



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	TB-395-316-017	Rev. No.	00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	MM	DKM	RS	
TITLE	LT SWITCHGEAR (AC & DC BOARDS)	SIGN				
		DATE	21.03.18	21/03/18	21/3/18	
		GROUP	TBEM			

CUSTOMER	Power Grid Medinipur Jeerat TRansmission Ltd.
PROJECTS	SUBSTATION PACKAGE-SS01 FOR ESTABLISHMENT OF 765/400KV S/S AT MEDINIPUR & JEERAT (NEW) ASSOCIATED WITH TRANSMISSION SYSTEM PROJECT "765kV STRENGTHENING IN EASTERN REGION (ERSS-XVIII)" UNDER TARIFF BASED COMPETITIVE BIDDING (TBCB) ROUTE.

CONTENTS

Section	Description	No. of Sheets
Section-1.	SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES	3
	ANNEXURE: Single Line diagram of LT AC & DC	2
Section-2.	DETAILED TECHNICAL REQUIREMENTS – EQUIPMENT SPECIFICATION	28
Section-3.	PROJECT DETAILS AND GENERAL SPECIFICATION,	26
Section-4.	SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS (TO BE SUBMITTED AT CONTRACT STAGE)	6
Section-5.	CHECK LIST (TO BE FILLED AT TENDER STAGE)	3
	Annexure-A1 (Technical Requirement)	2

Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS
				Distribution	TBMM TBQM TBCM TBTS

COPYRIGHT AND CONFIDENTIALITY
The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD.
It must not be used directly or indirectly in anyway detrimental to the interest of the company

TECHNICAL REQUIREMENT

Name of Project: - 765/400 kV s/s at Medinipur & Jeerat

Name of Item : LT Switchgear

Sr. No	Description	Supporting Document to be attached	Reference of attached documents																
01	The manufacturer whose LT Switchgear(s) are offered, must be a manufacturer of LT Switchboards of the type and rating being offered. He must have designed, manufactured, tested and supplied atleast 50 nos. draw out circuit breaker panels, out of which atleast 5 nos. should have been with relay and protection schemes with current transformer. He must have also manufactured atleast 50 nos. MCC panels comprising of MCCBs (i.e. Moulded Case Circuit Breakers) modules of the type offered which must be in satisfactory operation#. The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design, atleast one hundred circuit breakers of the make and type being offered must have been in satisfactory operation#.	1 .Bidder to Provide Compliance/Confirmation of fulfilling SL No.1 Technical Requirement. 2. Performance certificate /Letter /MOM etc. issued by end customer for Satisfactory operation 3. PO Copy / PO list in following format <table><tr><th>Sr s. No</th><th>ITEMS SUPPLIED TO</th><th>ORDER REFERENCE No. & DATE</th><th>ITEMS</th><th>QUANTITY</th><th>ORDER FULLY EXECUTED.</th><th>STATUS, IF ORDER UNDER</th><th>REMARK</th></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> 4. Type test certificates 5. Dispatch instructions/ Material receipt at site/ lorry receipt details etc	Sr s. No	ITEMS SUPPLIED TO	ORDER REFERENCE No. & DATE	ITEMS	QUANTITY	ORDER FULLY EXECUTED.	STATUS, IF ORDER UNDER	REMARK									
Sr s. No	ITEMS SUPPLIED TO	ORDER REFERENCE No. & DATE	ITEMS	QUANTITY	ORDER FULLY EXECUTED.	STATUS, IF ORDER UNDER	REMARK												

TECHNICAL REQUIREMENT

Name of Project: - 765/400 kV s/s at Medinipur & Jeerat

Name of Item : LT Switchgear

	# : satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.		
--	--	--	--

SECTION-1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE :

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of metal enclosed, indoor floor mounted, compartmentalized construction and free standing type AC and DC Distribution Board as listed in clause **1.2** below.

No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer.

This section covers the scope and quantities of LT AC & DC DB. The specific technical Requirements for the above item as specified by the customer are given in Section-2. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3, the specifications given under Section-1/Section-2 shall prevail and shall be treated as binding requirements.

The equipment is required for the following project:

Name of Customer : Power Grid Corporation of India Ltd.

Name of the Project: SUBSTATION PACKAGE-SS01 FOR ESTABLISHMENT OF 765/400KV S/S AT MEDINIPUR & JEERAT (NEW) ASSOCIATED WITH TRANSMISSION SYSTEM PROJECT "765kV STRENGTHENING IN EASTERN REGION (ERSS-XVIII)" UNDER TARIFF BASED COMPETITIVE BIDDING (TBCB) ROUTE.

Refer Section - 3 for Project Details and General Specifications.

1.1 SPECIFIC TECHNICAL REQUIREMENTS:

Please refer attached drawing number

TB-0-395-510-014	SLD FOR LT AC DC SYSTEM FOR JEERAT S/S
TB-0-395-510-034	SLD FOR LT AC DC SYSTEM FOR MEDINIPUR S/S

For further technical requirements refer Section-2

Technical Specification of LT SWITCHGEAR
Section-1: Scope, Specific Technical Requirements & Quantities

TB-395-316-017
REV.00

1.2 BILL OF QUANTITY :

Bidder must quote addition /deletion price for each and every type of complete module(Type of modules are defined in Section-2) This is required to account for any changes in the Single Line Diagram during detailed contract engineering stage.

For details of fitments of each module, refer Section 2 and **Single Line diagram as per 1.1 above.**

S. N	Description	Unit	Medinipur	Jeerat
1.	415V, 3Ph 4 wire ,1250A, 25kA for 1 sec MAIN SWITCHBOARD	Set	1	1
2.	415V,3ph 4 wire, 500A, MAIN LIGHTING DISTRIBUTION BOARD (including 2 nos. 300 kVA, 0.433/0.433kV Lighting transformer)	Set	1	1
3.	415V, 3ph 4 wire , 200A, EMERGENCY LIGHTING DISTRIBUTION BOARD (including 1 nos. 300 kVA, 0.433/0.433kV Lighting transformer)	Set	1	1
4.	415V, 3Ph, 4 wire, 800A, 20kA for 1s AC DISTRIBUTION BOARD	Set	1	1
5.	220V, 400A, 20kA (DC) for 1s DC DISTRIBUTION BOARD-I	Set	1	1
6.	220V, 400A, 20kA (DC) for 1s DC DISTRIBUTION BOARD-II	Set	1	1
7.	48V, 400A, 20kA (DC) for 1s DC DISTRIBUTION BOARD-I	Set	1	1
8.	48V, 400A, 20kA (DC) for 1s DC DISTRIBUTION BOARD-II	Set	1	1

FAULT RATING AS PER ATTACHED SLD

Please Note:

The bill of material of each type of module as mentioned in the Single line Diagram for LT AC & DC System shall be as below –

- a) Module Type AE : Refer clause 1.25.4 of Section 2
- b) Module Type –M1 : Refer clause 1.25.5 of Section 2
- c) Module Type E : Refer clause 1.25.6 of Section 2
- d) Module Type G-1 : Refer clause 1.25.7 of Section 2
- e) Module Type G-2 : Refer clause 1.25.8 of Section 2
- f) Module Type H & H (BC) : Refer clause 1.25.9 of Section 2
- g) Module Type S : Refer clause 1.25.10 of Section 2
- h) Module Type X : Refer clause 1.25.11 of Section 2
- i) Module Type-DC : Refer clause 1.25.12 of Section 2
- j) Module Type DG-1 : Refer clause 1.25.13 of Section 2

- k) Module Type H1 : Refer clause 1.25.14 of Section 2
- l) Module Type EL : Refer clause 1.25.15 of Section 2

1.3 TYPE TESTING, ERECTION , TESTING & COMMISSIONING

- a. Type tests shall be in line with Clause 1.21 of Section 2.
Erection, testing and commissioning shall be as per clause 1.22 of Section 2
- b. Commissioning checks tests shall be as per clause 1.23 of Section

1.4 Technical Requirement for LT Switchgear

Legend:

* : voltage class of respective equipment as applicable.

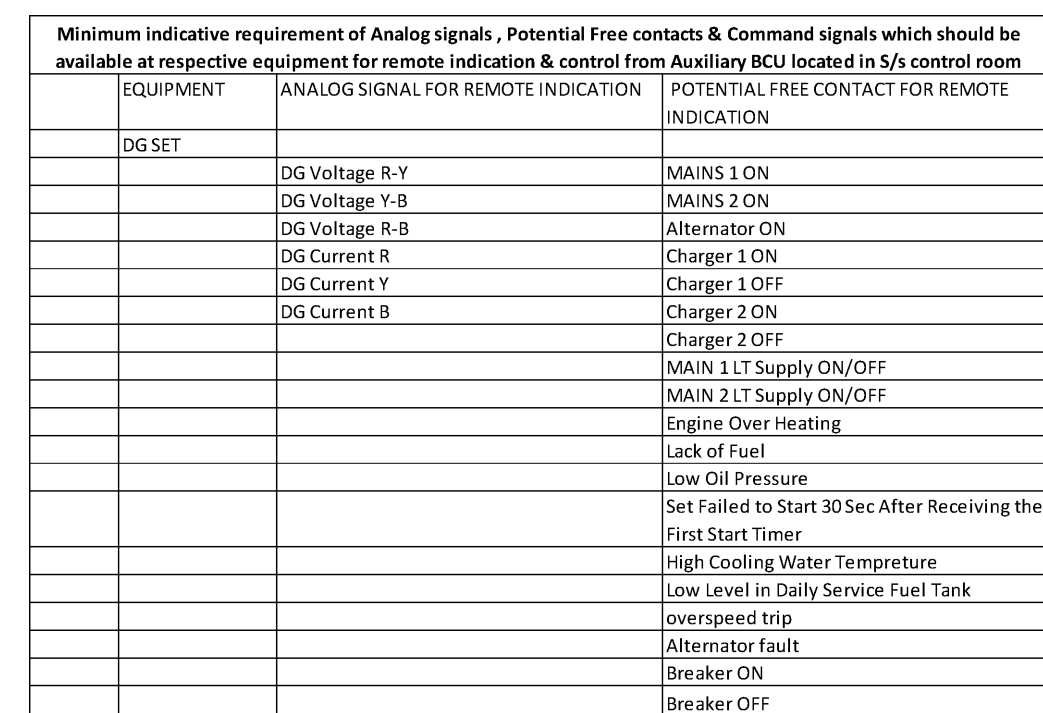
: satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

The manufacturer whose LT Switchgear(s) are offered, must be a manufacturer of LT Switchboards of the type and rating being offered. He must have designed, manufactured, tested and supplied at least **50 nos. draw out circuit breaker panels**, out of which at least **5 nos.** should have been with **relay and protection schemes with current transformer**. He must have also manufactured at least **50 nos. MCC panels comprising of MCCBs** (i.e. Moulded Case Circuit Breakers) modules of the type offered which must be in **satisfactory operation#**.

The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design, at least one hundred circuit breakers of the make and type being offered must have been in satisfactory operation#.

1.5 MANUFACTURING QUALITY PLAN:

Bidder shall follow Powergrid approved MQP at contract stage.



