MAIN TECHNICAL SPECIFICATION

FOR

LT SWITCHGEAR PACKAGE

PROJECT : TURBO BLOWER STATION (Package-010A)

CUSTOMER : M/s NMDC LIMITED, 3.0MTPY INTEGRATED STEEL PLANT, NAGARNAR, CHHATTISHGARH

CONSULTANT : M/s MECON, Ranchi

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1.0.0 INTENT OF SPECIFICATION

This specification covers the design, manufacture, assembly & testing at manufacturer's works; packing & transportation to site including transit insurance; supervision of erection, testing & commissioning of LT Switchgear complete with all accessories for efficient and trouble-free operation of the power plant.

It is not the intent to specify completely herein all details of the equipment; nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.

Should the bidder wish to deviate from this specification in any way, bidder shall draw specific attention to such deviation by listing the deviations in the deviation schedule without which bidder's offer will be considered in conformity with the specification in all respects.

SITE CONDITION:

Project	:	TURBO BLOWER STATION (PACKAGE-010A)
Site Location	:	NAGARNAR,CHHATTISHGARH.
Elevation above MSL	:	Upto 1000m above sea level
Maximum ambient temp	:	50°C
Humidity	:	100% not occurring simultaneously with maximum temperature.
Atmosphere	:	Dusty & Corrosive.

2.0.0 SCOPE OF WORK

2.1.1 Scope of Supply

i. ALL IMCCs & DBs SHALL BE SINGLE FRONT, DRAWOUT TYPE.

Sl.No	Switchboard	Main Qty (No.s)	Fault rating switchboard (for 1sec) (KA)
1	415V TB-MCC-1	1	50
2	415V TB-MCC-2	1	50
3	415V TB-MCC-3	1	50
4	415V PDB	1	50
5	220V DCDB-1	1	20
6	220V DCDB-2	1	20
7	240V UPSDB-1	1	20
8	240V UPSDB-2	1	20
9	WELDING RECEPTACLES	6	NA

ii. All cable termination accessories such as lugs, glands (Double compression type nickel-plated brass cable glands), bimetallic connectors at switchgear end for power, control, and signal cables etc. as per the cable sizes indicated against feeder list.

iii. Commissioning Spares & Tools and Tackles as per Annexure-7

iv. All MCCs and DBs shall be provided with Integral Base frame of ISMC-75.

2.1.2 Scope of Service

i. Supervision of Installation, testing and commissioning of Intelligent Controllers and communication with DCS by OEM.

ii. Supervision of Installation, testing and commissioning for modification/additional job at site, if required.

iii. Supervision of Installation, testing and commissioning of LT Switchgear Package

iv. Special Testing Equipment for commissioning of Intelligent Controller and communication with DCS if any at site shall be provided by Bidder.

3.0.0 LIST OF MATERIAL CODES

Variant no.	Description	Material code
01	415V TB-MCC-1,2 & 3	PY9755127011
02	415V PDB	PY9755127020
03	220V DCDB-1	PY9755127038
04	220V DCDB-2	PY9755127046
05	240V AC UPSDB-1	PY9755127054
06	240V AC UPSDB-2	PY9755127062
07	Commissioning Spares	PY9755127070
08	Tools & Tackles	PY9755127089
09	Welding Receptacles	PY9755127097
10	**SUPERVISION OF INSTALLATION, TESTING & COMMISSIONING OF INTELLIGENT CONTROLLERS BY THE OEM AT SITE** Inclusive of the following:- Lump-sum price for supervision of installation, testing & commissioning of Intelligent Controller and communication with DCS including travel, Lodging, Boarding etc. for Intelligent Controller' OEM for 6 man-days at site per visit.	PY9755127100
11	**MODIFICATION / ADDITIONAL JOB ON LT SWITCHGEAR PACKAGE AT SITE BY THE OEM** Inclusive of the following:- Lump-sum price for Modification / Additional Job on LT Switchgear package at site by the OEM including travel, Lodging, Boarding etc. for 6 man-days at site per visit.	PY9755127119
12	**SUPERVISION OF INSTALLATION, TESTING & COMMISSIONING OF LT SWITCH BOARDS (MCC,PDB,DBs)** Inclusive of the following:- Lump-sum price for Modification / Additional Job on LT Switchgear package at site by the OEM including travel Lodging, Boarding etc. for 6 man-days at site per visit.	PY9755127127

4.0.0 CODES AND STANDARDS

4.1.1 The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the following BIS standards unless otherwise specified.

IS: 1248	Electrical Indicating instruments
IS: 2147	Degree of protection provided by enclosures for low voltage Switchgear and Control gear.
IS: 13947	Specification for low voltage switchgear and control gear
IS: 2705	Current Transformers
IS: 3156	Voltage Transformers
IS: 4237	General Requirements for Switchgear and Control gear for voltages not exceeding 1000 V.
IS: 5082	Wrought Aluminium and Aluminium alloys for electrical purposes.
IS: 6875	Switches and push buttons.
IS: 8544	A.C. motor starters of voltage not exceeding 1000 volts.
IS: 8623	Factory built assemblies of Switchgear & Control gear for voltages up to and including 1000 V AC & 1200 V DC. Part-II particular requirements for busbar trunking systems (bus ways)
IS: 10118	Code of practice for selection, installation and maintenance of switchgear and controlgear.
IS: 12021	Specification of control transformers.
IS: 11171	Dry type power Transformers
IS: 13703	LV fuses
IS: 5	Colors for ready mixed paints and enamels
IS: 3231	Electrical relays for power systems
IS: 2824	Method of determining the comparative tracking index of solid insulating materials under moist conditions
IS: 11353	Guide for uniform system marking and identification of conductors and apparatus terminals.
IS: 6005	Code of practice of phosphating of iron and steel
IS:3618	Phosphate treatement of Iron and Steel for Protection against corrosion.
IS:5578	Guide for marking of insulating conductor

4.1.2 In case of imported equipments, standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian standards.

4.1.3 The equipment shall also confirm to the provisions of Indian electricity rules and other statutory regulations currently in force in the country.

