provided for above function.

4.16.5 Password protection shall be provided for implementing changes in the relay setting and configuration.

4.16.6 Motor protection relay shall be programmable to adjust characteristics in hot and cold conditions and also the staring duty specified for motor. Facility to display motor starting current shall be made. Facility to indicate running time of motor shall be provided.

4.16.7 Operating principle indicating algorithm, formulae used, block logic diagram in order to understand function of numerical relay for various protection shall be furnished.

4.16.8 All relays shall conform to the requirements of IS-60255 or equivalent. Relays shall be dust tight and have transparent covers removable from the front.

4.16.9 Auxiliary relays may be of fixed type mounted inside the cabinet. Auxiliary relays shall be rated to operate satisfactorily between 80%-110% of the rated voltage. Auxiliary relays like 3C and 3T shall be provided with freewheeling diodes.

4.16.10 Protection schemes/ relays mentioned above shall be complete in all respects. Auxiliary relays, timers etc., required to make the scheme complete shall be included in the scope.

4.16.11 Although AC auxiliary supply is specified, self-powered relays are also acceptable.

4.16.12 The details of protective relays indicated above are indicative, Bidder shall offer suitable relays details of which will be reviewed during tender/drawing approval. It is the responsibility of bidder to provide suitable protective relays approved by the purchaser.

4.16.13 The contact ratings of auxiliary and protective relays shall be properly selected by the bidder. In particular those wired in breaker close/trip coil circuits shall be scrutinized properly.

4.17 Starters

4.17.1 Direct on line starters shall be suitable for class AC3 duty, unless otherwise stated. Forward/reverse starters shall be suitable for class AC4 duty. Contactors for this purpose shall be electrically/mechanically interlocked. All starter modules shall have class-2 co-ordination as per IS:60947.

4.17.2 Thermal over load relays shall have following features:

4.17.2.1 They shall be three element, positive acting, ambient temperature (inside module) compensated and with inverse time characteristic with adjustable setting. The setting range shall be properly selected according to the motor rating.

4.17.2.2 They shall be of self-reset type. However, provision shall exist to make them hand reset type at site, if required.

4.17.2.3 For all blower and fan applications, motor may take longer starting time. In that case over load relay shall be selected and coordinated such a way that it shall not trip the motor during starting. Motor characteristics will be provided to the manufacturer. Saturable CT fed relays may be used.

4.17.2.4 They shall be provided with single phasing preventers.

4.17.3 All contactors shall have following features:

4.17.3.1 Contactors shall be of electromagnetic type rated for uninterrupted duty.

4.17.3.2 Each contactor shall be provided with 2 NO + 2 NC auxiliary contacts.

4.17.3.3 Insulation class of contactor shall be Class-E or better. Operating coil shall be suitable for 110V AC.

4.17.4 Indicative guideline for switch, fuse and contactor's ratings are given below. However manufacturer shall select appropriate rating of switches, fuses and contactors based on

indicative guideline, motor parameters, type of application, ambient condition, type-2 coordination, etc. Selected ratings are subject to purchaser's approval.

Table-1: Switch and fuse unit

Motor kW range	Minimum continuous current rating of switch in A	Maximum continuous current rating of fuses in A
Up to 7.5	32	32
7.6 to 18.5	63	63
18.6 to 45	125	125
45.1 to 55	250	160
55.1 to 75	250	200
75.1 to 90	250	250
90.1 to 110	315	315
110.1 to 120	400	400

Table-2: Contactors

Motor kW range	Minimum continuous current Rating of contactors in A
<5.5	16
5.6-15	32
15.1-30	63
30.1-54.9	110
55-75	250
75.1-120	400

4.17.5 The different types of feeders used in MCC/PMCC areas given in the following table. Tender drawings will have more details regarding the same.

Feeder type	**Description**
Type-A1	Consists of SFU and fuses for panel loads up to 63A
Type-A2	Consists of MCCB and power fuses for panel loads above 63A
Type-A3	Provided with SFU, contactor and control circuit based on 110V AC for Panel loads having Auto logic
Type-B1	Provided with SFU, contactor and control circuit based on 110V AC for locally controlled heater up to 50kW
Type-B2	Provided with SFU, contactor and control circuit based on 24V DC for remotely controlled heater up to 50kW
Type-B3	Provided with SFU, contactor and control circuit based on 24V DC for remotely controlled heater above 50kW. It also has Earth fault protection to provide Type-2 co-ordination with MCC/PMCC incomer.
Type-B4	Provided with SFU, contactor and control circuit based on 24V DC for remotely controlled heater up to 50kW

Type-B5	Provided with SFU, contactor and control circuit based on 24V DC for remotely controlled heater above 50kW
Type-C1	DOL starter and control circuit based on 110V AC for locally controlled pump/fan motor up to 50kW. It shall be provided with Earth fault protection for motor rating ≥30kW
Type-C2	DOL starter and control circuit based on 110V AC for locally controlled pump/fan motor above 50kW. It shall be provided with numerical relay for motor protection.
Type-C3	DOL starter and control circuit based on 24V DC for remotely controlled pump/fan motor up to 50kW. It shall be provided with Earth fault protection for motor rating ≥30kW
Type-C4	DOL starter and control circuit based on 24V DC for remotely controlled pump/fan motor above 50kW. It shall be provided with numerical relay for motor protection.
Type-C5	DOL starter and control circuit based on 24V DC for remotely controlled pump/fan motor up to 50kW. It shall be provided with Earth fault protection for motor rating ≥30kW. It shall have additional auxiliary contacts of contactor for purchaser's control logic.
Type-C6	DOL starter and control circuit based on 24V DC for remotely controlled pump/fan motor above 50kW. It shall be provided with numerical relay for motor protection. It shall have additional auxiliary contacts of contactor for purchaser's control logic.
Type-C7	DOL starter and control circuit based on 24VDC for remotely controlled pump/fan motor up to 50kW.
Type-C8	DOL starter and control circuit based on 24V DC for remotely controlled pump/fan motor above 50kW. It shall be provided with numerical relay for motor protection.
Type-C9	DOL starter and control circuit based on 110V AC for locally controlled ventilation air washer fan motor above 50kW. It shall be provided with numerical relay for motor protection.
Type-C10	DOL starter and control circuit based on 110V AC for locally controlled ventilation air washer fan motor up to 50 kW.
Type-C11	DOL starter and control circuit based on 110V AC and 24V DC supply.
Type-D1	Reversing starter for remotely controlled valve actuator motor
Type-D2	Reversing starter for remotely controlled valve actuator motor
Type-D3	Reversing starter for remotely controlled valve actuator motor
Type-D4	Reversing starter for remotely controlled valve actuator motor with inching operation
Type-P2	DOL starter and control circuit based on 110V AC
Type-P3	Reversing starter for remotely controlled valve actuator motor with 110 volts AC control supply and mechanical interlock.
Type-P4	Switch fuse unit with 100 amps HRC fuse.
Type-P5	MCCB with 20 Amps breaker for panel space heater.

4.18 Control transformers

4.18.1 415V/110V 1-Ø two winding dry type control transformer shall be provided in required modules to cater to that particular module. VA rating shall be suitably selected. The insulation class shall be Class-B.

4.18.2 Minimum voltage available during pick up of contactor shall not be less than 85% of 110V at 90% primary voltage.

4.18.3 Efficiency shall not be less than 80% at full load.

4.18.4 The control transformer shall have adequately rated fuses in the line leads of primary and secondary windings in order to protect from short circuit. The neutral or the earth lead of secondary shall have earth link. Control transformers of various modules shall be uniformly distributed across various phases to avoid unbalance.

4.19 Moulded case circuit breakers (MCCB)

4.19.1 MCCBs shall in general conform to IS: 60947. All MCCBs shall be suitable for utilization category-A duty.

4.19.2 All MCCBs shall be provided with microprocessor based over current, short circuit and earth fault releases. The time and current setting of the releases shall be adjustable at site. MCCB shall also be provided with shunt trip coil.

4.19.3 The MCCBs shall have rated service-breaking capacity not less than the connected load. MCCBs shall be manually operated. The operating handle shall give clear trip indication. MCCB shall be suitably de-rated based on the temperature in the feeder module where it is mounted.

4.21 Push buttons

4.21.1 Unless otherwise specified, push buttons shall be of momentary contact type with rear terminal connections. The push button knob shall be suitably shrouded to prevent inadvertent operation.