2. NO 2G AC SOURCE SHALL BE PARALLELED AT ANY STAGE.
3. DG SET SHALL BE AUTO START TYPE.
4. MECHANICAL INTERLOCKING PROVIDED TO ENSURE BREAKER OF DG SET WILL CLOSE ONLY WHEN SWITCHES 1 & 2 ARE OPEN
5. FOR COMPLETE DESCRIPTION OF EACH TYPE OF MODULE, PLEASE REFER TECHNICAL SPECIFICATION.
6. CABLE SIZES SHOWN ARE AS PER THE TECHNICAL SPECIFICATION.
7. EACH BAY SHALL BE PROVIDED WITH SLD INCLUDING FIDUCIAL/ SPARE (SHOWN DOTTED) ARE INCLUDED IN QUOTE OF SUPPLY.
8. EACH BAY, TRANSFORMER MB SHALL BE FED BY ATLEAST ONE SOURCE FROM ACDB, SECOND SOURCE FROM DBB, AND THIRD SOURCE FROM DBB & BUS-SECTION BAY FOR PRESENT & FUTURE FROM ANOTHER SOURCE FROM 415V ACB.
9. TRANSLOCATORS/AUX. CONTACTS REQUIRED FOR ANALOGUE AND DIGITAL INPUT SHALL BE AN INDEPENDENT SUPPLY.
10. ONE DC "X" TYPE MODULE IN EACH 220V DCDB SHALL BE PROVIDED FOR EACH LINE, LINE TO LINE, LINE TO FIDUCIAL AND BUS-SECTION BAY FOR PRESENT & FUTURE.
11. ONE DC "X" TYPE MODULE IN EACH 48V DCDB SHALL BE PROVIDED FOR EACH LINE BAY FOR PRESENT & FUTURE.
12. MODULE "X" REFERRED ABOVE, IS APPLICABLE WITH DP MCCB, MAXIMUM 220V. OF DP MCCB SHALL BE CONNECTED IN ONE MODULE OF OFFERED PANEL.
13. ALL MODULES OF MCCB, DP MCCB, TRANSLOCATOR, AND SEPARATE PROTECTIVE RELAYS, HOWEVER, AUX. ANALOGS/CONTACTORS SHALL BE INCLUDED AS PER SCHEME REQUIREMENT.
14. ALL DIGITAL / ANALOGS/OUTPUTS REQUIRED FOR SAs SHALL BE CONSIDERED.
15. ALL DIGITAL / ANALOGS/OUTPUTS REQUIRED FOR SAs SHALL BE CONSIDERED.
16. 5MB TO 5MB IN RETURN LOOPING WILL BE DONE BY 1, 3, 5SC 70 SQMM CABLE.
17. INSTANT OUTAGE OF COLONY LIGHTING IN CASE OF OUTAGE OF SEED FEEDER.
18. RATING OF BUSBAR/FEEDER INDICATED IN THIS DRAWING ARE MIN. REQUIREMENT AND MAY BE SUBJECT TO FURTHER ENLARGED ENGINEERING / FUND INADEQUATE WITH RESPECT TO OPERATING LOADS/SYSTEM.

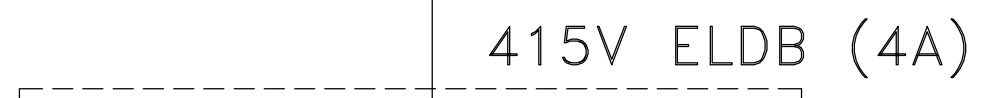
 DRAW OUT TYPE
AIR CIRCUIT BREAKER
 NON DRAW OUT TYPE
4-POLE MCCB
 NON DRAW-OUT
2-POLE MCB
 NON DRAW OUT TYPE
2-POLE MCCB
 NON DRAW OUT AIR BREAK SWITCH
 CONTROL FUSE
 BATTERY LINKS/FUSES
 TIMER

```

50N : INSTANTANEOUS EARTH FAULT RELAY (trippole pole)
50 : TRIPLE POLE INSTANTANEOUS OVER CURRENT RELAY
51 : DOUBLE POLE INVERSE DEFINITE MINIMUM TIME RELAY
50/2 : SINGLE POLE ADJUSTABLE DEFINITE TIME DELAY
      RELAY FOR MOTOR OVERLOAD ALARM
2 : TIME DELAY PICKUP RELAY
27X : AC DOUBLE POLE INSTANTANEOUS UNDER VOLTAGE RELAY
27K : DC INSTANTANEOUS UNDER VOLTAGE RELAY
59 : DC INSTANTANEOUS OVER VOLTAGE RELAY
96 : EARTH LEAKAGE RELAY
51V : THREE POLE VOLTAGE CONTROLLED DEFINITE TIME
      DELAY OVER CURRENT RELAY
87 : THREE POLE DIFFERENTIAL PROTECTION RELAY
95 : SINGLE POLE DEFINITE TIME OVER CURRENT
      RELAY , DG OVER LOAD RELAY

```

TB-3-595-510-021		SINGLE LINE DIAGRAM FOR 765/400 KV MEDINIPUR S/S.					
REF. DRG. NO.		TITLE					
NOA No. : MJLT/765kv/ERSS-XVIII/SS01/NOA-I/03(i) & NOA-II/03(ii) dated 29.09.2017							
		POWERGRID MEDINIPUR JEEAR TRANSMISSION LIMITED POWER GRID CORPORATION OF INDIA LIMITED					
ADDITIONAL INFORMATION H.O.No. : BTW003		SUBSTATION PACKAGE-SS01 FOR ESTABLISHMENT OF 765/400KV S/S AT MEDINIPUR & JEEAR (NEW) ASSOCIATED WITH TRANSMISSION SYSTEM PROJECT / 765KV STRENGTHENING IN EASTERN REGION (ERSS-XVIII)' UNDER TARIFF BASED COMPETITIVE BIDDING (TBCB) ROUTE.					
STATUS OF DRAWING		CONTRACT					
DISTRIBUTION OF PRINTS							
				भारत भारी इलेक्ट्रिकल्स लिमिटेड BIHAR HEAVY ELECTRICALS LTD. TRANSMISSION PROJECTS DIVISION		कक्षा / CLASS : पत्रांक / NO. : वर्ग / GRADE : प्रकार / TYPE : आयुष्य / AGE : डॉक्यूमेंट / DOCUMENT	
		रजिस्ट्रार / REGD. NO. : 422		NTS		पृष्ठ / PAGE : फोर्म / FORM : ड्राइंग नं./DRNG. NO. : शुद्ध/REV. : 01	
REV.	DATE	ALTERED BY	DESIGNED BY	CHECKED BY	TITLE		
01	16.03.18	APPROVED : MM	MM				
ZONE	DRG. REVISED AS PER POWERGRID COMMENTS DTD 25.01.18						
COMMENTS DTD 25.01.18							
FOR LT AC & DC SYSTEM AT MEDINIPUR					ड्राइंग नं./DRAWING NO. : TB-595-510-034 पत्रांक / SHEET NO. : 01		



Minimum initiative requirement of Analog signals, Potential Free contacts & Command signals which should be available at respective equipment for remote indication & control from Auxiliary B&B located in 5/s control room		
EQUIPMENT	ANALOG SIGNALS FOR REMOTE INDICATION	POTENTIAL FREE CONTACT FOR REMOTE INDICATION
DC SET		
DC Voltage 8 V		MAIN'S ON
DC Voltage 8 V		MAIN'S OFF
DC Voltage 8 V		Alternator ON
DC Current 1 A	Charge 100%	Charge 100%
DC Current 1 A	Charge 100%	Charge 100%
DC Current 1 A	Charge 100%	Charge 100%
DC Current 1 A	Charge 100%	Charge 100%
		MAIN 11.5 Supply ON/OFF
		MAIN 11.5 Supply ON/OFF
		Exhaust Over Heating
		Leak Oil Fuel
		Low Oil Pressure
		Hot Fuel To Start 30 Sec After Receiving 1st Start Signal
		High Cooling Water Temperature
		Low Level In Daily Service Fuel Tank
		Overvoltage Trip
		Alternator fault
		Breaker ON
		Breaker OFF



- LEGEND:-
- | | | |
|------|---|-------|
| 50N | : | INST. |
| 50 | : | TRIP |
| 51 | : | DOU |
| 50/2 | : | SING |
| | : | REL |
| 2 | : | TIME |
| 27X | : | AC D |
| 27 | : | DC I |
| 59 | : | DC I |
| 96 | : | EART |
| 51V | : | THRE |
| | : | DELA |
| 87 | : | THRE |
| 95 | : | SING |
| | : | REL |

1. NO 2G AIR SOURCE SHALL BE PARALLELED AT ANY STAGE
2. DG SET SHALL BE AUTO START TYPE
3. AIRCRAFT SHALL INTERLOCKED TO BE PROVIDED TO ENFORCE BREAKER OF DG SET WILL CLOSE ONLY WHEN SWITCHES 1 & 2 ARE OPEN
4. FOR COMPLETE DESCRIPTION OF EACH TYPE OF MODULE PL. REFER TECHNICAL SPECIFICATION
5. CABLE SIZES SHOWN ARE AS PER THE TECHNICAL SPECIFICATION.
6. SPECIFIC FEEDERS SHOWN ARE AS PER THE TECHNICAL SPECIFICATION. (SHOWN DOTTED) ARE INCLUDED SOURCE OF SUPPLY.
7. EACH BAY TRANSFORMER MB SHALL BE PROVIDED BY ATLEAST ONE SOURCE OF POWER. SECOND SOURCE SHALL BE LOOPEDED TO THE NEAREST PL. TRANSFORMER MB WHICH SHALL BE FED FROM ANOTHER SOURCE FROM 415V ACB BOARD.
8. FOR EACH AIRCRAFT CONTACTOR, THE FEEDER FOR ANALOGUE AND DIGITAL INPUT SHALL BE AN INTEGRAL PART OF LT/ACB BOARDS.
9. ONE DC "X" TYPE MODULE IN EACH 220V DCB SHALL BE PROVIDED FOR EACH LINE. TRANSFORMER MB SHALL BE PROVIDED FOR EACH DC-SECTION BAY FOR PRESENT & FUTURE BAYS AS SHOWN IN SUBSTATION SLID.
10. ONE DC "X" TYPE MODULE IN EACH 48V DCB SHALL BE PROVIDED FOR EACH LINE BAY FOR PRESENT & FUTURE BAYS AS SHOWN IN SUBSTATION SLID.
11. MODULE "X" REFERRED ABOVE, IS APPLICABLE WITH OF MCCB, MAXIMUM 2nos. OF DP, 2nos. OF MCCB AND 2nos. OF MCCB TO BE PROVIDED FOR EACH LINE BAY.
12. AE (800A, ACB) MODULE SHALL HAVE ONLY ACB WITHOUT SEPARATE PROTECTIVE RELAYS. HOWEVER, A/CB, RELAYS/CONTACTORS SHALL BE INCLUDED AS PER SCHEME REQUIREMENT.
13. ALL THE AIRCRAFT CONTACTORS SHALL BE PROVIDED WITH 2nos. OF MCCB TO BE PROVIDED FOR EACH LINE BAY.
14. GLAND PLATE SHALL BE OF NON METAGNIC WHEREAS SINGLE CORE POWER CABLE ARE OF METAGNIC.
15. BMB TO BMB INTERLOCKING WILL BE DONE BY 1 X 3,5c/7.0 SOURCE CABLE.
16. UNB SPECIFIED, SOURCE 1 WILL BE FED FROM BUS 1 AND SOURCE 2 FROM BUS 2. UNB SPECIFIED, SOURCE 1 WILL BE FED FROM BUS 1 AND SOURCE 2 FROM BUS 2.
17. RATING OF BUSBAR/FEDDER INDICATED IN THIS DRAWING ARE MIN. REQUIREMENT AND MAY BE INCREASED AS PER DETAILED ENGINEERING IT FOUND INADEQUATE WITH RESPECT TO OFFERED LOADS/STRESS.