4.1.4 In case Indian standards are not available for any equipment, standards issued by the IEC/BS/VDE/IEEE/NEMA or equivalent agency shall be applicable.

4.1.5 In case of any contradictions between various referred standards / specifications/ data sheets and statutory regulations the following order of priority shall govern:

i. Statutory regulations
ii. This Specification & Technical Specification for IMCC (Annexure-1)
iii. Switch boards SLDs

5.0.0 GENERAL REQUIREMENTS

5.1.1 The offered equipment shall be brand new with state of art technology and proven field record of accomplishment. No prototype equipment shall be offered.

5.1.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 15 years from the date of supply.

5.1.3 Vendor shall give a notice of at least one year to BHEL, end user of equipment and Consultant before phasing out the product/spares to enable the end user for placement of order for spares and services.

5.1.4 Only major meters and controls are indicated in the SLDs. Any Intelligent Controllers, auxiliary relays, timers, switches, etc, as required while developing the control schematic and felt necessary for safe operation, even if these are not specifically included, shall be supplied by the Bidder. All relays, metering and control components shall be mounted on the panel front only.

5.1.5 All dummy panels and rear extensions required for bus trunking, cable terminations, mounting of Intelligent Controllers, relays, metering and control components etc., shall be supplied by the bidder. The details of each type of such panels shall be furnished.

5.1.6 All incomers shall have ON/OFF/TRIP indication lamps and trip switch for sending end breaker.

5.1.7 Auto-Manual Changeover scheme for switchboard with two incomers and one Bus-Coupler:

The AUTO/ MANUAL CHANGEOVER scheme is described in brief as follows:

Facility to be provided

a. Auto changeover between the two incomers and one bus-coupler shall be in such a way that two-incomer breakers are 'ON' at a time and bus coupler breaker is 'OFF' at normal condition.

b. In case of failure of one of the feeders (say by upstream fault), it will be sensed by the under voltage relay which in turn will trip the incomer breaker after a pre-set time delay.

c. Through the normally closed auxiliary contacts of the tripped incoming breakers, the bus-coupler breaker shall close provided the other section is "Healthy".

d. The automatic transfer scheme shall be such that the automatic closing of the bus section can be done only once and in case the bus coupler breaker trips during auto changeover, no further auto closing shall be permitted. Auto changeover shall not take place if the incomer breaker trips on fault. The restoration of power shall be manual.

e. The automatic transfer circuit shall be controlled through an auto manual changeover switch.

f. Tripping of incomer on under voltage shall be blocked, if both the incomers simultaneously experience an under voltage.

5.1.8 Normal operating conditions:

a. Incomer no. 1 and 2 breakers are 'ON'. Bus-coupler breaker is 'OFF'. Initiation of auto Changeover when the incoming supply to breaker no. 1 or 2 fails, the respective incomer is tripped through under voltage relays and a timer. The time delay is in the range of 0.5 to 5 sec. Breaker trip on under voltage is blocked in case of power failure on both the incomers.

b. The voltage on healthy bus section has been above the set value of normal voltage for a specified duration (settable through a timer 0.5-5 sec) and the incomer breaker of healthy bus is closed in service position.

c. Bus-coupler is open and in-service position.

d. Auto/ Manual switch is set for 'AUTO' operation.

5.1.9 Bus-coupler will close if the following conditions are met:

a. One of the incomer breakers has tripped on under voltage.

b. The residual voltage on the bus that has lost supply is less than 40% of normal voltage.

c. Incoming voltage of healthy incomer has been above 80% of normal voltage for a specific duration of 3 sec. (Through timer 0.5 sec - 5.0 sec)

d. Auto/ Manual switch is set for 'AUTO' operation.

5.1.10 Specific blocking of auto transfer

a. Bus-coupler should not close, if any of the two incomer's trips due to faults.

5.1.11 Manual transfer

a. It is possible to trip incomer no. 1 or 2 after closing the bus-coupler to facilitate maintenance as required. Manual transfer would permit momentary paralleling and as such check-synchronizing relay shall be provided to ensure system safety.

b. When supply is again available at incomer breaker after auto changeover has already taken place, it shall be possible to restore the system to normal operating condition by operating selector switch (meant for tripping incomer no. 1 or 2 or bus-coupler) and by setting auto/ manual switch in 'Manual' mode.

c. In manual transfer the closing circuit shall be checked through contacts of check synchronizing relay.

5.1.12 As a minimum, contractor shall provide the signals as per the I/O List attached as Annexure-04 and Drive control Philosophy Annexure-05 (potential free contacts) for remote annunciation and metering

The following miscellaneous signals are also to be provided.

i. Auto/Manual switch in manual position
ii. Auto transfer completed
iii. Auto transfer blocked
iv. Supplies paralleled beyond preset time delay.

5.1.13 All potential free contacts (including spare contacts) and analogue input signals shall be duly wired to the terminal block in the respective panel for onward wiring.

5.1.14 The switchboards shall be suitable for installation and satisfactory operation in a pressurized substation or in substation with restricted natural air ventilation in a tropical, humid and corrosive atmosphere.