4.21.2 All push buttons shall have 2NO + 2NC potential free contacts. The contact faces shall be of silver/silver alloy. The contacts shall be able to make and carry 10A at 220V DC and shall be capable of breaking inductive load of 1A at 220V DC.

4.22 Indicating lamps

4.22.1 Indicating lamps shall be of the cluster LED type. Lamps shall be provided with lamp holders and covers. They shall give colour indications as per approved control schematics.

4.23 **Lighting, receptacle and space heaters**

4.23.1 Each vertical section of floor-mounted panels shall be provided with LED lighting fixtures rated for 240V, 1-Ø, 50Hz. A switch shall be provided to turn off the lamp when not required. Also, the door switch shall control the switching of lamp.

4.23.2 A 240V, 1-Ø, 50Hz. 5A, 3-pin universal receptacle with switch shall be provided at a convenient location in the interior of each vertical section.

4.23.3 Strip type space heaters with thermostat shall be provided in each vertical section. Space heaters shall be rated for 240V, 1-Ø, 50Hz power supply. Space heaters shall be mounted in such a way that they don't damage the wiring and other equipment.

4.24 Name plates and labeling

4.24.1 All panels, its components and feeders shall be properly identified with labels. Labels shall be made of anodised aluminium or stainless steel. Labels shall have white letters on dark blue/black background. Labels shall be fitted using proper fasteners or by riveting. Use of adhesives is not acceptable.

4.26. Protection co-ordination

It shall be the responsibility of the contractor to fully co-ordinate the over current, earth fault and short circuit tripping of the devices with the upstream and downstream fuse/MCCB/CB built-in releases/relays/fuses/motor starters. Change in ratings of fuses, MCCBs, etc. shall be carried out in order to achieve complete discrimination in protection coordination. Details shall be subject to purchaser's approval.

4.27 Items like switches, fuses, indicating lamps, push buttons, control switches, etc. are to be provided as per the requirements finalized during approval of drawings.

4.28 Qualification for seismic duty

4.29 Class-III and class-II panels will have to undergo seismic qualification as per IEEE- 344 and as per approved test procedures for specified seismic acceleration. Equipment (representative panels) used for seismic qualification shall be NPCIL property and shall be part of supply however they shall not be used in other panels and shall be kept as spare at site. Class-IV panels will have to undergo only codal qualification.

5.0 Spares

10% usable empty space as per the feeder size shall be provided for future use of purchaser in MCC sections of MCC/PMCC panels. It is subjected to purchaser's approval. 5% of fully wired individual spare module of each type and size consisting of all feeder components along with the carriage shall be provided to purchaser. Rating, type and quantity of wired spare modules are subjected to purchaser's approval.
Mandatory spare as given in covering specification shall be supplied.

6.0 Special tools and tackles

6.1.1 All necessary software, laptop, other hardware required for loading and reading the setting of protection relays and analyzing, downloading transient and steady state stored data from the protection relays, fault diagnosis of protection relays etc. shall be provided.

6.1.2 Software and hardware for configuring the communication module of PMCC incomer relays to communicate with purchaser's SCADA if applicable shall be supplied.

6.1.3 Required tools (hardware/communication cables/interface cables and software) as required for Network switches shall be supplied if applicable.

6.1.4 Portable mobile trolleys for ACB handling as given in covering specification shall be supplied.

6.1.5 Secondary injection test kit shall be supplied to test the MCCB protection functions if MCCBs are used.

7.0 QUALITY ASSURANCE PLAN

The Quality Assurance Plan given below shall be followed. However, minor modifications required due to manufacturer specific changes, changes in the governing standards in the intervening period and changes in testing facilities available in India can be accommodated subject to approval of NPCIL.

Abbreviations:
R Reviewed by
P Performed by
W Witnessed by (After lapse of due notice to NPCIL, manufacturer may proceed with manufacture)
H Hold (Unless a written clearance is obtained from NPCIL, manufacturer shall not proceed to next stage)

1.0 NPCIL
2.0 Prime Supplier/EPC Contractor
3.0 Approved External Laboratory or Sub Vendor QC (if vendor QC/facility not available)
AD NPCIL Approved Document such as Tender Document, Purchase Order, Drawings & Test Procedures.
TR Test Report IR – Inspection Report
PS Plant Standard
IS Indian Standards

Notes:

Wherever R& W are both indicated, NPCIL QS to witness test or review TRs.
Minor: The characteristics of a component, process or operation whose failure neither materially reduce the inability of the product in operation, nor does it affect the aesthetic aspects.
Major: The characteristics of a component, process or operation whose failure may cause operation failure which cannot be readily corrected at site or cause substandard performance, increased erection and maintenance cost, reduced life or seriously affect aesthetics or ergonomics.

Critical: the characteristics of a component, process or operation failure of which will surely cause operating failure or intermittent troubles which is difficult to rectify at site or render the unit unfit for use or safety hazards.

"Failure" of a characteristic means failure to meet the "acceptance norms".
If 100% "witness" is carried out by "Prime contractor", NPCIL will witness on sample basis, or if 100% "witness" of tests is carried out by "sub-contractor", "Prime contractor" will witness on sample basis.

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
1.0	**Raw Material/ Bought out items.**												
1.1	Sheets CRCA/HRCA & structural members.	Chemical composition.	Major	Chemical	Sampling 1 No. per lot per size	IS-513	IS-513	TR	1,2	3			
		Bending tests.	Major	Mechanical	Sampling 1 No. per lot per size	IS-513	IS-513	TR	1,2	3			
		Dimension/Thickness	Major	Measurement	Sampling 1 No. per lot per size	IS-513	IS-513	TR	1	3	2		
		Hardness	Major	Physical	Sampling 1 No. per lot. per size	IS-513	IS-513	TR	1,2	3			
		Surface finish	Major	Visual	Sampling 1 No. per lot per size	IS-513	IS-513	TR	1	3	2		
1.2	Bus bars	Chemical composition	Major	Chemical	Sampling 1 No. per lot per size	Al-IS:5082/ Cu-IS 613	Al-IS:5082/ Cu-IS 613	TR	1,2	3			

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
		Electrical conductivity	Major	Electrical	Sampling 1 No. per lot.	Al-IS:5082/ Cu-IS 613	Al-IS:5082/ Cu-IS 613	TR	1,2	3			
		Dimension check.	Major	Measurement	Sampling 1 No. per lot.	Al-IS:5082/ Cu-IS 613	Al-IS:5082/ Cu-IS 613	TR	1	3	2		
		Check for mechanical property	Major	Mechanical	Sampling 1 No. per lot.	Al-IS:5082/ Cu-IS 613	Al-IS:5082/ Cu-IS 613	TR	1,2	3			
		Visual check.	Major	Visual	100%	Free from defects	Free from defects	IR	1	3	2		
1.3	Control wires	Routine tests.	Major	Electrical	100%	IS:694	IS:694	TR	1,2	3			
		Acceptance tests.	Major	Electrical	As per IS	IS:694	IS:694	TR	1	3	2		
		Type tests.	Major	Electrical	1 No. per lot per size	IS:694	IS:694	TR	1	3	2		
1.4	Indicating Meters.	Routine tests	Major	Electrical	100%	IS:1248	IS:1248	TR	1	3	2		
		Review of type test reports.	Major	Electrical	1 no of each type & range	IS:1248	IS:1248	TR	1,2	3			
1.5	Fuses	Routine tests	Major	Electrical	100%	IS:13703	IS:13703	TR	1,2	3			
		Review of type test reports	Major	Electrical	1 no of each type & rating	IS:13703	IS:13703	TR	1,2	3			
1.6	Switches	Routine tests	Major	Mechanical	100%	IS:60947	IS:60947	TR	1,2	3			
		Review of type test reports.	Major	Electrical	1 no of each type & rating	IS:60947	IS:60947	TR	1,2	3			
1.7	Push buttons	Routine tests	Major	Mechanical	100%	IS:60947	IS:60947	TR	1,2	3			
		Review of type test reports.	Major	Electrical	1 no of each type & rating	IS:60947	IS:60947	TR	1,2	3			