[illegible]

SECTION - 2

MODEL TECHNICAL SPECIFICATION

SECTION: LT SWITCHGEAR

SECTION: LTSWITCHGEAR

Table of contents

Clause No.	Description	Page No.
1.1	CONSTRUCTIONAL DETAILS OF SWITCHBOARDS AND DISTRIBUTION BOARDS	1
1.2	DERATING OF EQUIPMENTS	4
1.3	POWER BUS BARS AND INSULATORS	4
1.4	EARTH BUS	4
1.5	AIR CIRCUIT BREAKERS	4
1.6	MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB	7
1.7	RELAYS	7
1.8	CONTACTORS	8
1.9	INSTRUMENT TRANSFORMERS	8
1.10	INDICATING INSTRUMENTS	9
1.11	CONTROL & SELECTOR SWITCHES	9
1.12	AIR BREAK SWITCHES	10
1.13	PUSH BUTTONS	10
1.14	INDICATING LAMPS	10
1.15	FUSES	11
1.16	TERMINAL BLOCKS	11
1.17	NAME PLATES AND LABELS	12
1.18	SPACE HEATER	12
1.19	CONTROL AND SECONDARY WIRING	12
1.20	POWER CABLES TERMINATION	13
1.21	TYPE TESTS	13
1.22	ERECTION, TESTING AND COMMISSIONING	13
1.23	COMMISSIONING CHECK TESTS	14
1.24	SPECIAL TOOLS AND TACKLES	16
1.25	EQUIPMENT TO BE FURNISHED	16
1.26	PARAMETERS	21
1.27	AUTOMATIC CONTROL OF OUTDOOR LIGHTING	25
1.28	AUTOMATIC SUPPLY CHANGEOVER	25
1.29	ANALOGUE INPUTS	26
1.30	DIGITAL (POTENTIAL FREE INPUTS)	26

SECTION: LT SWITCHGEAR

1.1. CONSTRUCTIONAL DETAILS OF SWITCHBOARDS AND DISTRIBUTION BOARDS

- 1.1.1. All boards shall be of metal enclosed, indoor floor mounted, compartmentalised double front construction and freestanding type.
- 1.1.2. All board frames, shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary. ***Gland plate shall be cold rolled sheet steel having thickness not less than 3 mm in all cases. However, in case of termination of single core power cables, gland plate shall be of non-magnetic material of at least 4mm thickness.***
- 1.1.3. All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.
- 1.1.4. The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.
- 1.1.5. All boards shall be of dust and vermin proof construction and shall be provided with a degree of protection of IP: 52, ***for category I enclosure*** as per IS 13947 (Part-1). However, the busbar chambers having a degree of protection of IP: 42, in accordance with IS 13947 (Part-1), are also acceptable where continuous busbar rating exceeds 1000 Amp. Provision shall be made in all ***draw out Air Circuit Breaker*** compartments for providing IP: 52 degree of protection, when Circuit breaker trolley, has been removed. ***Panels with lighting transformers shall have IP 31 degree of protection in accordance with IS 13947 (Part-1). Door frame of panels, meters, relays, Breaker cut-outs shall be provided with neoprene rubber gaskets generally conforming to Type-II, Class 2A as per IS: 11149.***
- 1.1.6. Provision of louvers on boards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating exceeds 1000 Amps. ***Panels with lighting transformers in lighting distribution boards shall have louvers.***
- 1.1.7. All boards shall be of uniform height not exceeding 2450 mm.
- 1.1.8. Boards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers ***of bus bar chambers.***

- 1.1.9. Boards shall be supplied with base frames made of structural steel sections, alongwith all necessary mounting hardware required for welding the base frames to the insert plates.
- 1.1.10. a) All boards shall be of double front construction and shall have :
- (i) A completely enclosed busbar compartment for running horizontal busbars and vertical busbars. Busbar chambers shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical busbars for repair and maintenance, which shall be feasible without disturbing feeder compartment. Vertical bus bar chambers shall be accessible from front as well as back side of the panel **and shall be of at least 350 mm width**. One set of vertical busbars shall be used in between two adjacent sections for switchgear connections. In case of ACB feeders, **the panel shall have single front without any vertical busbar chamber, however** vertical busbars **associated with ACBs shall be** located in rear side **and** shall be additionally covered with metallic perforated/ **transparent acrylic or polyvinyl** bolted sheets to avoid direct access after opening rear door of chamber.
 - (ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.
 - (iii) A distinct compartment or alley for power and control cables on each side of panel. Cable alley compartment shall have a through metallic partition for segregating cables on both sides. Cable alley door shall preferably be hinged. Cable alley shall have no exposed live parts. Any live terminals shall be fully shrouded/insulated from safety aspects. However, it shall be of atleast 350mm width.
 - (iv) A compartment for relays and other control devices associated with a circuit breaker.
- b) ***Lighting transformers shall be supplied in separate and distinct panel completely assembled for incoming cable connection from bottom and outgoing connection through busbar with adjacent associated lighting distribution board. Lighting transformers shall have provision of base channel with rollers for taking in and out from the panel in case of maintenance after disconnecting incoming and outgoing connections. Provision of single phase fans at least two (2) numbers of suitable ratings shall be made in the panel for ventilation. These fans shall run in sequential mode at suitable time interval to be controlled by thermostat and timer. The offered design of panel should be such that in no case, temperature rise of lighting transformers shall exceed the permissible limits for the class of insulation of lighting transformer.***
- 1.1.11. Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. Each shipping section shall have full metal sheets at both ends for transport and storage.
- 1.1.12. All equipments associated with a single circuit except MCB circuits shall be housed in a separate compartment of the vertical section. The Compartment shall be sheet steel enclosed on all sides with the withdrawal units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities. In case of circuits controlled by MCBs, group of MCB feeders can be offered in common compartment. In such case number of MCB feeder to be used in a common compartment shall not exceed 4 (four) and front of MCB compartment, shall have a viewing port of

toughen glass sheet for viewing and sheet steel door of module shall be lockable with star knob/panel key.

- 1.1.13. After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.
- 1.1.14. The minimum clearance in air between phases and between phase and earth for the entire run of horizontal and vertical busbars, shall be 25 mm. For all other components, the clearance between "two live parts", "A live part and an earthed part" and isolating distance shall be atleast ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal run of busbar minimum clearance of 25 mm should be maintained even if they are sleeved.
- 1.1.15. The temperature rise of horizontal & vertical busbars when carrying rated current along its full run shall in no case exceed 55°C, with silver plated joints and 40°C with all other type of joints over an outside ambient temperature of 50°C.
- 1.1.16. All busbar chambers shall be provided with removable bolted covers . The covers shall be provided with danger labels.
- 1.1.17. All identical circuit breakers and module chassis of same test size shall be fully interchangeable without having to carryout modifications.
- 1.1.18. All Circuit breaker boards shall be of Single Front type, with fully drawout circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position.
- 1.1.19. Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.
- 1.1.20. All disconnecting contacts for power circuits shall be of robust design and fully self aligning. Fixed and moving contacts of the power drawout contact system shall be silver plated. Both fixed and moving contacts shall be replaceable.
- 1.1.21. All AC & DC boards shall be of double Front type.
- 1.1.22. All module shall be fixed type except air circuit breaker module, which shall be drawout type.
- 1.1.23. The connections from busbars to the main switch shall be fully insulated/shrouded, and securely bolted. The partition between the feeder compartment and cable alley may be non-metallic and shall be of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.
- 1.1.24. All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to PURCHASER approval. Bidder shall submit dimensional drawings showing complete internal details of Busbars and module components, for each type and rating for approval.

- 1.1.25. The tentative power and control cable entries shall be from bottom. However, Purchaser reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implication.
- 1.1.26. Adopter panels and dummy panels required to meet the various busbar arrangements and layouts required shall be included in Bidder's scope of work.

1.2. **DERATING OF EQUIPMENTS**

- 1.2.1. The current ratings of all equipments as specified in the *Single Line Diagram For AC & DC System* are the minimum standards current ratings at a reference ambient temperature as per relevant Indian Standards.

1.3. **POWER BUS BARS AND INSULATORS**

- 1.3.1. All AC Distribution Boards shall be provided with three phase buses and a neutral bus bars and the DC Distribution Boards shall be provided with two busbars.
- 1.3.2. All busbars and jumper connections shall be of high conductivity aluminium/copper of adequate size.
- 1.3.3. The Cross-Section of the busbars shall be uniform through out the length of Switchgear and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.
- 1.3.4. All busbars shall be adequately supported by *adequate numbers of* high strength type Polyester fibre glass Moulded Insulators *to withstand short circuit withstand capability of panel*. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided anti-tracking barriers shall be provided between the supports.
- 1.3.5. All busbars joints shall be provided with high tensile steel bolts. Belleville/spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated Busbars joints shall be thoroughly cleaned at the joint locations and a suitable contact grease shall be applied just before making a joint.
- 1.3.6. All busbars shall be colour coded as per IS: 11353-1985: *Guide for Uniform System of Marking and Identification of Conductors and Apparatus Terminals*.
- 1.3.7. The Bidder shall furnish calculations, establishing the adequacy of busbar sizes for specified current ratings, On the basis of short circuit current and temperature rise consideration at specified ambient temp.

1.4. **EARTH BUS**

- 1.4.1. A galvanised steel earthing shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded/bolted to the frame work of each panel and breaker earthing contact bar vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus.
- 1.4.2. The earth bus shall have sufficient cross-section to carry the momentary short circuit and short time fault currents to earth without exceeding the allowable temperature rise.

- 1.4.3. Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Purchaser's earthing conductors. The horizontal earth bus shall project out the switchboard ends and shall have predrilled holes for this connection. A joint spaced and taps to earth bus shall be made through at least two bolts.
- 1.4.4. All non-current metal work of the Switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosures frame work and the truck shall be maintained even after painting.
- 1.4.5. The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions. SERVICES & ISOLATED, as well as through out the intermediate travel.
- 1.4.6. **Air Circuit Breaker (ACB)** module frame shall get engaged to the vertical earth bus, before the disconnecting contacts on these module are engaged to the vertical busbar.
- 1.4.7. All metallic cases of relays, instruments and other panel mounted equipments shall be connected to earth by independent stranded copper wires of size not less than 2.5 mm². Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering is not acceptable. Looping of earth Connection which would result in loss of earth connection to the devices when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths or earth bus is acceptable.
- 1.4.8. VT and CT secondary neutral point earthing shall be at one place only, on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.
- 1.4.9. All hinged doors shall be earthed through flexible earthing braid.
- 1.4.10. Caution nameplate 'Caution-Live Terminals' shall be provided at all points where the terminals are like to remain live and isolation is possible only at remote end.
- 1.5. **AIR CIRCUIT BREAKERS**
 - 1.5.1. Circuit breakers shall be three-pole air break horizontal drawout type and shall have inherent fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable.
 - 1.5.2. Circuit breakers shall be mounted along with it operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimise misalignment of the breaker.
 - 1.5.3. 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 energising the power circuits i.e. the power Contacts shall be disconnected while the Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the 'SERVICE', 'TEST' OR FULLY WITHDRAWN' position. It shall be possible to close the door in TEST position.
 - 1.5.4. All circuit breakers shall be provided with 4 NO and 4 NC potentially free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be

provided in both 'SERVICE' & 'TEST' position of the breaker. All contacts shall be rated for making continuously carrying and breaking 10 Amps at 240V AC and 1 Amp (Inductive) at 220V DC.