5.1.15 The switchboards shall be designed to operate under specified site conditions. If not specifically mentioned a design ambient temperature of 50 deg C and altitude not exceeding 1000 metres above mean sea level shall be considered.

5.1.16 All the equipment described in this specification is intended for continuous duty at the specified ratings under the specified ambient conditions.

5.1.17 Energy meters if provided separately shall be digital type with TTB.

6.0.0 TECHNICAL REQUIREMENTS

6.1.0 DESIGN AND FABRICATION REQUIREMENT

6.1.1 Intelligent MCC, PDB and DBs shall be metal enclosed single front, fully draw out, freestanding, floor mounting, compartmentalized, modular type suitable for indoor installation. Panels shall be free standing with ISMC-75.

6.1.2 The switchboard enclosure shall be dust and vermin proof and shall provide a degree of protection not less than IP-54.

6.1.3 The switchboard shall be assembled out of vertical panels of uniform height in single line up.

6.1.4 It shall be possible to extend the switchboards, in either direction at a later date. Ends of bus bars shall be suitably drilled for this purpose. Panels at extreme ends shall have openings, which shall be covered with plates screwed to the panel. Details of drilled holes in bus bar and openings in the panels, provided for future extension shall be clearly shown in the vendor drawings.

6.1.5 The switchboard shall be designed to ensure maximum safety during operation, inspection, connection of cables, relocation of outgoing circuits and maintenance, with the bus bar system energized and without taking any special precautions.

6.1.6 Adequate means shall be provided to prevent shorting of power and / or control terminals due to accidental dropping of maintenance tools etc. inside the switchboard. Checking and removal of components shall be possible without disturbing adjacent equipment.

6.1.7 All identical equipment and corresponding parts shall be fully inter-changeable.

6.1.8 The switchboard frame shall be fabricated CRCA. The frames shall be enclosed by using minimum 2.0mm thick CRCA for load bearing members, whereas doors and covers i.e non-bearing members shall be made of minimum 1.6 mm thick CRCA. Undrilled removable gland plate shall be provided & shall be 3mm thick.

6.1.9 The switchboard shall be provided with integral base frame of ISMC-75 for each vertical panel. The switchboard integral base frame shall be suitable for tack welding.

6.1.10 Module door interlocked with main power isolating devices. Power circuit isolation device to have pad locking in the OFF position with door closed.

6.1.11 Operating height shall be min.-300mm and max.-2000mm.

6.1.12 Paint shade shall be Light Grey RAL-7035.

6.1.13 Labelling: Clear legible identification labels (anodized aluminum with white letters engraved on black background) with letter sizes of:-

- 25-50mm for MCC/PDB/DBs panel in front and back side of the panel.
- 5mm for components and module nameplates.
- Danger board on front and rear sides in English, Hindi & regional Language.

6.1.14 Earthing: Two separate earthing terminals shall be provided. Bolted joints with tooth spring washers for good earth continuity. Earth bus to run in all cable alley of the panel and shall be extendable at both ends.

6.1.15 All openings, covers, removable covers, adjacent covers and doors shall be provided with neoprene Gaskets. Removable blanking plates shall be provided to cover the openings in the event of withdrawing the feeder modules. Number of blanking plates shall be 10% of each module size with a minimum of one number.

6.1.16 All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made by zinc-passivated cadmium plated high quality steel bolts, nuts and washers.

6.1.17 Lifting hooks for all shipping sections. Doors shall have concealed hinges. These hooks, when removed shall not leave any opening in the panels.

6.1.18 Shipping length shall be limited to 2.4 M.

6.1.19 Limiting Dimensions :

i. Width of MCC/PDB/DBs : 800mm
ii. Width of module : 500mm
iii. Width of Cable Alley : 300mm
iv. Height of Module : 400mm min.
v. Depth of MCC/PDB/DBs : 600mm max.
vi. However depth of the Incoming ACB panel will be 1200mm min.

6.1.20 The switchboard shall be formed using distinct vertical panels each comprising of following compartments.

i. A metal enclosed horizontal bus bar compartment running at top unless otherwise specified.
ii. Individual feeder modules in multi-tier mode.
iii. Vertical bus bars serving all feeder modules in the vertical panel.
iv. Cable termination compartment.
v. Perforated sheet steel / insulating material enclosed horizontal auxiliary bus bars for control, interlock, indication and metering wiring running horizontally.
vi. Metal sheets shall be provided between two adjacent vertical panels running up to full useful height of the switchboard.

6.1.21 All auxiliary devices for control, reset, indication, measurement and protection such as push buttons, control and selector switches, indicating lamps, measuring instruments and protective relays shall be mounted on the front side of the respective compartment. The design shall be such that all power on/off or start/stop and relay reset operations shall be performed without opening the panel door.