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
1.8	Indicating lamps assembly.	Current voltage rating/type	Major	Visual	100%	As per approved drgs		QC record	1,2	3			
		Operational test	Major	Electrical	100%	As per approved drgs.		QC record	1,2	3			
1.9	Lugs & Terminal block.	Appearance	Major	Visual	sample	As per Com drg/Mfgdrg	As per Com drg/Mfgdrg	QC record	1,2	3			
		Dimension	Major	Measurement	sample	As per Com drg/Mfgdrg	As per Com drg/Mfgdrg	QC record	1,2	3			
1.10	ACBs/MCCBs	Routine tests	Major	Electrical	100%	IS:60947	IS:60947	TR		3	1,2		
		Mechanical operation.	Major	Mechanical	100%	IS:60947	IS:60947	TR		3	1,2		
		Electrical function test	Major	Electrical	100%	IS:60947	IS:60947	TR		3	1,2		
		Calibration of releases.	Major	Electrical	100%	IS:60947	IS:60947	TR		3	1,2		
		Dielectric withstand	Major	Electrical	100%	IS:60947	IS:60947	TR		3	1,2		
		Type test as per sequence I & VI and EMC compatibility for electronic releases	Major	Electrical	1 no of each type & rating	IS- 60947	IS:60947	TR	1,2	3	2		
1.11	MCBs	Routine tests	Major	Electrical	100%	IS:60898	IS:60898	TR	1,2	3			
		Review of type test reports.	Major	Electrical	1 no of each type & rating	IS:60898	IS:60898	TR	1,2	3			
1.12	Contactors	Routine tests	Major	Electrical	100%	IS:60947	IS:60947	TR	1	3	2		
		Review of type test reports.	Major	Electrical	1 no of each type & rating	IS:60947	IS:60947	TR	1,2	3			

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
1.13	Protection relays	Routine tests	Major	Electrical	100%	IS:60255	IS:60255	TR	1	3	2		
		Review of type test reports.	Major	Electrical	1 no of each type & rating	IS:60255	IS:60255	TR	1,2	3			
		IEC 61850 Conformance test if applicable	Major	Test	1 no of each type & rating	IEC:61850	IEC:61850	TR	1,2	3			Only for numerical relay
		IEC 62439-3 (PRP) verification test if applicable	Major	Test	1 no of each type & rating	IEC:62439-3	IEC:62439-3	TR	1,2	3			
1.14	Auxiliary relays	Routine tests	Major	Electrical	100%	IS:60255	IS:60255	TR	1	3	2		
		Review of type test reports.	Major	Electrical	1 no of each type & rating	IS:60255	IS:60255	TR	1,2	3			
1.15	Transducers	Routine tests	Major	Electrical	100%	IS:14570	IS:14570	TR	1	3	2		
		Review of type test reports.	Major	Electrical	1 no of each type & rating	IS:14570	IS:14570	TR	1,2	3			
1.16	Control transformers	Routine test	Major	Electrical	100%	IS:12021	IS:12021	TR	1	3	2		
		Type tests	Major	Electrical	One of each type	IS:12021	IS:12021	TR	1	3	2		
1.17	Instrument transformers.	Routine test	Major	Electrical	100%	IS:16227	IS:16227	TR	1	3	2		
		Type tests	Major	Electrical	One of each type	IS:16227	IS:16227	TR	1,2	3			
1.18	Support insulators	Appearance	Major	Visual	By sampling	Com. drg	Com. drg	TR	1,2	3			
		Dimensional	Major	Measurement	By sampling	Com. drg	Com. drg	TR	1,2	3			

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
		Creepage distance	Major	Measurement	By sampling	Com. drg	Com. drg	TR	1,2	3			
		Type test	Major	Test	One of each type	IS:9431	IS:9431	TR	1,2	3			
		Acceptance Test	Major	Test	As per IS	IS:9431	IS:9431	TR	1,2	3			
1.19	Thermostat	Appearance	Major	Visual	100%	PS	PS	TR	1,2	3			
		IR, HV tests	Major	Electrical	100%	IS:302	IS:302	TR	1,2	3			
		Functional test	critical	Electrical	100%	IS:3017	IS:3017	TR	1,2	3			
1.20	Space heater, cubicle lamp & other accessories.	HV & IR test	Major	Electrical	100%	IS:302	IS:302	TR	1,2	3			
		Functional test	Major	Electrical	100%	PS	PS	TR	1,2	3			
		Dimensional check	Major	Measurement	100%	PS	PS	TR	1,2	3			
1.21	Gaskets	Surface finish	Major	Visual	5 nos per lot	PS	PS	TR	1,2	3			
		Dimension	Major	Measurement	1 no per lot	PS	PS	TR	1,2	3			
		Hardness	Major	Physical	1 no per lot per type	PS	PS	TR	1,2	3			
		Burning test	Major	Physical	1 no per lot per type	PS	PS	TR	1	3	2		
1.22	Fasteners, Washers, spring washers	Appearance	Major	Visual	5 sample/type/size	As per com. Drg.	As per com. Drg.	QS Record	1,2	3			
		Thickness of zinc Coating	Major	Visual	1 sample/type/size	IS:1573	IS:1573	TC	1,2	3			

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
		Dimension	Major	Measurement	1 sample/type/size	As per com. Drg.	As per com. Drg.	QS Record	1,2	3			
		Mechanical properties	Major	Mechanical	1 sample/type/size	IS:1367	IS:1367	TC	1,2	3			
1.23	Ethernet switches if applicable	Type test	Major	Test	One of each type	IEC	IEC	TR	1,2	3			
		Routine test	Major	Test	One of each type	IEC	IEC	TR	1,2	3			
1.24	Ethernet cables if applicable	Routine test	Major	Test	Sampling	IS 14493	IS:14493	TR	1,2	3			
2.0	**In Process inspection**												
2.1	Panel fabrication	Appearance	Major	Visual	1st Sample per batch	Com. drg	Com. drg	Shop record	1,2	3			
		Dimension	Major	Measurement	1st Sample per batch	Com. drg	Com. drg	Shop record	1,2	3			
2.2	Panel pretreatment	Seven tank phosphating process.	Critical	Visual/ Measurement	Per shift	PS	PS	Shop record	1,2	3	2		
		Visual or poor coating & patches.	Major	Visual	Each lot	PS	PS	Shop record	1	3	2		
		Coating weight for category 'C'.	Major	Measurement	Once in Quarter	PS	PS	Shop record	1	3	2		
2.3	Panel powder coating	Surface finish	Major	Visual	Sample/day	PS	PS	Shop record	1	3	2		
		Paint shade	Major	Visual	Sample/day	RAL	RAL	Shop record	1	3	2		

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
		Paint thickness	Major	Measurement	Sample/day	PS	50 micron Min	Shop record	1	3	2		
		Adhesion & peel of test.	Major	Physical	Once in a qutr	PS	PS	Shop record	1	3	2		
		Flexibility test-14" mandrel (bending test)	Major	Physical	Once in a qutr	PS	PS	Shop record	1	3	2		
		Scratch hardness	Major	Physical	Once in a qutr	PS	PS	Shop record	1	3	2		
		Salt spray	Major	Chemical	Once in 6 month	PS	PS	TR	1	3	2		
3.0	Assembly of panels	Visual	Major	Visual	100%	AD	AD	TR	1,2	3			
		Dimensional check	Major	Measurement	100%	AD	AD	TR	1,2	3			
3.1	Interconnecting wiring	Correctness	Major	Visual	100%	App drg	App drg	QC record	1,2	3			
		Pull test	Major	Mechanical	Once in quarter	Physical test	Physical test	QC record	1,2	3			
		Continuity	Major	Electrical	100%	App drg	App drg	QC record	1,2	3			
3.2	Bus bars	Finish and joint surface	Critical	Visual	Sample	PS	PS	Shop record	1	3	2		
		Visual inspection of sleeved busbar	Major	Visual	Sample	PS	PS	Shop record	1	3	2		
4.0	Assembled panel with all accessories mounted and	Appearance	Major	Visual	100%	AD	AD	QC Record	1,2	3			
		Verticality	Major	Measurement	100%	AD	AD	QC Record	1,2	3			