- 1.5.5. Suitable mechanical indications shall be provided on all circuit breakers to show 'OPEN', 'CLOSE', 'SERVICE', 'TEST' and 'SPRING CHARGED' positions.
- 1.5.6. Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half cycle of rated frequency.
- 1.5.7. All circuit breakers shall be provided with the interlocks as explained in further clauses.
- 1.5.8. Movement of a circuit breaker between SERVICE AND TEST positions shall not be possible unless it is in OPEN position. Attempted with drawl of a closed circuit breaker shall trip the circuit breaker.
- 1.5.9. Closing of a circuit breaker shall not be possible unless it is in SERVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.
- 1.5.10. 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.
- 1.5.11. A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.
- 1.5.12. Circuit breakers shall be provided with electrical anti-pumping and trip free feature, even if mechanical antipumping feature is provided.
- 1.5.13. Mechanical tripping shall be possible by means of front mounted RED 'Trip' push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.
- 1.5.14. Breaker controlled motors shall operate satisfactorily under the following conditions:
 - (i) Direct on-line starting of Induction Motors rated 110 kW to 220 kW with a locked rotor current of seven times the rated current, and starting time of up to 30 seconds.
 - (ii) Breaking on-load, full load and locked rotor currents of Induction Motors for rated 100 kW to 220 kW.
- 1.5.15. Means shall be provided to slowly close the circuit breaker in withdrawn position. If required for inspection and setting of Contacts, in service position slow closing shall not be possible.
- 1.5.16. Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC Control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class 'E' or better.
- 1.5.17. The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring.

- 1.5.18. Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.
- 1.5.19. The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.
- 1.5.20. Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.
- 1.5.21. All circuit breakers shall be provided with closing and trip coils. The closing coils shall operate correctly at all values of Voltage between 85% to 110% at rated control voltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.
- 1.5.22. Provision for mechanical closing of the breaker only in 'TEST' and 'WITHDRAWN' positions shall be made.
- 1.5.23. **PROTECTION CO-ORDINATION**
- 1.5.23.1. It shall be the responsibility of the Contractor to fully co-ordinate the overload and short circuit tripping of the circuit breakers with the upstream and down stream circuit breakers/fuses/motor starters, to provide satisfactory discrimination.
- 1.6. **MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB**
- 1.6.1. MCCB shall in general conform to IS: 13947 Part-2. All MCCB *offered* shall *have Ics = 100% Icu rating. Type test reports for offered model of MCCB shall be submitted during detailed engineering for owner's acceptance.*
- 1.6.2. MCCB shall be flush mounted on the AC/DC distribution boards *and shall have extended handle.*
- 1.6.3. MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The setting of the thermal release shall be adjustable between 80% to 100% of the rated current. The MCCB shall have breaking capacity not less than 20kA.
- 1.6.4. MCCBs used for ACDB incomers and Bus coupler shall be equipped with stored energy mechanism for electrical closing and tripping. All other MCCBs shall be manually operated. The operating handle should give a clear trip indication.
- 1.6.5. Miniature circuit breaker (MCB) shall conform to IEC: 898-1987 and IS: 8828.
- 1.7 **RELAYS**
- 1.7.1. All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-drawout cases.

- 1.7.2 All AC relays shall be suitable for operation, at 50 Hz with 110 volts VT secondary and 1 amp or 5 amp CT secondary.
- 1.7.3 All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.
- 1.7.4 All protective relays auxiliary relays and timers shall be provided with hand reset operation indicators (Flags) for analysing the cause of operation.
- 1.7.5 All relays shall withstand a test voltage of 2 KV (rms) for one minute.
- 1.7.6 Motor starters shall be provided with three element, ambient temperature compensated, time lagged, hand reset type overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relays shall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.
- 1.7.7 All fuse-protected contactor-controlled motors shall have single phasing protection, either as a distinct feature in the overload relays (by differential movement of bimetallic strips), or as a separate device. The single phasing protection shall operate even with 80% of the set current flowing in two of the phases.
- 1.8 CONTACTORS**
- 1.8.1 Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IS:13947 (Part 4).
- 1.8.2 Contactors shall be double break, non-gravity type and their main contacts shall be silver faced.
- 1.8.3 Direct on line starter contactors shall be of utilisation category AC2. These contactors shall be as per IS:13947 (Part 4).
- 1.8.4 Each contactor shall be provided with two (2) normally open (NO) and two (2) normally close (NC) auxiliary contacts.
- 1.8.5 Operating coils of contactors shall be of 240V AC Unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall drop out at 70% of the rated voltage.
- 1.9 INSTRUMENT TRANSFORMERS**
- 1.9.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the outside ambient temperature is 50°C.
- 1.9.2 All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.

1.9.3 All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

1.9.4 Current transformers may be multi or single core type. All voltage transformers shall be single phase type. The Bus VTs shall be housed in a separate compartment.

1.9.5 All VTs shall have readily accessible **MCBs** on both primary and secondary sides.

1.10 **INDICATING INSTRUMENTS**

1.10.1 All indicating and integrating meters shall be flush mounted on panel front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall have an accuracy class of 2.5 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

1.10.2 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for zero adjustment without removing or dismantling the instruments.

1.10.3 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

1.10.4 Ammeters provided on Motor feeders shall have a compressed scale at the upper current region to cover the starting current.

1.10.5 Watt-hour meters shall be of 3 phase three element type, Maximum demand indicators need not be provided.

1.11 **CONTROL & SELECTOR SWITCHES**

1.11.1 Control & Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred.

1.11.2 Circuit breaker selector switches for breaker Controlled motor shall have three stay put positions marked 'Switchgear', 'Normal' and 'Trial' respectively. They shall have two contacts of each of the three positions and shall have black shade handles.

1.11.3 Ammeter and voltmeter selector switches shall have four stayput position with adequate number of contacts for three phase 4 wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.

1.11.4 Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.

1.11.5 The contact ratings shall be at least the following :

- | | | |
|-------|-----------------------------|---------------------------|
| (i) | Make and carry continuously | 10 Amp. |
| (ii) | Breaking current at 220V DC | 1 Amp (Inductive) |
| (iii) | Breaking current at 240V AC | 5 Amp (at 0.3 pf lagging) |

1.12 AIR BREAK SWITCHES

- 1.12.1 Air breaker switch shall be of the heavy duty, single throw group operated, load break, fault make type complying with IS:13947, **Part-3**.
- 1.12.2 The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such as overload, locked motor, short circuit etc.
- 1.12.3 Switch operating handles shall be provided with padlocking facilities to lock them in 'OFF' position.
- 1.12.4 Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in 'OFF' position and to close the switch only when the door is closed. However suitable means shall be provided to intentionally defeat the interlocks explained above.
- 1.12.5 Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

1.13 PUSH BUTTONS

- 1.13.1 Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.
- 1.13.2 All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.
- 1.13.3 All push-buttons shall be provided with integral escutcheon plates marked with its function.
- 1.13.4 The colour of the button shall be as follows :
- | | | | |
|-------|-------|---|--------------------------------|
| (i) | GREEN | : | For motor START, Breaker CLOSE |
| (ii) | RED | : | For motor TRIP, Breaker OPEN |
| (iii) | BLACK | : | For overload reset. |
- 1.13.5 All push-buttons on panels shall be located in such a way that Red-push-buttons shall always be to the left of green push-buttons.

1.14 INDICATING LAMPS

- 1.14.1 Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.
- 1.14.2 Lamps shall have translucent lamp-covers of the following colours, as warranted by the application :
- | | | | |
|-------|-------|---|---|
| (i) | RED | : | For motor ON, Breaker CLOSED |
| (ii) | GREEN | : | For motor OFF, Breaker OPEN |
| (iii) | WHITE | : | For motor Auto-Trip |
| (iv) | BLUE | : | For all healthy conditions (e.g. control supply, and also for 'SPRING CHARGED') |

- (v) AMBER : For all alarm conditions (e.g. overload) Also for 'SERVICE' and 'TEST' positions indicators.

- 1.14.3 Lamps shall be easily replaceable from the front of the cubicle.
- 1.14.4 Indication lamps should be located just above the associated push buttons/control switches. Red lamps shall invariable be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and Amber lamps should normally be located above the Red and Green lamps.
- 1.14.5 When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button. All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

1.15 FUSES

- 1.15.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC Circuits shall be of class 2 type, 20 kA (RMS) breaking current at 415 AC, and for DC circuits Class 1 type 4 kA breaking current.
- 1.15.2 Fuses shall have visible operation indicators.
- 1.15.3 Fuses shall be mounted on fuses carriers, which are mounted on fuse bases, wherever it is not possible to mount fuses on carriers fuses shall be directly mounted on plug in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.
- 1.15.4 Fuse rating shall be chosen by the Bidder depending upon the circuit requirements and these shall be subject to approval of PURCHASER.

1.16 TERMINAL BLOCKS

- 1.16.1 Terminal blocks shall be of 750 volts grade and have continuous rating to carry the maximum expected current on the terminals. It shall be complete with insulating barriers, clip-on-type/stud type terminals for Control Cables and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to 'ELEMEX' standard type terminals, cage clamp type of Phoenix or WAGO or equivalent
- 1.16.2 Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities. It shall be similar to 'Elem.' 'CATD' - Type.
- 1.16.3 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also be available.
- 1.16.4 All terminal blocks shall be suitable for terminating on each side, two (2) Nos. of 2.5 mm square size standard copper conductors.
- 1.16.5 All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.

- 1.16.6 Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.
- 1.16.7 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.
- 1.17 **NAME PLATES AND LABELS**
- 1.17.1 All switchgears, AC/DC distribution boards, shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.
- 1.17.2 All name plates shall be of non-rusting metal or 3-ply lamicaid with white engraved lettering on black back ground. Inscriptions and lettering sizes shall be subject to PURCHASER approval.
- 1.17.3 Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so as to be clearly visible and shall give the device number as mentioned in the module wiring drawings.
- 1.18 **SPACE HEATER**
- 1.18.1 Space heater shall be provided in all the boards for preventing harmful moisture condensation.
- 1.18.2 The space heaters shall be suitable for continuous operation on 240V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.
- 1.19 **CONTROL AND SECONDARY WIRING**
- 1.19.1 All switchboards shall be supplied completely wired internally upto the terminal blocks ready to receive Purchaser's control cables.
- 1.19.2 All inter cubicle and inter panel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the bidder.
- 1.19.3 All internal wiring shall be carried out with 1100 V grade, single core, 1.5 square mm or larger stranded copper wires having colour coded, PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires. Voltage grade and insulation shall be same as above.
- 1.19.4 Extra-flexible wires shall be used for wiring to device mounted on moving parts such as hinged doors.
- 1.19.5 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminals blocks.
- 1.20 **POWER CABLES TERMINATION**

- 1.20.1 Cable termination compartment and arrangement for power cables shall be suitable for stranded aluminium conductor, armoured XLPE/PVC insulated and sheathed, single core/three core, 1100 V grade cables.
- 1.20.2 All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc. shall be provided by the successful bidder, to suit the final cable sizes which would be advised later.
- 1.20.3 The gland plate shall be of removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable glands. For all single core cables, gland plates shall be of non-magnetic Material.
- 1.21 **TYPE TESTS**
- 1.21.1 Type tests reports on Panels (Switchgear and Control gear assemblies) as per IS 8623 Part-I shall be submitted for the following tests in line with clause 9.0 of Section GTR :
- i) Verification of temperature rise limits
 - ii) Verification of the dielectric properties
 - iii) Verification of short circuit strength
 - iv) Verification of the continuity of the protective circuit
 - v) Verification of clearances and creepage distances
 - vi) Verification of mechanical operation
 - vii) Verification of degree of protection
- 1.21.2 Contractor shall submit type test reports for the following Switchgear and Control gears before the fabrication of switchgear is started:
1. Circuit breakers/MCCB as per IS 13947 Part-II
 2. Protective Relays as per IEC: 60255.
 3. ***Lighting transformers as per IS:2026***
- For above equipments, test conducted once are acceptable (i.e. The requirement of test conducted within last ***ten*** years shall not be applicable)
- 1.22 **ERECTION, TESTING AND COMMISSIONING**
- 1.22.1 The Contractor shall unload, erect, install, test and put into commercial use all electrical equipment included in this specification.
- 1.22.2 Equipment shall be installed in a neat, workman like manner so that it is level, plumb, square and properly aligned and oriented. Tolerance shall be as established in Contractor's drawings or as stipulated by purchaser. No equipment shall be permanently bolted down to foundations until the alignment has been checked and found acceptable by the purchaser.
- 1.22.3 Contractor shall furnish all supervision, labour tools equipment rigging materials, bolts, wedges, anchors, concrete inserts etc. in proper time required to completely install, test and commission the equipment.
- 1.22.4 Manufacturer's and purchaser's instructions and recommendations shall be correctly followed in handling, setting, testing and commissioning of all equipment.