6.1.22 Disconnecting Link type TB shall be provided for CTs.

6.2.0 CONSTRUCTION & TECHNICAL PARAMETERS OF MAIN COMPONENTS:-

6.2.1 Bus-bars		
Main horizontal & vertical busbars		
a)	Arrangement	Three phase & neutral.
b)	Material	High conductivity electrolytic Aluminum alloy confirming to grade E91E as per IS-5082 -1981.
c)	Phase Bus-bar Rating	Shall be able to carry continuously the connected load (considering diversity factor) plus a 25% margin Max. current density shall be :- 1.0 A/sq.mm for Aluminum 1.5 A/sq.mm for Copper.
d)	Neutral Busbar Rating	50 % of phase busbar rating
e)	Short circuit rating	50 kA for 1 sec.
f)	Busbar configuration	Red-yellow-blue from front to back or top to bottom or left to right as viewed from front.
g)	Busbar insulation	Heat shrinkable PVC R,Y,B coloured sleeves for phases. Black for neutral.
h)	Busbar supporting insulators	Non-hygroscopic Flame retarded Track resistant High strength Sheet moulded compound or equivalent polyster fibre glass moulded type.
i)	Max. temp. rise of bus	Not to exceed 40 deg. C. above ambient of 50 deg.C.
j)	Air clearance for bare busbar	Phase to phase :- 25.4 mm (minimum) Phase to earth :- 19.0 mm (minimum)
k)	Joints and tap off	Busbar joints and tap off points shall be shrouded

	points	and bolted (with cadmium coated bolts with plain and spring washers and locknuts). Bimetallic connectors for connection between dissimilar metals. Anti-oxide grease for all bus connections.
l)	Neutral bus isolation	Through disconnecting link.
m)	Vertical busbar	Rear side
n)	Creepage distance	As per IS: 13947 (1993), Part-1.
Earth bus		
o)	Material	GI/Al
p)	Size	Minimum 50 x 6 mm with extension at both ends.
Control bus		
q)	Material	Copper.
r)	Size	Minimum 25 x 3 mm.
s)	Segment	Control bus shall be sectionalized and each bus shall be fed from control trafo of respective section, however selector switch in one module shall be available to select the feed of both sections of control bus from either of control trafo also.
t)	Selector switch	4 position (Trafo -1, Trafo -2, Individual, OFF) and as described above for all Control Transformers.
Insulation level		
u)	Rated insulation voltage	1100 V
v)	Impulse withstand voltage	4 kV as per IS-13947 (Part I) 1993
w)	One minute power frequency withstand voltage	2.5 kV for power circuit & 500 V for control circuit

6.2.2 Technical Parameters of Welding Receptacles:

63A, 415V, 3-PHASE, 5-PIN WELDING RECEPTACLE WITH PLUG:

i. Receptacles shall be dust proof/ vermin proof metal clad gasketted construction and shall be weatherproof with IP 55 degree of protection. Outdoor type socket shall be provided with external canopy to protect from tropical rain.

ii. Receptacles enclosure shall be CRCA sheet steel of 14 SWG (2mm) and painted with epoxy powder coating after galvanization. Paint shade of Grass Green RAL 6010 as per IS 5 (shall be finalized during detail engineering) if not otherwise specified.

iii. Receptacle shall be provided with 5-pin(3P+lN+lE) socket & Plug with porcelain base non reversible type confirm to IEC 60309-2.

iv. The socket outlet shall be provided with isolating TPN MCCB of 63A. Short circuit rating of MCCB shall have service breaking capacity (ICS) of at least 75% of ultimate short circuit breaking capacity as per IEC60947-2.

v. Receptacles shall be suitable for wall / column mounting. All mounting hardware shall be supplied along with receptacles. Outdoor type receptacle shall have rain hood/ canopy to protect from heavy tropical rains. Receptacle box shall be provided with internal & external earthing stud with washer & nuts welded on the surface for grounding.

vi. The plug assembly shall be mechanically rugged, light and shall not unduly stress the socket or its own pins when fitted on the socket.

vii. In order to prevent accidental removal of plug from socket, the engagement and disengagement shall be by two separate and distinct movements and positions.

viii. Stud type terminals along with tinned cu. lugs suitable for 3.5CX70 sq mm Al. wire shall be provided for all outgoing and incoming cables.

ix. All internal power wiring shall be done with l6sqmm cu. wire of 660V grade PVC insulated.

x. Each outlet shall be provided with either a spring loaded hinged cover or a cap connected metallic chain to close the outlet when not in service.

xi. Each socket shall have two cable entries of 3.5C x 70 sq mm Al. XLPE Cable (if not specified) with looping facility along with two numbers of weather proof double compression brass cable glands and one number sealing plug to seal the unused cable entry.

xii. Inscription plate / name plate shall be provided indicating tag no. of receptacle and voltage rating as per clause E-V of this spec.

xiii. Makes of major components shall be as per the sub vendor list ANNEXURE-3.

xiv. Receptacle Boxes shall be supplied complete in all respect with all internal accessories like Socket, Switch, TBs etc. Other accessories like mounting hardware, Cable Glands, Cu. Lugs, Al. blanking plug shall be supplied in loose.

xv. All necessary test certificates from qualified agency in support of the technical requirement should be produced during approval of drawings and inspection or whenever asked.

6.2.3 Space Heaters

i. Panel Space heater to be provided in each panel with thermostat, fuse, switch.

ii. Each switchgear cubicle shall be provided with space heaters to prevent moisture condensation, and maintain cubicle temperature 50 deg C above the ambient.

iii. The space heaters shall be located at the bottom of the switchboards, and shall be controlled through a thermostat with an adjustable

setting and a manually operated switch. The thermostat shall preferably be located in the metering or relay chamber.

iv. Panel & motor space heaters shall be fed from a separate 240 V AC bus derived from the upstream side of Incomer. Which in-turn shall be fed from separate space heating transformer. These space heating transformer shall be located in each bus with auto changeover facility among the transformers.

v. Power supply for space heaters of motors shall be fed from same space heater bus through MCB and interlocked with Main Power contactor of respective motor feeder.