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
	wired.	Verification	Major	Physical	100%	AD	AD	QC Record	1,2	3			
		Dimension check	Major	Measurement	100%	AD	AD	QC Record	1,2	3			
		Interchangeability of similar modules.	Critical	Physical	Random	PS	PS	QC Record	1,2	3			
		Tightness of busbar joints	Critical	Physical	random	PS	PS	QC Record	1	3	2		
5.0	Final test	Routine test on MCC/PMCC panel											
		Appearance	Major	Visual	100%	AD	AD	Test Report		3	1,2	1	
		Bill of material	Major	Visual	100%	AD	AD	Test Report		3	1,2	1	
		Dimension	Major	Measurement	100%	AD	AD	Test Report		3	1,2	1	
		Surface finish	Major	Visual	Random	AD	AD	Test Report		3	1,2	1	
		Provision of partitions/compartments.	Major	Visual	100%	AD	AD	Test Report		3	1,2	1	
		Interchangeability	critical	Physical	Random	AD	AD	Test Report		3	1,2	1	
		Mechanical operations of ACB	Major	Electrical	100%	AD	AD	Test Report		3	1,2	1	
		Clearance between main busbar	Major	Measurement	Random	AD	AD	TR		3	1,2		

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
		Electrical control, mechanical & electrical interlock and sequential operation	Major	Electrical	100%	AD	AD	Test Report		3	1,2	1	
		Wiring checks neatness of wiring and accessibility & adequacy of space for external wiring termination.	Major	Electrical /Visual	100%	AD	AD	Test Report		3	1,2	1	
		Functional test on all equipment	Major	Electrical	100%	AD	AD	Test Report		3	1,2	1	
		Power frequency withstand test	Major	Electrical	100%	IS:61439	IS:61439	Test Report		3	1,2	1	
		IR test	Major	Electrical	100%	PS	PS	Test Report		3	1,2	1	
		Demonstration of communication of numerical relay and	Major	Test	100%	PS	PS	Test Report		3	1,2	1	
		Type test											
		Degree of protection.	Major	Electrical	Sample	IS:60529	IS:60529	Test report	1,2	3		1	
		Short circuit withstand test	Major	Electrical	Sample	IS:61439	IS:61439	Test report	1,2	3		1	

Sl. No.	Components	Characteristics checked	Category	Method check	Extent check	Reference document	Acceptance norms	Format of record	Agency				Remark
									R	P	W	H	
		Mechanical operation and performance test on breaker	Major	Electrical	Sample	IS:60947	IS:60947	Test report	1,2	3		1	
		Special type tests											
		Temperature rise test	Major	Testing	Sample	AD	AD	Test report		3	1,2	1	
		Seismic Analysis if applicable	Major	Testing/Analysis	Sample	IEEE	AD	Test report		3	1,2	1	
		IV & V test verification part if applicable	Major	Testing	100%	AD	AD	TR		3	1,2	1	Only for Cl-II & III numerical relys
		Validation part if applicable	Major	Testing	Sample	AD	AD			3	1,2	1	
6.0	End documents	Type test reports	Major	Visual	100%	QAP/spec.	QAP/spec.		1,2	3			
		Routine test reports	Major	Visual	100%	QAP/spec.	QAP/spec.		1,2	3			
		Stage inspection reports	Major	Visual	100%	QAP/spec.	QAP/spec.		1,2	3			
		Final Report	Major	Visual	100%	QAP/spec.	QAP/spec.		1,2	3			
		O&M Manuals/Catalogues of all bought out items.	Major	Visual	100%	QAP/spec.	QAP/spec.		1,2	3			

8.0 Factory Inspection and Testing

8.1 General

8.1.1 The routine tests, acceptance tests, special tests and type tests are covered in this section. Inspections and tests at raw material stage, semi-finished or module level are detailed in the typical QAP given above.

8.1.2 All the equipments offered should have been successfully type tested as per the relevant standards, amended up to date. In case the equipment of the type and design offered has already been type tested, the contractor shall furnish type test reports before proceeding with manufacture. Type tests must not have been conducted earlier than five years from the date of opening of bids. In case the type tests were conducted earlier than five years, such type tests shall be carried out by the contractor free of cost before commencement of supply. As a part of technical offer, contractor shall include a tabulation detailing various type tests on each type of equipment along with applicable type test certificate number, details of the equipment subjected to type test, place of testing and final results.

8.1.3 The purchaser reserves the right to demand repetition of some or all the type tests in the presence of his representative. Contractor shall quote unit rates for carrying out each type test and special test.

8.1.4 If there are changes in the components or in the design/type already type tested and the design/type offered against this specification, the purchaser reserves the right to demand repetition of tests without any extra cost before commencement of supply. The contractor shall bring out in his offer all such changes made in components, materials, design etc. as the case may be and likely effects of such changes on type qualification.

8.2 Routine Tests

8.2.1 All routine tests as per applicable Indian Standards on 415V MCC/PMCC panels shall be performed in the presence of purchaser's representative and reports issued. These tests shall include the following:

8.2.2 Visual inspection, dimensional checks, verification of bill of material and wiring as per approved schematics shall be done for all feeders. Continuity and polarity tests on all coils and circuits shall be done.

8.2.3 Mechanical operation tests on circuit breakers, switches, contactors, etc..

8.2.4 Interchangeability of removable elements shall be proven.

8.2.5 Power frequency voltage dry tests and insulation resistance tests using 500V megger on the main circuit, control and auxiliary circuits shall be done. The values of test voltages to be applied shall be as specified in data sheets of the specification.

8.2.6 Functional tests on all equipment.

8.2.7 Numerical Relays and Ethernet switches shall be demonstrated for data acquisition, control, time synchronization and PRP with vendor software/tools if communication with Purchaser's SCADA is required as per SLD.

8.3 Type Tests

8.3.1 Mechanical operation and performance tests on breaker.

8.3.2 Short circuit withstand capacity test.

8.3.3 Verification of clearance and creepage distance.

8.3.4 One minute power frequency voltage withstand test and insulation resistance test on the main bus bars.

8.3.5 Verification of degree of protection.

8.3.6 Type test for Ethernet switches are given below if applicable
Emission tests- IEC 61850-3 standard is to be followed.
Immunity tests- Following tests shall be conducted on Ethernet switches as per IEC 61850-3:

a) Radiated radio frequency electromagnetic field compatibility test
b) Conducted disturbance induced by radio frequency fields
c) Fast transients
d) 1 MHz oscillatory wave test
e) Surge immunity test
f) Power frequency immunity test
g) Power frequency magnetic field immunity test
h) Electrostatic discharge test
i) DC voltage dips, short interruptions, and variations
j) AC ripple on DC supply

Environmental tests
These tests shall be performed as per IEC:60255-27/IEC:60068. The tests to be conducted are:-

k) Dry heat test
l) Cold test
m) Cyclic temperature with humidity
n) Vibration
o) Shock
p) Seismic

Safety related tests These tests shall be performed as per IEC 60255-27. The tests to be conducted are:-

q) Impulse voltage test
r) AC or DC dielectric voltage test
s) Insulation resistance test

8.4 Special Tests

8.4.1 Temperature rise test on a representative panel

8.4.2 Seismic withstand test if applicable

8.4.3 IV & V for numerical relays/ microprocessor based relays used in Class-III, II system.

8.5 All major components used in the equipment should have been type qualified in accordance with the applicable standards and applicable valid type test reports shall be submitted as demanded by the purchaser.

9.0 Tests at site

The following tests on 415V MCC/PMCC shall be performed by the contractor at site at the time of erection and commissioning. Commissioning checks indicated below are indicative. The contractor shall carry out actual commissioning checks on all the equipment covered in this specification as per manufacturer’s recommendation and purchaser’s instructions. The original equipment manufacturer's engineer shall be present during performance of tests at site and manufacturer's concurrence taken before completion.