- 1.22.5 Contractor shall move all equipment into the respective room through the regular door or openings specifically provided for this purpose. No part of the structure shall be utilised to lift or erect any equipment without prior permission of Purchaser.
- 1.22.6 All boards shall be installed in accordance with *relevant code of practices* and at Purchaser's instructions. All boards shall be installed on finished surfaces, concrete or steel stills. Contractor shall be required to install and align any channel sills which form part of foundations. In joining shipping sections of switchboards together adjacent housing of panel sections or flanged throat sections shall be bolted together after alignment has been completed. Power bus, enclosures ground and control splices of conventional nature shall be cleaned and bolted together being drawn up with torque spanner of proper size or by other approved means.
- 1.22.7 All boards shall be made completely vermin proof.
- 1.22.8 Contractor shall take utmost care in holding instruments, relaying and other delicate mechanism wherever the instruments and relays are supplied separately they shall be mentioned only after the associated panels have been erected and aligned. The packing materials employed for safe transit of instrument and relays shall be removed after ensuring that panel have been completely installed and to further movement of the same should be necessary. Any damage shall be immediately reported to Purchaser.
- 1.22.9 Equipment furnished with finished coats of paint shall be touched by up Contractor if their surface is specified or marred while handling.
- 1.22.10 After installation of panels, power and control wiring and connections, Contractor shall perform operational tests on all switchboards, to verify proper operation of switchboards/panels and correctness of all equipment in each and every respect. The cable opening and cables entries for cables terminating to the panels shall be sealed with fire sealing materials.
- 1.23 **COMMISSIONING CHECK TESTS**
- The Contractor shall carry out the following commissioning checks, in addition to the other checks and tests recommended by the manufacturers.
- 1.23.1 **General**
- 1.23.1.1 Check name plate details according to the specification.
- 1.23.1.2 check for physical damage.
- 1.23.1.3 Check tightness of all bolts, clamps, joints connecting terminals.
- 1.23.1.4 Check earth connection.
- 1.23.1.5 Check cleanliness of insulators and bushings.
- 1.23.1.6 Check all moving parts for proper lubrication.
- 1.23.1.7 Check settings of all the relays.

1.23.2 **Circuit Breakers**

- 1.23.2.1 Check alignment of breaker truck for free movement.
- 1.23.2.2 Check correct operation of shutters.
- 1.23.2.3 Check control wiring for correctness of connections, continuity and IR values.
- 1.23.2.4 Manual operation of breaker completely assembled.
- 1.23.2.5 Power closing/opening operation, manually and electrically.
- 1.23.2.6 Breaker closing and tripping time.
- 1.23.2.7 Trip free and anti-pumping operation.
- 1.23.2.8 IR values, minimum pick up voltage and resistance of coils.
- 1.23.2.9 Contact resistance
- 1.23.2.10 Simultaneous closing of all the three phases.
- 1.23.2.11 Check electrical & mechanical interlocks provided.
- 1.23.2.12 Check on spring charging motor, correct operation of limit switches, and time of charging.
- 1.23.2.13 All functional checks.
- 1.23.3 **Current Transformers**
- 1.23.3.1 Megger between winding and winding terminals to body.
- 1.23.3.2 Polarity test
- 1.23.3.3 Ratio identification checking of all ratios on all cores by primary injection of current.
- 1.23.3.4 Spare CT cores, if available, to be shorted and earthed.
- 1.23.4 **Voltage Transformer**
- 1.23.4.1 Insulation resistance test
- 1.23.4.2 Ratio test on all cores.
- 1.23.4.3 Polarity test.
- 1.23.4.4 Line connections as per connection diagram.
- 1.23.5 **Cubicle Wiring**
- 1.23.5.1 Check all switch developments.
- 1.23.5.2 Each wire shall be traced by continuity tests and it should be made sure that the wiring is as per relevant drawing. All interconnections between panels/equipment shall be similarly checked.

- 1.23.5.3 All the wires shall be meggered to earth.
- 1.23.5.4 Functional checking of all control circuit e.g. closing, tripping control, interlock, supervision and alarm circuit.
- 1.23.6 **Relays**
 - 1.23.6.1 Check connections and wiring.
 - 1.23.6.2 Megger all terminals to body.
 - 1.23.6.3 Megger AC to DC terminals.
 - 1.23.6.4 Check operating characteristics by secondary injection.
 - 1.23.6.5 Check minimum pick up voltage of DC coils.
 - 1.23.6.6 Check operation of electrical/mechanical targets.
 - 1.23.6.7 Relays settings.
 - 1.23.6.8 Check CT and VT connections with particular reference to their polarities for directional relays, wherever required.
- 1.23.7 **Meters**
 - 1.23.7.1 Check calibration by comparing it with a sub-standard.
 - 1.23.7.2 Megger all insulated portions.
 - 1.23.7.3 Check CT and VT connections with particular reference to their polarities for power type meters.
- 1.24 **SPECIAL TOOLS AND TACKLES**
 - 1.24.1 The Bidder shall include in his proposal any special tools and tackles required for erection, testing commissioning and maintenance of the equipments offered.
 - 1.24.2 The list of these special tools and tackles shall be given in the bid proposal sheets alongwith their respective prices.
 - 1.24.3 The total price of the special tools and tackles shall be included in proposal sheets.
- 1.25 **EQUIPMENT TO BE FURNISHED**
 - 1.25.1 The Bidder shall quote for various AC/DC distribution boards in accordance with this specification.
 - 1.25.2 Standard scheme of interconnection of switchboards and distribution boards alongwith tentative feeder disposition for each board is indicated in Standard SLD of AC & DC system enclosed alongwith bid documents. The bidder shall quote board prices on the basis of standard SLD and their estimation of feeders for entire present and future bays

requirement. Any other feeder required as per system requirement for efficient and reliable operation shall be deemed to be included in bidder's scope.

1.25.3 The Bill of Materials for each type of module shall be as under. These are minimum indicative requirement of the system. The necessary auxiliary relays, push buttons and indicating lamps shall be provided as per scheme requirement. Any other item/component required with in a module for efficient and reliable operation shall be deemed to be included in bidder's scope.

1.25.4 Module Type AE (Electrically controlled circuit breaker for incoming and Bus Coupler Circuit).

- (i) One (1) Triple pole air circuit breaker complete with all accessories and power operated mechanism as specified.
- (ii) Two (2) Neutral link.
- (iii) Three (3) Current Transformer for metering.
- (iv) One (1) Ammeter with selector switch.
- (v) Three (3) Current Transformer for relaying.
- (vi) One (1) Triple pole instantaneous over-current relay having the setting range of 200-800% or 500-2000% of CT secondary and adjustable definite minimum time.
- (vii) One (1) Instantaneous earth fault relay having an adjustable setting range of 10-40% or 20 - 80% of CT secondary current and adjustable definite minimum time. The earth fault relay shall be provided with a stabilising resistor.
- (viii) *One(1) set Current and Voltage transducers.*
- (ix) *One(1) set High speed tripping relays.*

1.25.5 **Module Type - M1 (Circuit Breaker Controlled Motor Feeder)**

- (i) One (1) Triple pole Air Circuit Breaker complete with accessories, and power operated mechanism as specified.
- (ii) One (1) Three position 6 pole selector switch
'SWITCHGEAR/NORMAL /TRIAL'.
- (iii) Three (3) Current Transformer for metering.
- (iv) One (1) Ammeter with Ammeter Selector Switch
- (v) Three (3) Current Transformer for relaying.
- (vi) One (1) Triple pole instantaneous over-current relay for providing positive sequence current protection in all the three phases. The relay setting range shall be continuously adjustable between 200-800% or 400-1600% of CT secondary rated current as required.

- (vii) One (1) Double pole inverse definite minimum time over current relays connected in R & B phases for over current protection of motor rated 110 kW - 200 kW. The relay shall have an adjustable setting range of 50% - 200% of CT Secondary current and time setting range of 0-30 Second. The relay shall be CDGM-22 of EE or equivalent.
- (viii) One (1) Single pole adjustable definite time delay relay for motor overload alarm connected in Y-phase only. The relay shall have resetting ratio of not less than 90%. The relay shall have continuously adjustable time delay range of 2.5 to 25 Sec.
- (ix) One (1) Instantaneous earth fault relay having an adjustable setting range of 10-40% or 20-80% of CT secondary current. The earth fault relay shall be provided with a stabilising resistor.
- (x) *One(1) set* **Current and Voltage transducers.**
- (xi) *One(1) set* **High speed tripping relay.**

1.25.6 **Module Type E**

- (i) One (1) Four pole MCCB

1.25.7 **Module G-1 (VT Module with under Voltage Relay)**

- (i) Three (3) $\frac{415}{\sqrt{3}} / \frac{110}{\sqrt{3}}$ volts single phase voltage transformer star/star connect with star point solidly earthed mounted on common draw out chassis. Accuracy Class 0.5 for protection and metering with 50VA Burden.
- (ii) Six (6) HRC Fuses mounted on the above chassis.
- (iii) One (1) Four position voltmeter selector switch.
- (iv) One (1) Voltmeter (0-500V)
- (v) One (1) Double pole instantaneous under voltage relays with continuous variable setting range of 40-80% of 110 Volts.
- (vi) One (1) Time delay pick up relay having a time setting range of 0.5 to 3 secs. with 3 'NO'. Self reset contacts, suitable for 220V DC.
- (vii) One (1) Auxiliary relay 220V DC with 2 NO. self reset contacts.
- (viii) Three (3) Indicating lamps with series resistor and colour lenses (Red, Blue & Yellow).

1.25.8 **Module Type G-2**

- (i) Three (3) HRC Fuse
- (ii) One (1) Voltmeter (0-500V)
- (iii) One (1) Voltmeter selector switch four position (R-Y, Y-B, B-R OFF).
- (iv) Three (3) Indication lamps (Red, Blue & Yellow)

1.25.9 Module Type H & H (BC) (Isolating Switch Controlled Incoming Circuit)

- (i) One (1) Four pole MCCB
- (ii) One (1) Red Indicating lamp to indicate isolating switch closed position.

1.25.10 Module Type S : (DC Metering and Protection Module)

- (i) One (1) Voltmeter 300-0-300V DC for 220V DC DB/Voltmeter 0-75V DC for 50V DCDB
- (ii) One (1) Three (3) position voltmeter selector switch
- (iii) One (1) Instantaneous under voltage relay with 95% of 220V DC. The resetting ratio of relay of relay should not be more than 1.25. The relay shall be provided with a series resistor and a push button across if for resetting (pick up) the relay at about 105% of the drop out voltage.
- (iv) One (1) Instantaneous over voltage relay with setting range of 110% of 220V DC. The resetting ratio of relay should not be less than 0.8. The relay shall have a push button in series of resetting the relay at about 95% of the operating voltage.
- (v) One (1) Earth leakage relay only for 220V DC system having adjustable pick up range between 3 to 7 milliamps the relay shall be suitable for 220V DC/240V AC Auxiliary supply.