6.2.4 Auxiliary Bus bars

Auxiliary bus bars each of minimum size 25X3 mm copper, shall be provided for following applications. Exact number of bus bars shall depend on various controls, metering and auxiliary power distribution requirement.

i. Panel space heater supply and motor space heater supply.

ii. Control supply for breaker tripping, closing and indication circuits, breaker spring charging motors.

iii. Control supply for motor starter control and indication circuit.

iv. 240V AC UPS Bus for Motor Intelligent Controller.

Tee-off connectors shall be used for distributing auxiliary supply to each vertical panel. Rubber grommets shall be used for all wire entries to make the entries dust and vermin proof.

6.2.5 Wiring and Terminals

Panel wiring		
a)	Power / current transformer circuit	1.1kV grade single core, black colour PVC insulated, stranded copper conductor of minimum size 2.5 sq.mm. For feeder rating 100A and above all the power circuit shall be through rigid busbar.
b)	Control and potential circuit	1.1kV grade single core Black colour PVC insulated Stranded copper conductor of minimum size 1.5 sq.mm.
c)	Ferrules	Numbered plastic/ceramic ferrules. Self locking type.
d)	Marking	Wiring will be properly marked as per relevant IS.
e)	Spare contacts	All spare contacts of relays selector switches & contactors will be wired upto the terminal block. Each component shall have at least one potential free spare contact.
f)	Terminals	- Power & control terminals shall be segregated by insulating material like hylam/bakelite sheet. - Power terminals will be stud type. - Control terminals will be ELMEX type suitable for connecting two cores of 2.5 sq.mm wires. - Minimum 20 % spare terminals will be provided. - The minimum rating of control terminal shall be 10 Amps.

		- Colour coded wires, TB's of different voltage rating to be provided. - Uniform color-coding to be followed for cabling, TB, etc.
g)	Cable glands	Double compression Nickel plated brass cable glands for receiving external power and control cables
h)	Cable Lugs	Tinned copper heavy duty lugs for receiving external power and control cables

6.2.6 Painting

i. All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying a coat of phosphate paint and coat of yellow zinc chromate primer. The under surface shall be made free from all imperfections before undertaking the finishing coat.

ii. After preparation of the under surface, the switchboard shall be spray painted with two coats of epoxy based final paint or shall be powder coated.

iii. Painting shall be of synthetic Enamel/Powder coated. For painting seven tanks method shall be followed. Shade shall be Light grey & Bright white as exterior and interior respectively.

iv. Color shade of final paint shall be Light Grey RAL 7035.

v. The finished panels shall be dried in stoving ovens in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint etc. Vendor shall supply final paint (1 litre per switchboard) in non-returnable container for final touch up at site.

vi. All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust formation. If these parts are moving elements then they shall be greased.

6.2.7 Circuit breaker compartment

i. The circuit breaker compartment shall be fully draw-out. Suitable guides shall be provided to facilitate easy withdrawal of the circuit breaker.

ii. The current transformers for the ammeter/protection circuits shall be mounted on the fixed portion of the compartment. However, current transformers associated with built-in releases may be mounted on the breaker trolley.

iii. All terminals except wiping/sliding type control terminals shall be shrouded with plastic covers to prevent accidental contact. For direct termination – clip on shrouded type terminals shall be provided.

iv. There shall be three positions for the draw out trolley viz:

a. "Service" position - In this position both power and control circuits shall be connected. This shall be the normal operating position of the circuit breaker.

b. "Test" position – The power contacts shall be disconnected in this position but the control connections shall not be disturbed, it shall be possible to close and trip the breakers in this position.

c. "Draw out" Position – both power and control circuits shall be disconnected in this position and breaker removed from the cubicle.

v. The circuit breaker shall be lockable in "service" and "test" positions. Safety shutters shall be provided when the breaker is in withdrawn/drawout position.

vi. The earth connection must remain connected in "Test" position; Earthing of the unit shall be done with a "pin" or with scrapping earth connections.

vii. The earth connection shall make before the main power / control contacts make and break after the power / control contacts are disconnected. Earthing connection through a plug and socket connection shall not be acceptable.

6.2.8 Interlocks

Following interlocks shall be provided:

i. Compartment doors shall be interlocked against opening when breaker is in closed condition. However, it shall be possible to defeat this interlock for inspection purposes.

ii. It shall not be possible to push "in" a drawn out circuit breaker in closed condition or withdraw a circuit breaker in closed condition.

iii. It shall be possible to operate a circuit breaker only in the defined "Full in" or "service" and "test" position inside the panel. It shall not be possible to operate the breaker in intermediate positions. While inserting or withdrawing circuit breaker.

iv. Any unused circuit breaker compartment shall be fully equipped and provided with compartment door, vertical bus bars and control terminals/wiring etc. such that the same could be used for housing outgoing breakers in future without any modifications to the panel.

6.3.0 TECHNICAL PARAMETER OF COMPONENTS

6.3.1 MOULDED CASE CIRCUIT BREAKER (MCCB)

i.	Reference standard	IS : 13947 (Part-2) : 1993
ii.	Rated Current	As per the load ratings.
iii.	MCCB for motor feeders	MCCBs for motor feeders shall be motor protection type confirming to type-2 co-ordination with short-circuit release only & Isc>12In.
iv.	Short circuit rating	50 kA (Minimum) (Ics =Icu).