9.1 Pre-commissioning checks

9.1.1 Verification of name plate, bill of materials, etc.

9.1.2 Verification of panel and components mounted inside for transit damages.

9.1.3 Verification of cleanliness of equipment.

9.1.4 Checks on proper mounting and verification of welding/ anchor fasteners.

9.1.5 Checks on proper termination and glanding of cables.

9.2 Commissioning tests

9.2.1 Wiring checks as per approved document and continuity test.

9.2.2 Functional tests on switches, indicating lamps, space heater, etc.

9.2.3 Bus bar clearances and healthiness of bus bar joints.

9.2.4 IR measurement.

9.2.5 High voltage tests.

9.2.6 Check alignment of breakers for free movement and correct operation of shutter.

9.2.7 Proper closing/opening operation at minimum, nominal and maximum DC voltage.

9.2.8 Manual operation of breaker.

9.2.9 Limit switch interlock at various breaker positions.

9.2.10 Breaker closing and tripping time.

9.2.11 Trip free and anti-pumping operation.

9.2.12 Breaker main power contact resistance.

9.2.13 Functional requirement of spring charging motors and its charging time.

9.2.14 Tests on current transformers: polarity, ratio, shorting of spare cores, CT connections, etc..

9.2.15 Tests on potential transformer: polarity, voltage ratio on all cores, PT connections, etc..

9.2.16 Checks on meters, transducers, etc. including calibration checks.

9.2.17 Checks on relays using tests kits, check on settings and actual operation, etc..

9.2.18 Check on thermal overload relays.

9.3 Contractor shall perform above inspections and tests under the supervision of original equipment manufacturer. Original manufacturer's clearance shall be obtained before handing over the equipment to the purchaser.

10.0 GURANTEED TECHNICAL PARTICULARS (GTP)

The TENDERER shall submit the following guaranteed technical particulars along with bid as part of Section-D.GTPs marked with * are mandatory for bid evaluation. Successful bidder shall furnish all technical parameters to purchaser during the detailed engineering. Following details shall be filled for each rating/type of MCC/PMCC covered by the tender.

1.0 Details of MCC/PMCC

Sl. No.	Item Description		Tenderer’s details
1	Manufacturer’s name & country		
2	Panel designations	*	
3	Manufacturer’s type designation	*	
4	Single front or double front	*	
5	Modular construction	*	

6	Fully draw out /Semi Draw out /fixed	*	
7	Total dimensions of each complete Switchgear panel/ standard section length of bus duct	*	
8	Width of each vertical section with cable alley	*	
9	Width of cable alley only	*	
10	Have all the feeders and components as specified in enclosed drawings and data sheets been provided	*	
11	Whether the rating, type of components are selected so as to ensure complete discriminative protection as specified and if during the course of contract if the same is not satisfied, whether rating, type of components will be changed without any commercial implications to purchaser?	*	
12	**Construction/ Design details:**	*	
	a) Material cold rolled/hot rolled	*	
	b) Thickness in mm: Frames Doors Side and top covers Panel partitions	*	
	c) Sheet metal treatment in accordance with the specification?	*	
	d) Sheet metal Painting in accordance with the specification?	*	
	e) Panel Mounting arrangement	*	
	f) Cable entry location	*	
	g) Thickness and size of gland plate.	*	
	h) Minimum Distance between gland plate and the first row of terminal blocks.	*	
	i) Degree of protection provided by the enclosure	*	
13	One minute power frequency withstand voltage (kV) Main circuit Control circuit	*	
14	Bus bars	*	
	a) Material of Busbars	*	
	b) Bus bar cross section	*	
	c) Continuous current rating under siteconditions	*	
	Short time rating (1s) of busbars in kA (rms)	*	
	e) Momentary rating in kA (peak)	*	
	f) Whether busbars have been insulated	*	
	g) Type of insulation	*	
	h) Temperature rise over the reference ambient of 45°C when carrying rated current.	*	
	i) Material of bus bar supports	*	
	j) Spacing between the supports	*	
	k) Spacing between busbars	*	

	l) Clearance in air (in mm): Between live parts Live parts and earth	*	
	m) Earth Bus bar size	*	
	n) Earth Bus bar material	*	
15	Wiring	*	
	a) Voltage rating	*	
	b) Minimum size of wires for power circuits	*	
	c) Minimum size of wires for control circuits	*	
	d) Conductor material	*	
	e) Insulation material	*	
	f) Whether appropriate de-rating factors are considered while sizing the wires?	*	
	g) Applicable standards	*	
16	Terminal blocks	*	
	a) Make and type	*	
	b) Voltage rating	*	
	c) Minimum current rating	*	
	d) Whether 10% spare terminal blocks considered?	*	
17	Type qualification	*	
	Whether the identical equipment has been type tested as per applicable standards? If yes, enclose details.	*	

2.0 Following details shall be submitted furnished for (1) 415V ACBs, (2) 415V MCCBs, (3) Switch and switch-fuse units and (4) MCBs

Sl. No.	Item Description		
1	Make	*	
2	Type designation	*	
3	Rated voltage	*	
4	Rated continuous current	*	
5	De-rating factor for operating under site condition	*	
6	Number of poles	*	
7	Rated frequency	*	
8	Fixed type or draw out type	*	
9	Type of operating mechanism	*	
10	Limit of voltage for satisfactory operation of the following devices as % of nominal voltage	*	
10.1	Operating mechanism	*	
10.2	Closing coil	*	
10.3	Tripping coil	*	
11	Power required for closing at		
11.1	Normal voltage		
11.2	80% voltage		
12	Spring charging motor detail		
12.1	Rating		
12.2	Rated voltage		
12.3	Spring charging time		

12.4	Class of insulation		
12.5	Mechanical indication for spring charged/ discharged condition provided		
13	Rated service breaking capacity		
14	Rated ultimate breaking capacity		
15	Rated category of duty		
16	Rated short circuit withstand capacity (rms for 1s)		
17	Rated short circuit withstand capacity (peak)		
18	Rated electrical endurance capacity		
19	Rated mechanical endurance capacity		
20	Total opening time		
21	Total closing time		
22	Have electrical and mechanical anti pumping feature provided		
23	Have mechanical interlocks of transformer feeder breaker with tie breaker are provided		
24	Current limiting features for MCB?		
25	Setting range for each of the protection devices of releases		
26	Operating temperature range		
27	Type of the protection release (thermal/ magnetic/ electronic/ microprocessor based)		
28	Is electronic/ microprocessor based releases are compatible with electromagnetic disturbances?		
29	All interlocks are provided?		
30	Number of auxiliary contacts provided		
31	Rating of auxiliary contacts (continuous rating, make and break)		
32	Maximum temperature rise of main current carrying contacts at specified current.		
33	Maximum temperature rise of terminals at specified current.		
34	Whether the components offered have applicable type test certificates as per applicable standards?		
35	Applicable standards		
36	Are latest technical literature enclosed?		
37	Mean time between failure		
38	Recommended test frequency		
39	Impact of ageing on component performance		
40	Life in terms of cycle of operation/ years		
41	Recommended calibration frequency		

3.0 Following details shall be furnished separately for (1) PTs, (2) Metering CTs, (3) Protection CTs and (4) CBCTs:

Sl. No.	**Item Description**		
1	Make		

2	Type		
3	Class of insulation		
4	System voltage and frequency		
5	Ratio in line with one line diagram and data sheet		
6	Rated VA burden		
7	Accuracy class		
8	Instrument security factor		
9	Accuracy limit factor		
10	Short time current rating		
11	Power frequency withstand test voltage		
12	Minimum knee point voltage		
13	Maximum magnetization current at proposed setting		
14	CT secondary resistance		
15	Rated voltage factor in case of VT		
15.1	Continuous		
15.2	8 hours		
16	Temperature rise at specified voltage, frequency and highest rated output		
17	HV fuse rating in case of VT		
18	LV fuse rating in case of VT		
19	Rupturing capacity		
20	Standard applicable		
21	Whether technical literatures are enclosed?		
22	Mean time between failure		
23	Recommended test frequency		
24	Impact of ageing on component performance		
25	Life in terms of cycle of operation/ years		
26	Recommended calibration frequency		

4.0 Following details shall be submitted separately for (1) Numerical relays for feeder protection, (2) Numerical motor protection relays, (3) Lock out relays, (4) Supervision relays, (5) Under voltage relays, (6) Auxiliary relays and (7) Timers:

Sl. No.	Item Description		
1	Make		
2	Type		
3	Whether all protections are included as per schematic/ data sheet		
4	Is provided with measuring, status menu of motors and recording function, if so list out each function		
5	List out user interface detail		
6	Input current for phase and earth		
7	Frequency		
8	Auxiliary power supply		
9	VA burden for phase and earth fault element		
10	VA burden of auxiliary power supply		