1.25.11 Module Type X

- One (1) Double pole 250 V MCB

1.25.12 Module Type-DC (Incomer from Battery & Chargers)

- (i) One (1) Double pole 250V DC MCCB for incomer from Battery.
- (ii) One (1) DC ammeter with shunt and range of 90-0-400 Amps. For 220V DC DB and 90-0-200 Amp for 50V DC DB.
- (iii) Two (2) Double pole 250V DC MCCB/MCB
- (iv) One (1) Double pole single throw 250V DC air break switch connecting battery & charger sections to DC DB.

(v) *One(1) set Voltage and Current Transducers*

1.25.13 **Module Type DG-1 (Electrically Controlled Circuit Breaker for Incomer from DG Set)**

- a) One (1) Triple pole circuit breaker complete with all accessories and power operated mechanism as specified.
- b) One (1) Frequency meter.
- c) One (1) Voltmeter with selector switch.
- d) One (1) Remote/Local Selector switch.
- e) Three (3) Current transformer for metering.
- f) Six (6) Current Transformers for differential protection (out of this 3 Nos. will be supplied loose for mounting in DG set panel).
- g) Three (3) Current transformer for relaying.
- h) One (1) Ammeter Selector Switch.
- i) One (1) Ammeter
- j) One (1) Wattmeter of range 0-300 KW.
- k) One (1) Three pole voltage controlled definite time delay relay having current setting range of 50-200% of CT secondary current and adjustable time delay 0.3 to 3 secs.
- l) One (1) Watt hour meter with six (6) digits and minimum count of one (1) kwh.
- m) One (1) Single pole definite time over current relay having a continuous setting range of 50-200% of CT secondary current and a time delay of 2.5-25 secs connected in CT of Y phase for overload alarm. The relay shall have a setting ratio of not less than 90%.
- n) One (1) Three pole differential protection relay having an operating current setting range of 10-40% of generator full load current. The relay shall be of high impedance type, with necessary stabilizing resistors.
- o) Two (2) Push buttons for Remote starting & stopping of DG Set (Red, Green).
- p) *One(1) set Current and Voltage transducers.*
- q) *One(1) set High speed tripping relays.*

1.25.14 **Module Type H1**

One (1) Double pole DC Switch with pad locking facility in off position.

1.25.15 **Module Type EL**

(i) One (1) Four pole MCCB

(ii) One (1) Contactor

(iii) Electronic Timer suitable for continuous operation, push button and selector switch be as per scheme requirement

1.26 **PARAMETERS**

1.26.1 **Power Supply**

1.26.1.1 AC System 3 phase, 4 wire, solidly earthed

a) Voltage 415 Volts, $\pm 10\%$

b) Frequency 50 Hz $\pm 5\%$

c) Combined variation $\pm 10\%$ Absolute Sum
in Voltage & frequency

d) Fault Level 20 kA (rms)

1.26.1.2 **DC System** 2 Wire, unearthed

a) System voltage 220V $\pm 10\%$

b) Fault Level 4 kA

c) System Voltage **48 V** $\pm 10\%$

d) Fault Level --

1.26.2 **Control Supply Voltage**

a) Trip and closing coils 220V DC Unearthed

b) Spring charging 220V DC Unearthed

1.26.3 **Cubicle Data**

1.26.3.1 **Busbar Rating**

a) Continuous As specified in *Standard SLD*

for Vertical panels. *For AC & DC system.*

- | | | |
|----|---|------------------|
| b) | Short time (1 sec.
kA (rms)) | 20 kA |
| c) | Momentary (kA)
PEAK | 45 kA |
| d) | Ambient Temperature | 50°C |
| e) | One Minute Power Frequency Withstand | |
| | I. Power Circuit | 2500 Volts (rms) |
| | II. Control Circuit | 2500 Volts (rms) |

1.26.3.2 Cubicle Colour Finish

- | | | |
|----|----------|---------------------------------|
| a) | Interior | Smoke Grey shade No.692 of IS:5 |
| b) | Exterior | Smoke Grey shade No.692 of IS:5 |

1.26.4 Circuit Breaker

- | | | |
|----|---|---|
| a) | Type | Air Break |
| b) | No. of poles | 3 |
| c) | Voltage & Frequency | 415 ± 10%, 50 HZ + 5% |
| d) | Rated Operating Duty | As per IS |
| e) | Rated service short-circuit
Breaking capacity (Ics) | 20 kA (RMS) |
| f) | Short Circuit
making current | 45 kA (Peak) |
| g) | Short time withstand
current for 1 sec.
duration. | 20 kA (RMS) for 1 sec. |
| h) | Operating Mechanism
current for 1 sec.
duration. | 20 kA (RMS) for 1 sec. |
| i) | No. of auxiliary
contacts | 4 NO & 4 NC contacts for Purchaser's
use on fixed portion of the cubicle |
| j) | Short Circuit
breaking current | |
| | I. AC Component | 20 kA (RMS) |
| | II. DC Component | As per IS: 13947 (Part 2) |

1.26.5

MOULDED CASE CIRCUIT BREAKER

	AC System	DC System
a) No. of poles	4	2
b) Voltage & Frequency	415 $\pm$ 10%, 50 HZ $\pm$ 5%	250V
c) Rated Operating Duty	As per IS	
d) Rated service short-circuit Breaking capacity (Ics)	20 kA (RMS)	4 kA
e) Short Circuit making current	45 kA (Peak)	-
f) No. of auxiliary Contacts (<i>only for incomer And bus-coupler MCCBs</i>)	1 NO & 1 NC	1 NO & 1 NC
g) <i>Rated Ultimate Short Circuit breaking capacity</i>		
I. AC Component	20 kA (RMS)	As per IS
II. DC Component	As per IS 13947	As per IS 13947

1.26.6

Meters

a) Accuracy class	2.5
b) One minute power frequency withstand test voltage in KV	2.0

1.26.7

Current Transformers

a) Type	Cast resin, Bar primary
b) Voltage class and frequency	650V, 50 Hz
c) Class of Insulation	E or better
d) Accuracy class metering CT	Class 1, VA adequate for application but not less than 7.5 VA.
e) Accuracy class protection CT	5 P 15, VA adequate for application, but not less than 7.5 VA.
f) Accuracy class differential protection	PS, KPV = 300V

- g) Short Time Current Rating
(for CTs Associated with
circuit breakers)
- | | | |
|------|--|--------------|
| I. | Current | 20 kA (RMS) |
| II. | Duration | One Second |
| III. | Dynamic Rating | 45 kA (Peak) |
| IV. | One minute power
frequency withstand
test voltage. | 2.5 kV (rms) |

1.26.8 Voltage Transformer

- | | | |
|----|--|-----------------------------------|
| a) | Type | Cast Resin |
| b) | Rated Voltage | |
| | Primary | 415/ $\sqrt{3}$ V |
| | Secondary | 110/ $\sqrt{3}$ V |
| c) | Method of connection | |
| | Primary | Star |
| | Secondary | Star |
| d) | Rated voltage factor | 1.1 continuous, 1.5 for 3 seconds |
| e) | Class of insulation | E or better |
| f) | One minute power
frequency withstand
voltage | 2.5 KV (RMS) |
| g) | Accuracy class | 0.5, not less than 20VA |

1.26.9 Relay

- | | | |
|----|--|------------|
| a) | One minute power
Frequency withstand test | 2 kV (rms) |
|----|--|------------|

1.26.10	<i>Transducers (1 phase)</i>	<i>Current</i>	<i>Voltage</i>
	<i>a) Operating Voltage</i>	<i>220 V DC</i>	<i>220V DC</i>
	<i>b) I/P</i>	<i>1A.</i>	<i>110V AC</i>
	<i>c) O/P</i>	<i>4-20 mA</i>	<i>4-20 mA</i>
	<i>d) Type</i>	<i>Analogue</i>	<i>Analogue</i>

1.26.11 **Lighting Transformers**

Lighting transformers shall be of 300 KVA rating (in case of substations where highest voltage is 765 kV)/ 100 KVA rating (in case of substations where highest voltage is 400 kV)/ 25 KVA rating (in case of substations where highest voltage level is 132kV), 415/415 V, 3 phase, 50 Hz Dry type natural air cooled type. The technical parameters of these lighting transformers are as follows:

Technical Parameters of Lighting Transformer

Type of transformer	:	Dry type natural air cooled
Rating	:	300 KVA , 100 KVA or 25 KVA (as applicable)
Voltage ratio	:	415/415 volts
No. of phases	:	Three
Frequency	:	50 Hz
Winding connection	:	Dyn-1
Class of insulation	:	'B' class
Impedance	:	4% $\pm$ 10%
No. of taps & steps	:	5, $\pm$ 5% in steps of 2.5%
Ref. standard	:	IS:2026

1.27 **AUTOMATIC CONTROL OF OUTDOOR LIGHTING**

- 1.27.1 EL-type module of 415V Main lighting distribution board and Emergency lighting distribution board and shall be controlled by timer and contactor module to facilitate its operation automatically.

1.28 **AUTOMATIC SUPPLY CHANGEOVER**

Automatic changeover between Incomer I, Incomer II, and DG set is to be carried out during the failure of supply in one/or both the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirement of changeover under various conditions are as below:

- (i) Under normal conditions i.e. when supply is available in both the incomers, incomers I&II of 415 V Main switchboard, ACDB shall be in closed condition and Bus couplers and DG set breaker shall be in open condition.
- (ii) In case of failure of either of the sources, the incomer of that source shall trip and Bus coupler shall get closed. On restoration of supply, normal conditions described above are to be established automatically.
- iii) In case of failure of supply in both the sources, both incomers, incomers of ACDBs and ACDB Bus coupler shall trip and DG set breaker switched on.
On restoration of one or both sources, DG set breaker shall trip, DG set stopped and conditions described in paragraph (i) /(ii) shall be restored.

To avoid unnecessary operation of switchgear for momentary disturbances all changeovers from one state to another shall be initiated after a time delay, after the conditions warranting such change has been detected.

1.29 ANALOGUE INPUTS

LT System shall have provision of following analogue inputs for owner's substation automation purpose. These analogue inputs shall be generated by distinct transducers to be provided in respective modules. These inputs shall be wired up to respective terminal blocks.

ANALOGUE INPUTS:

- i) Voltage R-Y, Y-B, B-R of Main Switch Board section-I
- ii) Voltage R-Y, Y-B, B-R of Main Switch Board section-II
- iii) Current from LT transformer-I
- iv) Current from LT transformer-II
- v) Voltage of 220V DCDB-I
- vi) Voltage of 220V DCDB-II
- vii) Current from 220V Battery set-I
- viii) Current from 220V Battery set-II
- ix) Voltage of 48V DCDB-I
- x) Voltage of 48V DCDB-II
- xi) Current from 48V Battery set-I
- xii) Current from 48V Battery set-II

1.30 DIGITAL (Potential Free) INPUTS:

LT System shall have provision of following digital inputs for owner's substation automation purpose. These digital inputs shall be made available in the form of potential free contacts to be provided in respective modules. These potential free contacts shall be wired up to respective terminal blocks.