		Ics = Service short circuit breaking capacity. Icu = Rated ultimate short circuit breaking capacity.
v.	Service Short circuit breaking capacity (Ics)	100% of rated ultimate short circuit breaking capacity (Icu)
vi.	Operating handle	Yes
vii.	Safety Door interlock	Door interlock, Padlocking in ON/OFF position.
viii.	Withstand capability	Rated short time with-stand current (Icw) will be 12 times maximum rated operational current for 1 sec.
ix.	Utilisation category	AC23B
x.	Electrical features	- S/C, O/C, Over load, Thermal magnetic release), E/F protection for power supply feeders & crane trolley line feeder MCCB's. - Features to minimise the let-through energy (I2t) in the event of short circuit on load side. - Complete with continuous electronic / microprocessor based adjustable thermal and magnetic releases. Adjustable type for feeders less than 160A not required. - MCCB's for motor feeders shall be of motor duty class with magnetic trip only.
xi.	Auxiliary contacts	1 NO + 1 NC. (Spares shall be provided apart from Scheme requirements). Alarm contacts.
xii.	Miscellaneous	Can be used in load side or line side vice versa. Shunt trip coil.

6.3.2 AC CONTACTORS

i.	Service	Indoor within steel cubicle for maximum system voltage, starting of motors and miscellaneous loads.
ii.	Standard	Shall confirm to IS/IPSS.
iii.	No. poles	3 pole air break.
iv.	Operating type	Magnetic coil operated at 240 V AC. No economy resistors. Insulation for coils shall be class 'E' or better
v.	Rating	25A (Minimum) , Rated generally for 150% of full load motor rated current.
vi.	Interrupting capacity	Ten times the rated current for rated size upto 100A and eight times the rated current for larger sizes.
vii.	Duty	According to IEC 158-1 - AC 1 duty: - Non-inductive or slightly inductive loads. - AC 2 duty :- Slip ring motors : starting , plugging - AC 3 duty :- Squirrel cage motors : starting ,

		switching off motors during running - AC4 duty: - Squirrel cage motors: Plugging, inching. Derated AC4 ratings shall be selected for inching and plugging operation of the drive (crane duty).
viii.	Utilisation category	AC23A for unidirectional motors AC24A for bi-directional motors
ix.	Aux. contact requirement	- Minimum 4 NO +4 NC contacts with minimum rating of - 10A , 415 V for rated duty AC-11. - 2A , 220 V for rated duty DC-11. - Shall have the facility of adding add-on contact blocks.
x.	Closing (pick-up)	85% to 110%
xi.	Dropout	65% to 45%
xii.	Miscellaneous	For RDOL feeders the power contactors shall be mechanically interlocked.

6.3.3 Current transformers:

i.	Type	Bar type primaries and 5A (max) secondary with thermal and dynamic ratings corresponding to the units with which they are used. Resin Cast, window type.
ii.	Accuracy class	- Measuring CT accuracy class 1.0. - Protective CT accuracy class 10 P10 or better.

6.3.4 Control transformers:

i.	Type	Dry type, cast resin, class-B or better.
ii.	Voltage	415V/240V
iii.	Primary taps	+2.5 %, +5 %

6.3.5 Indicating instruments:

i.	Basic details	- Shall not damage by passage of fault current or existence of over voltage for the maximum permitted duration of fault conditions. - Ammeters for drives above 45 kW shall be CT operated. - Voltmeters protected by fuses placed as close to the bus-bar as possible. - Maximum reading 700% of IFL for motor feeders.
ii.	Mounting	Flush mounting, square dial with zero adjusting device for external operation.
iii.	Accuracy class	1.5
iv.	Size	- Size of voltmeter and ammeter for incomer 144 x 144 mm for incoming feeders.

		- Size of ammeter for motor feeders 96 x 96 mm.

6.3.6 Thermal Overload Relays.

	Standard	IEC:292-1
i.	Basic details	- Triple pole - Ambient temperature compensated. - Inverse time lag. - Hand reset type. - Bimetallic with adjustable setting and built in single phase protection. - Reset PB shall be operable from outside. - Shall be able to withstand prospective short circuit current without damage or injurious heating till the motor protection MCCB/MPCB clears the fault. - Auto tripping shall be indicated on MCC.
ii.	Contacts	1 NO + 1 NC contacts with minimum rating of - 10A, 415 V for rated duty AC-11. - 2A, 220 V for rated duty DC-11.

6.3.7 Magnetic Overload Relays.

i.	Standard	IEC:292-1
ii.	Basic details	- Triple pole - Ambient temperature compensated. - Adjustable time lag feature or of instantaneous type. - Provided with a latch and hand reset feature or auto reset with flag indication. - Adjustable current setting and time delay calibrated between nominal current and twice nominal current rating
iii.	Contacts	1 NO + 1 NC contacts with minimum rating of - 10A , 415 V for rated duty AC-11. - 2A , 220 V for rated duty DC-11.

6.3.8 Push Buttons

i.	Basic details	- All push button switches including illuminated push buttons shall be of sturdy design. - Shrouded actuator for "START" application and “STOP” application shall be provided. - Mushroom Head actuator for "EMERGENCY STOP" application shall be latched type with turn to release. - Press to latch in operated position and turn-to-release in unactuated position. - Key "STOP" application for "LOCK-OUT" application shall be provided. - Double break parallel contact design or other suitable design feature enhancing contact reliability required in circuits with electronic interfaces involving low voltages and small currents shall be

		adopted.
ii.	Size	- 22.4 mm diameter
iii.	Contact rating	- Minimum 2 NO + 2NC contacts (or 4NC Contacts for Emg. Stop PB) with following current ratings . • Continuous - 10 A • AC 11 - 1.5 amps at 240V • DC 11 - 0.5 amps at 110 V DC, L / R - 40 ms - All contact faces of contacts shall be of silver or silver alloy. - Facility of adding add-on contact blocks to be provided
iv.	Colour	• Accept - Blue • Test - Yellow • Reset - Black