11	Thermal withstand current		
12	Accuracy		
12.1	Protection		
12.2	Measurement		
13	Over current/ earth fault setting range		
14	Over current/ earth fault time		
15	Tripping curves detail		
16	Setting range of motor protection		
17	HV withstand detail		
18	Electrical environment detail		
19	Operating and storage ambient condition		
20	Are no of output potential free contacts are provided as per specification		
21	Contact rating at specified DC voltage		
22	No of mechanical operation of contact		
23	Is provided with analogue out put option, if so list out analogue out puts		
24	Are relays suitable for operation under auxiliary voltage variation between -20% and + 10%		
24	Are relays type tested, if so list out the type tests and their applicable standards		
25	MTBF		
26	Are relays type tested, if so list out the type tests and their applicable standards		
27	Are relays compatible with electromagnetic interference, if so furnish test report		
28	Voltage rating of under voltage relay		
29	VA burden of under voltage relay		
30	Operating time of U/V relay		
31	Coil voltage of auxiliary relays and timers		
32	VA burden of auxiliary relays and timers		
33	Time delay range for timer		
33.1	For pick up		
33.2	For drop out		
33.3	Whether operation indicator provided		
34	Are technical literature enclosed		
35	Recommended test frequency		
36	Impact of ageing on component performance		
37	Life in terms of cycle of operation/ years		
38	Recommended calibration frequency		
39	IEC 61850 Conformance if applicable		
40	IEC 62439-3 (PRP) Conformance if applicable		

5.0 Following details shall be furnished separately for (1) Ammeters, (2) Voltmeters, (3) RTMs and (4) Transducers:

Sl. No.	Item Description		
1	Make		
2	Type Designation		
3	Range		
4	Accuracy		
5	Movement type		
6	Angular movement of the scale		
7	Voltage coil rating		
8	Voltage coil burden		
9	Current coil rating		
10	Current coil burden		
11	No of digit		
12	Whether resetting knob provided		
13	Load resistance/ capability		
14	Repeatability		
15	Rated burden on the input system (CT/ PT)		
16	Applicable ambient temperature		
17	No. of output channel of transducers		
18	Maximum permissible burden on each output channel		
19	Requirement of auxiliary supplies.		
20	Whether the components offered have applicable type test certificates as per applicable standards?		
21	Are technical literature enclosed		

6.0 Following details shall be furnished separately for (1) Push buttons, (2) Indicating lamps and (3) Space heaters:

Sl. No.	Item Description		
1	Make		
2	Type designation		
3	No of NO & NC contact		
4	Rated voltage		
5	Wattage of lamp		
6	Series resistors		
7	Heater rating		
8	Thermostat setting range		
9	Are type tests certificates enclosed		
10	Are technical literature enclosed		

7.0 Following details shall be submitted separately for (1) Contactors, (2) Thermal overload relays and (3) Control transformers:

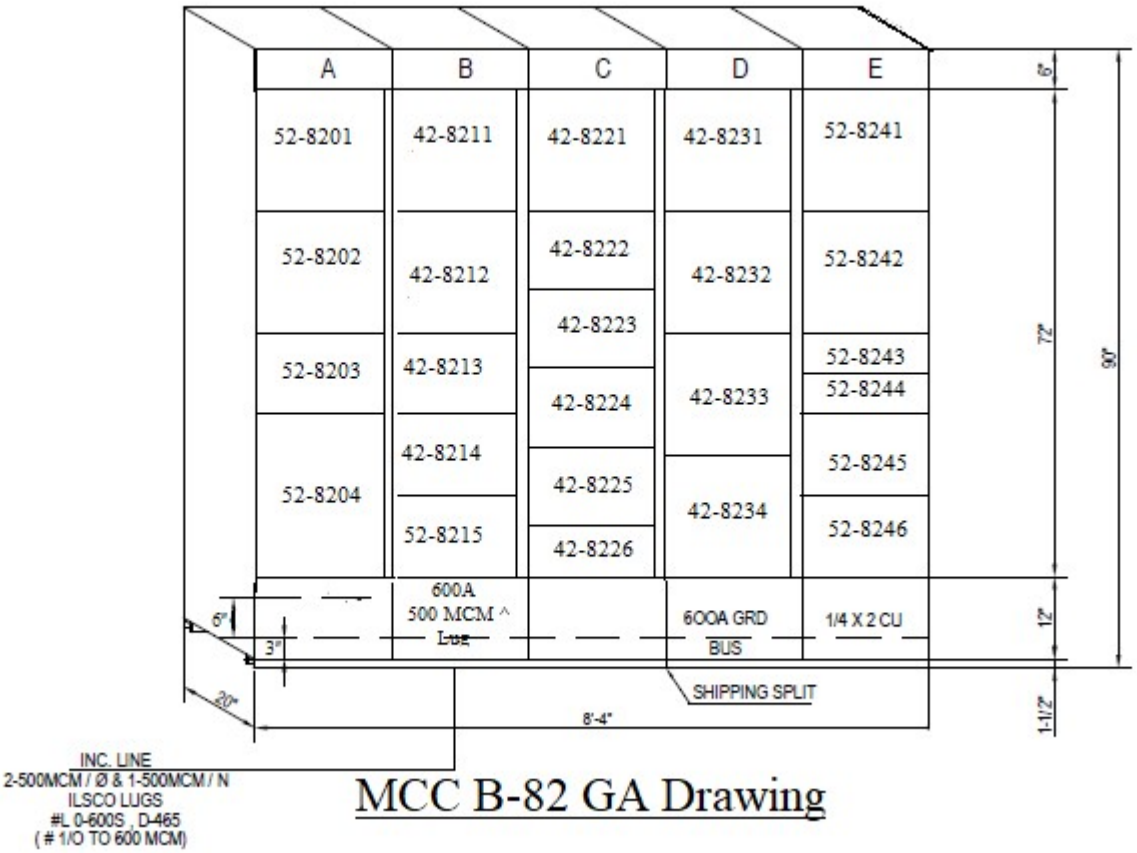
Sl. No.	Item Description		
1	Make		

2	Type		
3	Applicable standards		
4	Ratio		
5	Rated working voltage		
6	Class of insulation		
7	Rated output		
8	Rated duty		
9	No of poles		
10	Rated voltage of main contact		
11	Rated voltage of auxiliary contact		
12	Rated breaking capacity		
13	Rated making capacity		
14	Class of insulation		
15	One minute power frequency voltage withstand voltage		
16	Impulse withstand voltage		
17	Limit of operation		
17.1	Supply voltage variation		
17.2	Supply frequency variation for closing		
17.3	Pick up voltage		
17.4	Drop out voltage		
17.5	VA rating		
17.6	Regulation of transformer at power factor during contactor pick up		
17.7	Regulation of transformer at unity power factor		
18	Current rating of auxiliary contact at 110V AC		
18.1	Make and carry		
18.2	Break		
19	Thermal over load relay with built in single phasing preventer		
19.1	Setting range		
19.2	No of contacts		
19.3	Whether time/ current characteristic enclosed		
20	Are technical literature enclosed		
21	Recommended test frequency		
22	Impact of ageing on component performance		
23	Life in terms of cycle of operation/ years		
24	Recommended calibration frequency		
25	MTBF		

8.0 Following details shall be submitted separately for Industrial Ethernet switches and Ethernet Cables if applicable as per SLD