- i) Main (MSB) Incomer-I breaker On/Off
- ii) Main (MSB) Incomer-II breaker On/Off
- iii) Main (MSB) 415V Bus-I/II U/V
- iv) Main (MSB) bus coupler breaker on/off
- v) DG set breaker on/off
- vi) LT transformer-I Buchholz Alarm & trip
- vii) LT transformer-II Buchholz Alarm & trip
- viii) LT transformer-I WTI Alarm & trip
- ix) LT transformer-II WTI Alarm & trip
- x) LT transformer-I OTI Alarm & trip
- xi) LT transformer-II OTI Alarm & trip
- xii) 220 V DC-I earth fault
- xiii) 220V DC-II earth fault

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details	
a)	Owner	POWERGRID	
b)	Customer	POWERGRID	
c)	Project Title	765/400kV Switchyard at Medinipur & Jeerat	
d)	Location	Medinipur	Jeerat (new)
		West Bengal	West Bengal
e)	Transport Facilities	Nearest rail head - Medinipur	Nearest rail head - Kolkata
SITE CONDITIONS			
a)	Max. ambient air temp.	50°C	
b)	Min. ambient air temp.	0°C	
c)	Max. design ambient temp.	50°C	
d)	Design reference temp.	50°C	
e)	Average Humidity	Max. 100%	
f)	Special corrosion conditions	No	
g)	Solar Radiation		
h)	Atmospheric UV radiation	High	
i)	Altitude above sea level	Less than 1000meter	
j)	Pollution Severity	High Pollution level	
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS / IEC-62271-300 but not less than 0.3g horizontal	
WIND DATA			
	Wind velocity	50m/s	
	Average No. of thunderstorm days per annum	As per IS	

	Main Electrical Parameters:	
	Fault Levels:	765kV: 50kA for 1 sec 400kV: 63kA for 1 sec 66kV : 25kA for 3 sec
	Creepage Distance	31mm/kV for string insulator hardware and 25mm/kV for Equipment

1.0 GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

- a) Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes unless included in the list of exclusions.
- b) Material and components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.
- c) Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.
- d) In case any Deviation Schedule, Bid Proposal Sheet, Schedule of Data Requirements (DRS), test reports or any other document/information are not furnished along-with the bid, the bid is liable to be rejected. Unless brought out clearly, the Bid will be deemed to conform to the specification scrupulously. All deviations from the specification shall be clearly brought out in the respective deviation schedule.
- f) The Bidder shall clearly indicate in the bid, the specific standards in accordance with which the works will be carried out.
- g) The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice and latest state of art, and in accordance with purpose for which they are intended and ensure satisfactory performance throughout the service life.
- h) All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same materials and workmanship as the corresponding parts of the equipment. Where feasible, common components, units shall be employed in different pieces of equipment in order to optimize the spare part stock-up and utilization.

-
- i) The requirement regarding external RIV as specified for equipment shall include the terminal fittings and the equipment shall have been tested preferably with fittings, if any.

2.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- a) The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc.
- b) The equipment shall be able to withstand forces due to wind load, short circuit, system over voltages, fluctuations, frequency variations etc., all forces considered together.

3.0 SUPPORT STRUCTURES (If in the scope of Bidder)

- a) The support structures should be hot dip galvanised with minimum **610 gm/sq-m** net of zinc.
- b) The design calculations taking into account the environmental conditions of the substations shall be furnished for sizing of the structures.

4.0 STANDARDS

- a) The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified under respective Chapters of this Specification. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other. The bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- b) Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted.
- c) In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in additional information schedule alongwith English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to POWERGRID's approval.

5.0 ENGINEERING DATA AND DRAWINGS

- 5.1 The list of drawings/documents which are to be submitted to the Purchaser shall be discussed and finalised by the Purchaser at the time of award. The supplier shall necessarily submit all the drawings/ documents unless anything is waived.
- 5.2 The Contractor shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Purchaser. The contractor shall also submit the softcopy of the above documents in addition to hardcopy.

5.3 Drawings

5.3.1 All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

5.3.2 Drawings submitted by the Contractor shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.3.3 The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Purchaser may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Purchaser shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.5 All engineering data submitted by the Contractor after final process including review and approval by the Purchaser shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Purchaser in Writing.

5.7 Approval Procedure

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Purchaser would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments/ Purchaser on initial	As per agreed by schedule submission
ii)	Resubmission	Within 3 (three) weeks

Section-3

REV.00

	(whenever required)	from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.
iv)	Furnishing of distribution copies (5 hard copies per substation and one scanned copy (pdf format) for Corporate Centre)	2 weeks from the date of approval
v)	Furnishing of distribution copies of test reports	
(a)	Type test reports (one scanned softcopy in pdf format per substation plus one for corporate centre & one hardcopy per substation)	2 weeks from the date of final approval
(b)	Routine Test Reports (one copy for each substation)	-do-
vi)	Furnishing of instruction/ manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	As per agreed schedule operation
(vii)	As built drawings (two sets of hardcopy per substation & one softcopy (pdf format) for corporate centre & per substation)	On completion of entire works

NOTE :

- (1) The supplier may please note that all resubmissions must incorporate all comments given in the earlier submission by BHEL/POWERGRID or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.
- (2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.
- (3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.
- (4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the supplier to BHEL/POWERGRID.
- (5) The manufacturer shall furnish to the Purchaser catalogues of spare parts.
- (6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

6.0 MATERIAL WORKMANSHIP

6.1 General Requirement

- 6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.
- 6.1.2 In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Purchaser shall decide upon the question of similarity. When required by the specification or when required by the Purchaser the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the supplier.
- 6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads.
The use of other thread forms will only be permitted when prior approval has been obtained from the BHEL/POWERGRID.
- 6.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
- 6.1.5 All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

-
- 6.1.6 The supplier shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The supplier shall apply all operational lubricants to the equipment installed by him.
 - 6.1.7 All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help POWERGRID in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.
 - 6.1.8 Corona and radio interference voltage test and seismic withstand test (for 132kV and above voltage level) procedures for equipments shall be in line with the procedure given at Annexure-A and B respectively.

6.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

6.2.1 Space Heaters

- 6.2.1.1 The heaters shall be suitable for continuous operation at 240V as supply voltage. On-off switch and fuse shall be provided.
- 6.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.
- 6.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

6.2.2 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

6.2.4 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

- a) Installed out door: IP- 55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area: IP-52
- d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.
- e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS:13947 (Part-I) / IEC-60947(Part-I) / IS 12063 / IEC-60529. Type test report for degree of protection test, shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into successful Operation, shall be furnished by the supplier unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION

- 7.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the Purchaser or the Contractor may propose changes in the specification of the equipment or quality thereof and if the Purchaser & contractor agree upon any such changes, the specification shall be modified accordingly.
- 7.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.
- 7.3 The supplier shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of

the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

7.4 The supplier has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Purchaser. The names of agencies shall be intimated to the successful bidders.

7.5 The supplier will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Purchaser (if any) during the period of Contract. The Contractor shall attend such meetings at his own cost at POWERGRID Corporate Centre, Gurgaon (Haryana) or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

8.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the supplier's Works or at his Sub-contractor's premises or at the Purchaser's site or at any other place of Work are in accordance with the specifications, the supplier shall adopt suitable quality assurance programme to control such activities at all points necessary. The detailed programme shall be submitted by the contractor after the award for reference. A quality assurance programme of the supplier shall generally cover the following:

- (a) His organisation structure for the management and implementation of the proposed quality assurance programme;
- (b) Documentation control system;
- (c) Qualification data for bidder's key personnel;
- (d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- (e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
- (f) Control of non-conforming items and system for corrective actions;
- (g) Inspection and test procedure both for manufacture and field activities.
- (h) Control of calibration and testing of measuring instruments and field activities;
- (i) System for indication and appraisal of inspection status;
- (j) System for quality audits;
- (k) System for authorising release of manufactured product to the Purchaser.
- (l) System for maintenance of records;
- (m) System for handling storage and delivery; and
- (n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to

each item of equipment furnished and/or services rendered.

POWERGRID/BHEL or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the supplier/his vendor's quality management and control activities.

8.2 Quality Assurance Documents

The supplier would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of POWERGRID/BHEL inspection of equipment/material

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

9.2 The reports for all type tests as per technical specification shall be furnished by the supplier alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all project with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening i.e. ~~23.11.16~~. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to BHEL.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the date of bid opening.

- i) Lightning Impulse Test
- ii) Switching Impulse Test
- iii) Multiple Chopped Impulse Test (For CT)
- iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests (for instrument transformers) as mentioned above are conducted earlier than 5 (five) years prior to the date of bid opening i.e. ~~23.11.16~~, the contractor shall repeat these test(s) at no extra cost to the purchaser.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

The supplier shall intimate the BHEL/POWERGRID the detailed program about the tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Further, in case type tests are required to be conducted/repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the supplier.

- 9.3 The Purchaser intends to repeat the type tests on Power Transformer and Shunt Reactor except Dynamic short circuit tests on transformers, for which test charges shall be payable as per provision of contract. The price of conducting type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected. BHEL/POWERGRID reserves the right to witness any or all the type tests. The BHEL/POWERGRID also reserves the right to waive the repeating of type tests partly or fully and in case of waiver, test charges for the same shall not be payable.

The Purchaser shall bear all expenses for deputation of purchaser's representative(s) for witnessing the type tests under this clause except in the case of re-deputation if any, necessitated due to no fault of the purchaser.

For outdoor receptacles, trefoil clamps, diesel engine, alternator, motors, cable glands, lighting fixtures, ACSR/AAC conductor, IPS aluminum tube and junction boxes, type test reports are not required to be submitted for the makes indicated at Annexure-E /POWERGRID approved list of subvendors. For the new makes (other than those indicated at Annexure-E / POWERGRID approved list of subvendors), type test reports as per relevant standard shall be submitted for POWERGRID's approval.

- 9.4 The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, despatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

- 9.5 The supplier shall give the Purchaser /Inspector fifteen (15) days written notice for on-shore and six (6) weeks notice for off-shore material being ready for joint testing including contractor and POWERGRID. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Purchaser/inspector, unless witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to have been made in the

Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

- 9.6 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.
- 9.7 When the factory tests have been completed at the Contractor's or Sub- Contractor's works, the Purchaser/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser /Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer/Inspector. Failure of the Purchaser /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of CIP by the Purchaser.
- 9.8 In all cases where the Contract provides for tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser /Inspector or to his authorised representative to accomplish testing.
- 9.9 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
- 9.10 The Purchaser will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.
- 9.11 The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the Purchaser.

10.0 TESTS

10.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Contractor for correctness and completeness of

installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance programme.

10.2 Commissioning Tests

- 10.2.1 The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.
- 10.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- 10.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.
- 10.3 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by POWERGRID on production of requisite documents.

11.0 PACKAGING & PROTECTION

- 11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Purchaser, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Purchaser takes no responsibility of the availability of the wagons.
- 11.2 All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

12.0 FINISHING OF METAL SURFACES

- 12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition 4. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS:2629.
- 12.2 HOT DIP GALVANISING
 - 12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness

requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

12.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

12.2.4 The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

12.3 PAINTING

12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

12.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards/panels/junction boxes is also acceptable. The exterior colour for panels shall bematching with the existing panels in case of extension of a substation. Each coatof primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

12.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air

Conditioning systems

S.No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line – Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	
Air Conditioning System			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting.

13.0 HANDLING, STORING AND INSTALLATION

13.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

-
- 13.2 Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.
- 13.3 The contractor shall have to ensure that the hard and flat indoor and outdoor storage areas are in place prior to commencement of delivery of material at site. Contractor shall also ensure availability of proper unloading and material handling equipment like cranes etc. and polyester/nylon ropes of suitable capacity to avoid damage during unloading and handling of material at site. All indoor equipments shall be stored indoors. Outdoor equipment may be stored outdoors but on a hard and flat raised area properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress. However, all associated control panels, marshalling boxes operating boxes etc. of outdoor equipments are to be stored indoors only. Storage of equipment on top of another one is not permitted if the wooden packing is used. Material opened for joint inspection shall be repacked properly as per manufacturer's recommendations. During storage of material regular periodic monitoring of important parameters like oil level / leakage, SF6 / Nitrogen pressure etc. shall be ensured by the contractor.
- 13.4 In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.
- 13.5 Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- 13.6 Supplier shall be responsible for examining all the shipment and notify the Purchaser immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the Purchaser every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
- 13.7 The supplier shall be fully responsible for the equipment/material until the same is handed over to the Purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by
-

Purchaser, as well as protection of the same against theft, element of nature, corrosion, damages etc.