6.3.9 Indicating Lamps

i.	Type	- LED Cluster type
ii.	Basic details	- Sufficient number of lamp grips shall be provided for easy replacement of lamps.
iii.	Size	- 22.4 mm diameter
iv.	Voltage level	- Suitable for any of the following voltages as per the system requirement : • 415V AC / 230V AC / 240V AC / 24V DC / 220V DC - All indicating lamps shall be suitable for continuous operation at 90 to 100 percent of their rated voltage.
v.	Colour	- For motor `ON', valve/damper/gate 'OPEN', supply `ON', breaker `CLOSE' : Red - For motor `OFF', valve/damper/gate 'CLOSE', supply `OFF', breaker `OPEN' : Green - Fault indication, over load, alarm condition, 'SERVICE & TEST POSITION' indication. : Amber - General purpose indication, motor `AUTO TRIP'. : White Other colours may be adopted depending upon particular application as approved by the Purchaser.
vi.	Layout of indication lamps on boards / panels	• Indicating lamps shall be located just above the associated push-button / control switches. • Red lamps shall invariably be located to the right of green lamps. • In case a white lamp is also provided, it shall be placed between red and green lamps along the centre line of control switch/ push button pair. • Blue and Amber should normally be located above the Red and Green lamps. • When associated with push buttons, red lamps shall be directly above the green push button and green lamp shall be directly above the red push button.

vii.	Legend plates	Anodised aluminium

6.3.10 Miniature Circuit Breakers (MCB)

i.	Type	Heat resistant plastic moulded type
ii.	Ref . Standard	IS: 8828 –1978
iii.	Protections	MCB's shall be provided with • quick break trip-free mechanism • direct acting thermal overload • short circuit trip elements.
iv.	Short circuit capacity	Not less than 9kA at 0.8pf
v.	Mounting	• DIN Channel mounting. • Single phase MCBs mounted adjacent to each other and connected to different phases will be provided with adequate insulated phase barriers.
vi.	Current Rating	• The MCBs shall be selected from standard current ratings.(As per SLD) • Motor duty MCBs will be provided, if specified. • MCB shall be of C curve .

6.3.11 Selector Switches

i.	Basic details	- All control selector switches shall be of sturdy design. - Shall have modular construction with number of switching contacts for each position operated by a single shaft. - Inscription for each position shall be provided. - Stay-put or spring return arrangement shall be provided as per the circuit and control/operational requirement. - The contacts shall be designed for higher contact reliability and electronics compatibility involving low voltage and small value of currents. - The operating handle shall be robust and strong. - One number of potential free switching contact for each position shall be provided as spare. - Control switches for circuit breaker ON/OFF control 3 position spring return to neutral with lost motion device and pistol grip handle. - Other control and selector switches - stay put type with wing type knobs.
ii.	Contacts	2 NO + 2 NC contacts with minimum rating of - All the selector switches shall be of 10 A rating - 25A for sturdy applications . - 1 NO & 1 NC contact / poles shall be potential free for PLC inputs .

6.3.12 Ammeter, Voltmeter, kW Meter

Analogue meters shall be of moving iron type. The range shall be as indicated on the SLD. Ammeters for motor feeders shall have a non linear compressed scale at the end to indicate motor starting current. Red pointer shall be provided which can be adjustable at site for indicating full load current of the motor.

6.3.13 Frequency Meter

These shall be of direct reading or digital type, and shall operate on a VT secondary voltage of 110V.The standard range shall be 45-50-55 Hz.

6.3.14 Power Factor Meter

Power factor meters shall operate on a VT secondary voltage of 110 V. The CT secondary current shall be as shown on the relevant drawings. The standard range shall be 0.5lead–1.0–0.5lag.

6.3.15 Timers

i. The timers shall be electronic, pneumatic or synchronous type with manual / auto reset features as per the functional requirements. The timers shall be 'ON delay' or 'OFF delay' type as specified . The repeat accuracy shall be 0.5% or better.

ii. Timers for re-acceleration duty shall be pneumatic type and shall have adjustable time setting of 0-60 sec. The time setting wherever specified, shall be accurately set before dispatch of the switchboard. Timers for auto transfer schemes shall be of static type with timing ranges suitable for the scheme employed.

7.0.0 INSPECTION AND TESTS

7.1.1 During fabrication, the switchboard shall be subjected to inspection by BHEL to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to inspectors.

7.1.2 Tests shall be carried out at the manufacturer's works before _dispatch. All routine tests as specified by the applicable codes and standards shall be conducted. Type test certificates for the switchgear panel, circuit breakers and Intelligent Controller from a recognized testing authority, shall be furnished with the bids.

7.1.3 All routine & acceptance tests shall be carried out at manufacturer's work under his care & expense.

7.1.4 Type tests if asked shall be performed. Short circuit test shall be performed at CPRI and heat run test may be performed at manufacturer's works. Heat run test shall be performed on at least one incomer & two outgoing vertical panels of the ordered switchboard.

7.1.5 Type, Routine & Acceptance test shall be witnessed by an inspector of BHEL or an agency authorized by the BHEL . Prior notice of minimum 4 weeks shall be given to the inspector for witnessing the tests.