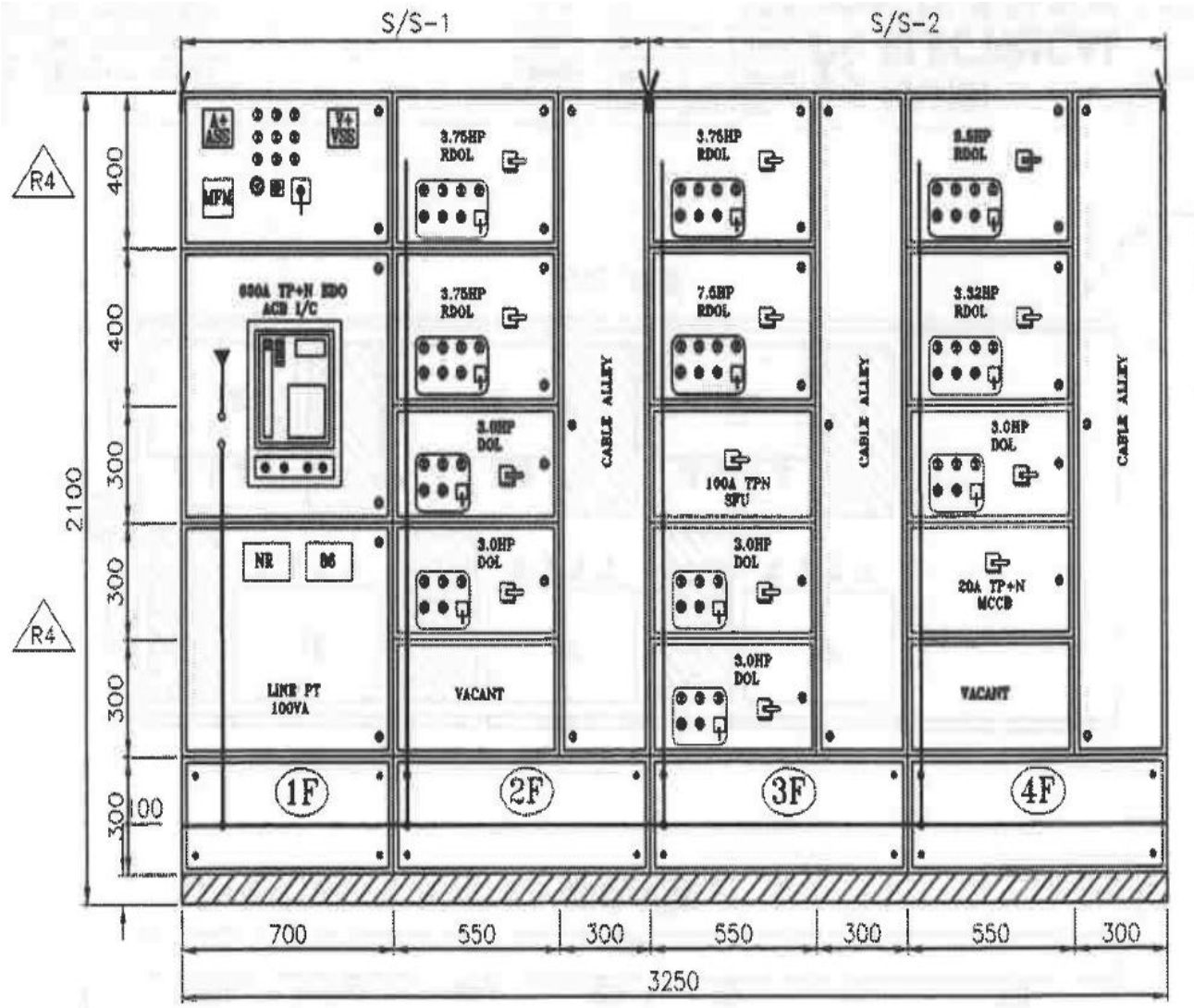
Sl. No.	**Item Description**		
	Industrial Ethernet switches		
1	Make and type		

2	Dimensions		
3	Mounting		
4	Port types and speed		
5	Power supply a) Whether operate on 220VDC b) If not, whether dedicated converter per switch is provided		
6	Switching method		
7	Switching latency		
8	Frame buffer memory		
9	MAC address table		
10	MAC address learning		
11	USB interface		
12	Operating temperature range		
13	IEC 62439-3 PRP supported		
14	IEC 61850 supported		
15	IEEE 802.3 for 10Base-T compliant		
16	IEEE 802.3u for 100Base-TX compliant		
17	IEEE 802.3ab for 1000Base-T compliant		
18	IEEE 802.3z for 1000Base-X compliant		
	Ethernet cables		
19	Make and type		
20	Conductor material		
21	Insulation material		
22	Shielded/Unshielded		
23	Conforms to TIA 568-C.2		
24	Conforms to IEC 11801		
25	Meets tests requirements of IEC 61156		