7.1.6 In addition, acceptance tests shall be conducted as follows to check mechanical and electrical operation of various equipment and control circuits:

a) A general visual check shall be carried out. This shall cover measurement of overall dimensions, location, number and type of devices, terminal boxes, location and connection of terminals etc.

b) Manual and electrical operation of Circuit breakers / Intelligent Controller/ Releases shall be checked under worst conditions of auxiliary supply voltage.

c) Dry insulation test with power frequency voltage shall be conducted for the main and auxiliary circuits.

d) Insulation resistance of the main and auxiliary circuits shall be checked before and after the high voltage withstand test.

e) Operation check shall be carried for every control function as per the schematic diagram by manually simulating fault condition and operation of control switches, relays etc.

f) The Relays/Releases/Intelligent Controller shall be tested with secondary injection test equipment.

g) For bought out equipment, certified test reports of tests carried out at the manufacturer's works shall be submitted. Normally all routine tests as specified in the relevant standards shall be conducted by the sub-supplier at manufacturer's works.

7.1.7 Tests shall be finally performed at site, in the presence of the manufacturer's specialist, once the external cable connections have been completed.

8.0.0 INFORMATION REQUIRED BY PURCHASER FROM THE BIDDER

The vendor shall submit with his offer the following information:

8.1.1 Full technical description and performance details of the equipment and components offered including heat losses for all components in kW.

8.1.2 Overall dimensions, GA drawing, shipping dimensions & weight of the switchboard.
Bidder to note that GA Drawing shall be submitted along with the offer for evaluation.

8.1.3 Deviation taken by the vendor from the requirements of this specification.

8.1.4 Guaranteed technical particulars.

8.1.5 Type test certificates

8.1.6 Bill of material including makes of components.

9.0.0 PACKING AND DESPATCH

9.1.1 Detailed packing list (including information of all the loose items to be supplied with the equipment) shall be submitted during inspection.

9.1.2 All the equipment shall be divided into several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for selected mode of transportation i.e. by ship / rail or trailer. The panels shall be wrapped in polyethylene sheets before being placed in wooden cases

to prevent damage to the finish. Cases shall have skid bottoms for handling. Cases shall be suitable for lifting by cranes. Special precaution notations such as Fragile, This side up, center of gravity, weight, Owner's particulars, Purchase order number etc. shall be clearly marked on the package together with other details as per purchase order.

9.1.3 The commissioning spare items, mandatory spare items, tools & tackles and cable glands & lugs shall be separately packed. Each packet shall have its respective label on the outside for clear identification.

9.1.4 The equipment may be stored outdoors for long periods before installation. The packing should be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed.

10.0.0 DOCUMENTATION:

10.1.1 Documents to be submitted along with the technical bid / offer:

a) Deviation schedule (Refer Annexure-6)
b) Switchboard wise GA, dimensions and weights
c) Un-priced price format (Refer Annexure-8)
d) Type test certificates (Short circuit, Temperature rise and IP class) for switchboards which are similar in configuration to the switchboards present in this Project.
e) Duly filled Check List (Annexure-11)

Technical offer of the bidder will be evaluated only on the basis of deviation schedule and Price Format. Nature of Deviations shall only be of Design / Manufacturing constraints and non-availability of items / components / makes in market.
Switchboard dimensions are for fixing Purchaser's tentative room layout.

Un-priced price format consists of Items of Main offer and Unit rates for additions / deletions of supplies / services / spares during execution. All fields shall be quoted in this format only.

Note: No price implications shall be entertained for deviations withdrawn during the technical scrutiny. If any deviations are accepted by BHEL during technical scrutiny then also there will be no price implication. Hence, in no case there will be consideration of Price implications.

10.1.2 Offer is liable for rejection when

a) The offer is incomplete with respect to above clauses.
b) The above documents are not submitted in BHEL's formats.
c) Any field is left blank in the Price format.
d) Discrepancy is observed between Un-priced and Priced bid.

10.1.3 Documents to be submitted after award of contract: Refer Annexure-10.

11.0.0 GUARANTEE:

11.1.1 The supplier shall be fully responsible in respect of design, selection of components, manufacture, quality of workmanship and operation of all the equipments, accessories etc. supplied under this scope of contract up to the Guarantee period.

11.1.2 Guarantee period shall be as per the commercial terms and conditions of the NIT.

12.0.0 QUALITY PLAN

12.1.1 Quality Assurance Program

The successful Bidder shall provide and implement a documented Quality Assurance programme. The programme shall be capable of providing assurance that design, purchasing, manufacturing, loading, shipping, storage, erection, construction, testing, and examination of Scope of Supply to ensure that it will comply with the requirements of the Specifications and documents.

The quality control organization shall follow-up the inspection and testing to ensure adherence to quality of the Scope of Supply and compliance with the programme and with the test procedures. In particular, it shall:

- Provide all design and engineering Divisions and its Sub vendor with detailed instructions regarding inspection and testing;
- Organise the tests required in the programme, witness them and issue test certificates;
- Inspect the Equipment before packing, check the quality of packing and if Equipment and packing are found to comply with the requirements, authorise shipment.
- Inspect for possible transport damages if any, and prepare and submit repair procedures for approval;
- Organise and witness all inspection and testing on Site and issue test certificates.

No Equipment shall be packed, prepared for shipment, or dismantled for the purpose of packing for shipment, unless it has been satisfactorily inspected and approved for shipment.

12.1.2 Quality Assurance Manual

The successful Bidder's Quality Assurance Programme shall be documented in a Quality Assurance Manual. A copy of the Quality Assurance Manual shall be submitted for review and comment.

12.1.3 Quality Management System

Successful Bidder Quality Management System shall meet the requirements of ISO 9001, "Quality Systems - Model for quality assurance in design/development, production, installation and servicing". The successful Bidder shall demonstrate compliance with this requirement.

RECORD OF REVISIONS

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