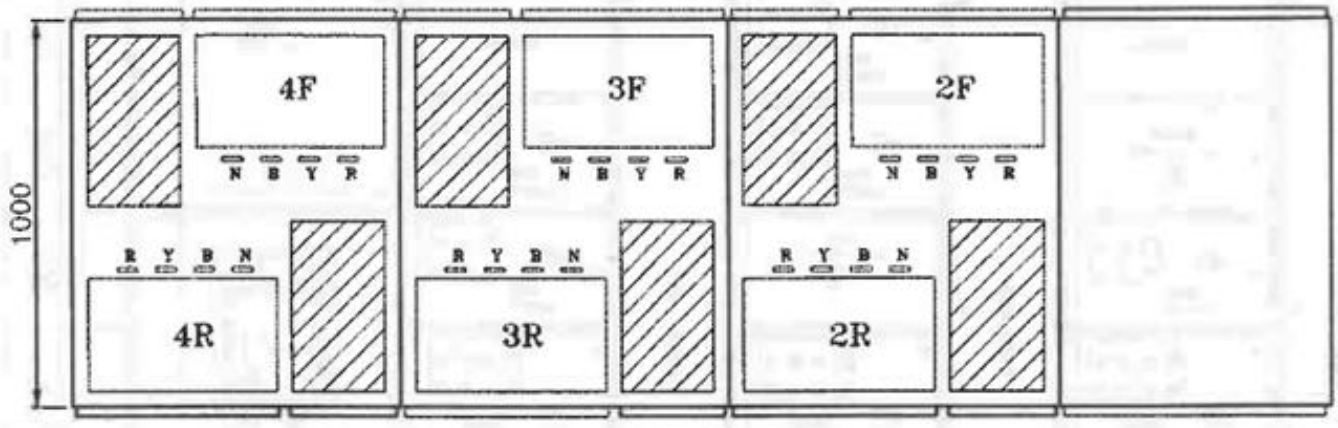


MCC B-82 GA Drawing

Proposed MCC Draft GA Drawing

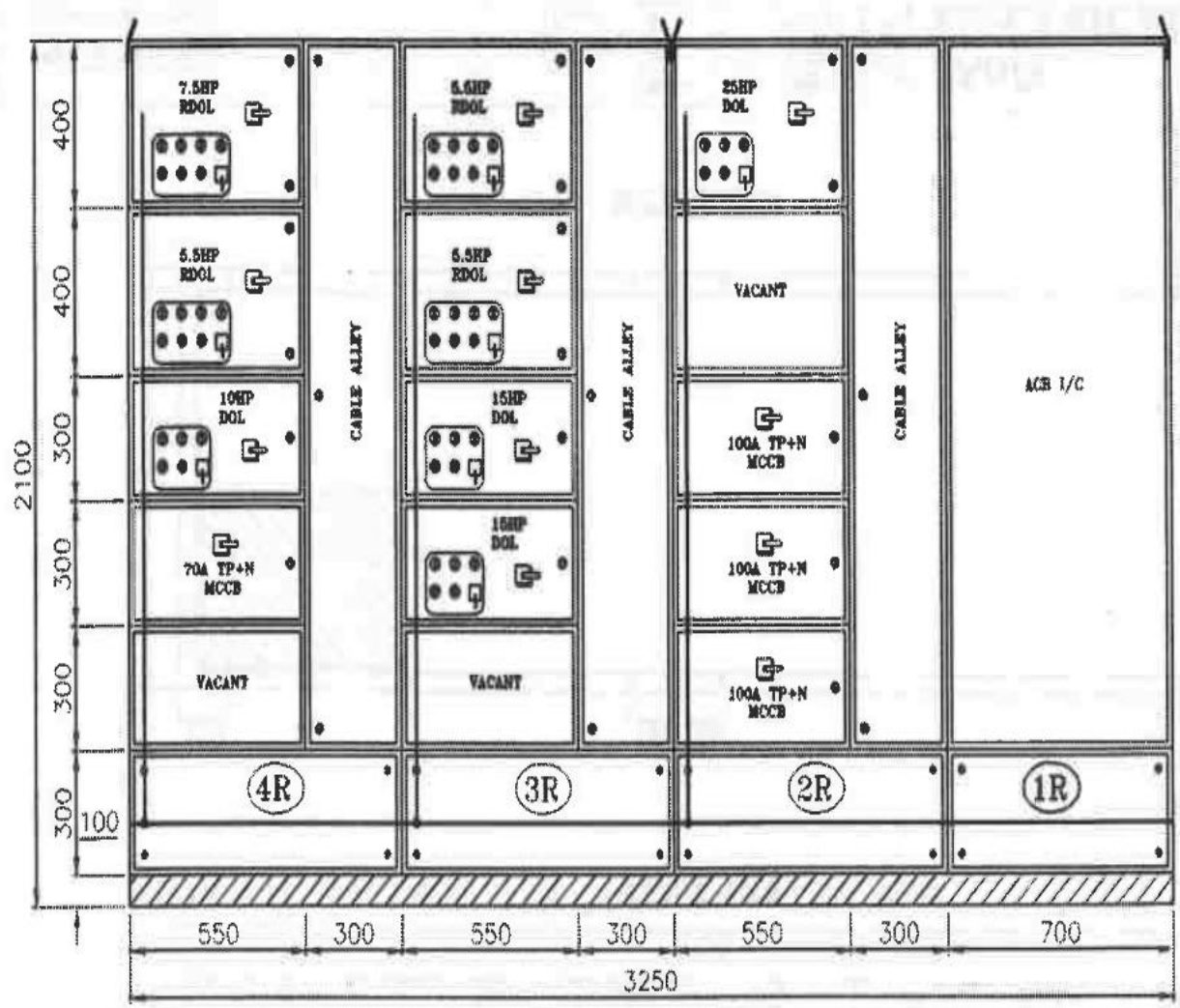


FRONT VIEW

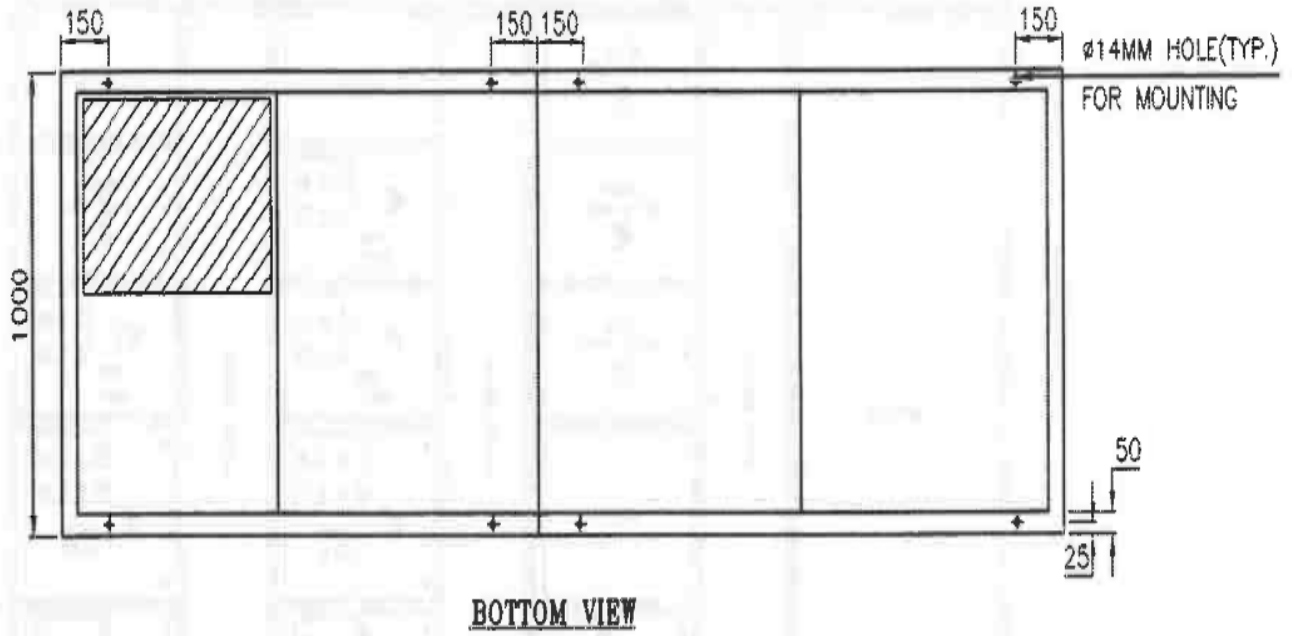


TOP VIEW

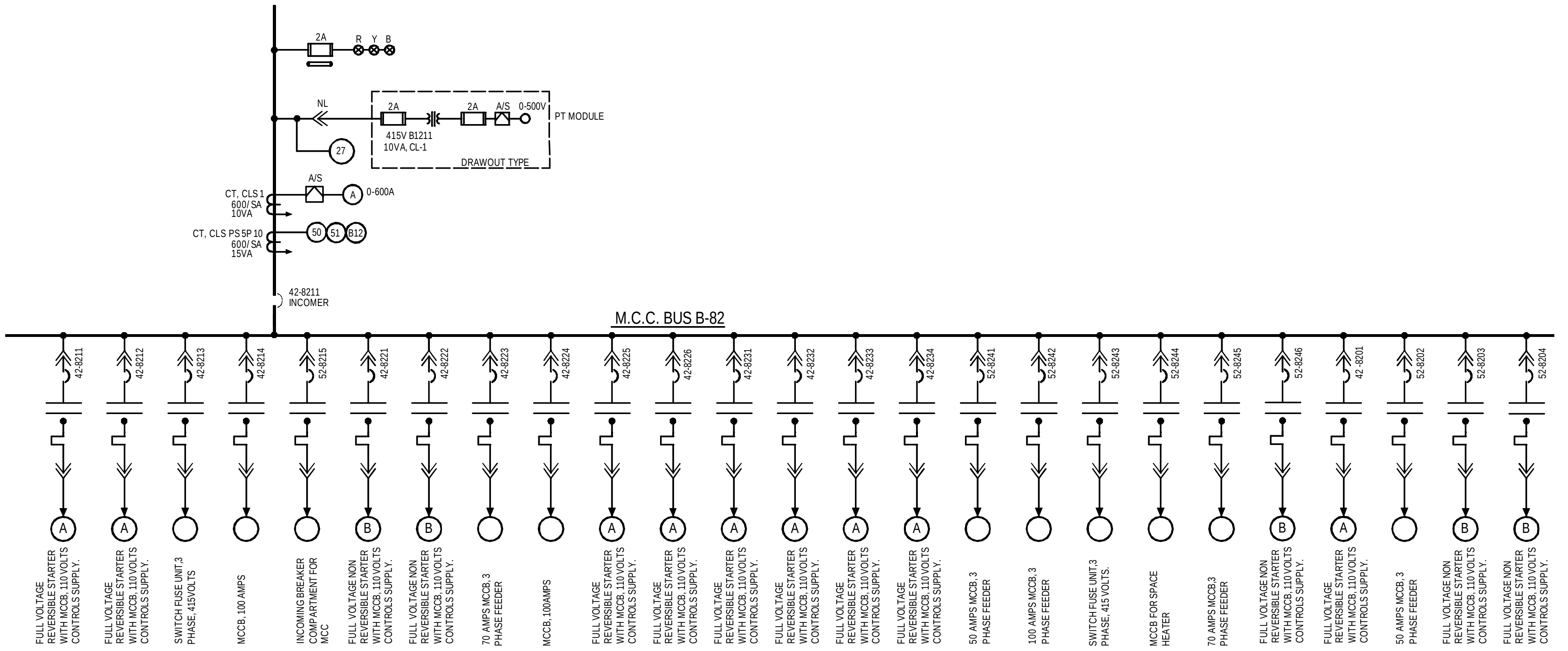
Proposed MCC Draft GA Drawing



REAR VIEW



BOTTOM VIEW



(A) FULL VOLTAGE REVERSIBLE STARTER WITH MECHANICAL INTERLOCK. (COL)

(B) FULL VOLTAGE NON REVERSIBLE STARTER (DOL)

NOTE :- 1) MCCB SHOULD BE BUITABLE FOR 3/2 PH, SQURREL CAGE INDUCATION MOTOR
2) FULL VOLTAGE REVERSIBLE STARTER SHOULD HAVE MECHANICAL INTERLOCK.

nyai@layar pavar kaparSana Aaf [iDyaa ilaimaTD
NUCLEAR POWER CORPORATION OF INDIA LTD.
tarapr prmaaNa ibajalaIGar 1 eva 2
TARAPUR ATOMIC POWER STATION 1& 2

DRN BY	k.k. kaLI TECH. SUPR.-A	CHK'D		REV'D		APPD.	
DATE	24/11/2023	DATE		DATE		DATE	

TITLE: SINGLE LINE DIAGRAM B-82 MCC

SCALE: N.T.S.	DRG. No.	REV