13.8 Where material / equipment is unloaded by Purchaser before the Contractor arrives at site or even when he is at site, Purchaser by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.

13.9 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage.

13.10 The words 'erection' and 'installation' used in the specification are synonymous.

13.11 Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

13.12 Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

14.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

15.0 AUXILIARY SUPPLY

15.1 The sub-station auxiliary supply is normally met through a system indicated under section "Electrical & Mechanical Auxiliaries" having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform the parameters as indicated in the following.

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
48V	-	DC	-	2 wire system (+) earthed

Combined variation of voltage and frequency shall be limited to ± 10%.

16.0 SUPPORT STRUCTURE (If in the scope of supplier)

16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter and 5.9 meter from plinth level for 765

kV,420 kV and 245 kV substations respectively. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

16.2 Support structure shall meet the following mandatory requirements:

16.2.1 The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

17.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below :

- | | | |
|----|--|---|
| a) | For connecting ACSR conductors | Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617 |
| b) | For connecting equipment terminals made of copper with ACSR conductors | Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner and all test shall conform to IS:617 |
| c) | For connecting G.I | Galvanised mild steel shield |
| d) | i) Bolts, nuts & Plain, washers | i) Electrogalvanised for sizes below M12, for others hot dip galvanised. |
| | ii) Spring washers items 'a' to 'c' | ii) Electro-galvanised mild for steel suitable for atleast service condition-3 as per IS:1573 |

17.2 Necessary clamps and connectors shall be supplied for all equipment and connections. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

17.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.

17.4 Low voltage connectors, grounding connectors and accessories for grounding allequipment as specified in each particular case, are also included in the scope of Work.

17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic strips shall be provided for Bi-metallic clamps.

17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities.

All sharp edges and corners shall be blurred and rounded off.

- 17.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- 17.8 Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.
- 17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 17.10 Clamps and connectors shall be designed to be corona controlled.

17.11 Tests

- 17.11.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).
- i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)
 - ii) Short time current test
 - iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)
 - iv) Resistance test and tensile test

18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

- 18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:
- 18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.6 mm thick stainless steel can also be used. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.
- 18.3 A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

-
- 18.4 Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.
- 18.6 All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.
- 18.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.
- 18.8 For illumination, a fluorescent tube or CFL of approximately 9 to 15 watts shall be provided. The switching of the fittings shall be controlled by the door switch. .
For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.
- 18.9 All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.
- 18.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.
- 18.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.
- 18.12 a) The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:
i) Check for wiring
ii) Visual and dimension check
b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2.5 KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.
-

19.0 Deleted.

20.0 TERMINAL BLOCKS AND WIRING

- 20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.
- 20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type of Elmex or Phoenix or Wago or equivalent make.
- 20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 20.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.
- 20.6 The terminal blocks shall be of extensible design.
- 20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- | | | |
|----|------------------------------------|--|
| a) | All circuits except CT/PT circuits | Minimum of two of 2.5 sq copper flexible. |
| b) | All CT/PT circuits | Minimum of 4 nos. of 2.5 sq copper flexible. |
- 20.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.
- 20.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.
- 20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 20.13 The supplier shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets. For

equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltages either transferred through the equipment or due to transients induced from the EHV circuits.

- 20.14 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

21.0 LAMPS & SOCKETS

21.1 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

21.2 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

21.3 Switches and Fuses:

- 21.3.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker / switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.
- 21.3.2 All fuses shall be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

22.0 Bushings, Hollow Column Insulators, Support Insulators:

- 22.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable. The bidder may also offer composite hollow insulators, conforming to IEC-61462.
- 22.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.
- 22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.
- 22.4 Support insulators/bushings/hollow column insulators shall be designed to

have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

22.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

22.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

22.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS:2544 & IS : 5621.

23.0 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

23.1 Enclosures

- a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.
- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

23.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in

the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

23.3 Starting Requirements:

- a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

23.4 Running Requirements:

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

23.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the equipment Contractor or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

-
- (a) Insulation resistance.
 - (b) Phase sequence and proper direction of rotation.
 - (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.
-

ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132kV and above.

2. Test Levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3. Test Methods for RIV:

- 3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.
- 3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.
- 3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.
- 3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

- 3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.
- 3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4. Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

- 4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a

voltage which results in corona.

- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE-B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132kV and above) shall be carried out along with supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/POWERGRID sites for the purpose of seismic withstand test only. The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the POWERGRID.

SECTION IV

GUARANTEED TECHNICAL PARTICULARS FOR AC-DC DISTRIBUTION BOARDS

For each type and rating of board proposed, the bidder shall provide the following information.

S.No.	PARTICULAR	Unit	AC BOARD	DC BOARD
1.00	GENERAL			
	a) Manufacturer's Designation			
	b) Type Designation			
1.1	Rated Voltage			
1.2	a) Symmetrical Short Circuit withstand current at rated voltage of switchgear/ MCC cubicle			
	b) Peak short circuit withstand current			
	c) Rated current at 50°C			
1.3	Degree of protection as per IS 13947 (IS 13947)			
	a) Breaker / MCC Cubicle			
	b) Busbar Chamber			
1.4	Cubicle sheet metal details			
	a) Cold rolled/ hot rolled			
	b) Thickness, structural & load bearing members			
	c) Thickness front and rear			
	d) Thickness, sides and top			
	e) Thickness of gland plates			
1.5	Painting shade and thickness of as per IS 5			
	a) External Surface			
	b) Internal Surface			
1.6	Minimum clearance in air (busbars)			
2.0	POWER BUSBARS & INSULATORS			
2.1	Material & applicable standards			
2.2	Bare/ painted/ epoxy/ insulated/ sleeved			
2.3	Bus joints silver faced			
2.4	Minimum Clearance			
	a) Phase to Phase			
	b) Phase to Earth			
2.5	Continuous Current Rating			
	a) at 40 deg C ambient			

Technical Specification

AC & DC BOARD

	b) at 50 deg C ambient			
2.6	Temperature rise over design ambient temperature of 50 deg C for continuous current rating (deg. C)			
2.7	Cross sectional area per phase for different ratings			
	a) Horizontal Busbars			
	b) Vertical Busbars			
2.8	Material of the Support Insulators			
2.9	Tracking Index of Insulators			
2.10	One Second Current rating			
3.0	AIR BREAK SWITCHES			
3.1	Make			
3.2	Type			
3.3	Applicable Standards			
3.4	Rated current at design ambient temperature			
3.5	Design Ambient temperature in deg C			
3.6	Derating factor for use under site ambient conditions			
3.7	Rated breaking current			
3.8	Maximum through fault withstand current			
3.9	Maximum size of fuse recommended			
3.10	Temp. rise of contacts when carrying continuous rated current			
3.11	Door interlock as specified has been provided			
3.12	No. of auxiliary contacts and its rating			
4.0	CONTACTOR			
4.1	Make			
4.2	Type and applicable standards			
4.3	No. of poles			
4.4	No. and configuration of auxiliary contacts			
4.5	Rated Voltage of coils			
4.6	Limits of operation			
	a) Supply Voltage Variation ($\pm$) %			
	b) Supply frequency variation ($\pm$) %			
	c) Drop off Voltage %			
4.7	Rated (thermal) current			
4.8	Rated Duty			
4.9	Rated Utilization Category as per IS 2459 (IS 13947)			

4.10	Rated breaking capacity			
4.11	Rated making capacity			
4.12	Coil winding insulation			
4.13	Rated making capacity			
4.14	Max. Recommended back up HRC fuse size			
4.15	Coil VA burden			
5.0	AUXILIARY CONTACTOR			
5.1	Make			
5.2	Type			
5.3	Coil Burden (VA)			
5.4	Operating Time (ms)			
5.5	No. of contacts			
	a) Normally Open			
	b) Normally Closed			
5.6	Contact rating			
6.0	FUSES (FOR EACH TYPE & RATING)			
6.1	Make			
6.2	Type			
6.3	Applicable Standards			
6.4	Rated Voltage			
6.5	Prospective Breaking Current			
6.6	Peak cut-off current			
6.7	Whether mounted on an insulated carrier			
7.0	SPACE HEATER			
7.1	Make			
7.2	Type Designation			
7.3	Rated Voltage			
7.4	Heater Output (W)			
7.5	Thermostat - Type, Make and Setting range (°C)			
8.0	WIRING & TERMINAL BLOCKS			
8.1	Voltage grade of wires			
8.2	Insulation of wires			
8.3	Minimum size of conductor for			
	a) Power Wiring (sq. mm)			
	b) Control wiring (sq. mm)			
8.4	Type of control wiring terminal blocks on			

Technical Specification
AC & DC BOARD

	a) fixed portion and draw-out portion of draw-out MCC modules			
	b) switchgear panels			
	c) for CTs			
8.5	Make & type of terminal blocks			
8.6	Minimum current rating of terminal blocks			
8.7	Suitable for 2x2.5 sq. mm cable termination on each side			
9.0	MCB/MCCB/			
9.1	Maker's name & country of manufacture			
9.2	Applicable standards			
9.3 a)	Nominal voltage class			
b)	Rated maximum voltage			
9.4	Number of poles			
9.5	Rated normal current			
a)	Under normal conditions			
b)	Under site conditions			
9.6	Rated frequency			
9.7	Rated short circuit breaking current			
a)	RMS value of a. c. component			
b)	Duration of short circuit			
c)	Rated short circuit making current			
9.8	Rated operating sequence			
9.9 a)	Opening time at 100% rated breaking current			
b)	Arcing time at 100% rated breaking current			
c)	Closing time			
9.10	Maximum rise of temperature over ambient for current rating under item 5 (b) above.			
9.11	No of auxiliary contacts provided for owner's use			
9.12	Number of breaks in series per pole			
9.13	Type of main contact			
9.14	Type of arcing contacts / or arc control device			
9.15	Material of contacts			
a)	Main			
b)	Arcing			
c)	If silver plated, thickness of coating			
9.16	Insulation level of breaker			
	One minute power frequency withstand voltage			

Technical Specification
AC & DC BOARD

9.17	Clearances			
a)	Between phases			
b)	Between live part and earth			
c)	Centre to centre distance between phases			
d)	Safety boundaries during the breaking operation			
9.18	Whether circuit breaker is fixed trip or free			
9.19	Method of closing			
a)	Normal			
b)	Emergency			
9.20	Type of closing mechanism			
9.21a	Normal voltage of closing coil			
b)	Pick up range			
9.22a	Auxiliary power at normal voltage of closing mechanism			
b)	Power at 85% of normal voltage			
9.23	Type of tripping mechanism			
9.24	Normal voltage of tripping coil			
9.25a	Power at normal voltage for tripping coils			
b)	Power at 85% of normal voltage for tripping coils			
10.0	INSTRUMENTS			
10.1	Make			
10.2	Type			
10.3	Dial Size			
11.0	INSTRUMENT TRANSFORMERS			
11.1	Make			
11.2	Type			
11.3	Rated Voltage			
11.4	Ratio			
11.5	Accuracy and Limit factor			
11.6	Rated Burden			
12.0	RELAYS			
12.1	Make			
12.2	Type			
12.3	Rated Voltage			
12.4	Accuracy and Limit factor			
12.5	Rated Burden			
12.6	1 min power frequency withstand voltage			

12.7	Power supply required			
------	-----------------------	--	--	--

Technical Specification
AC & DC BOARD

ANNEXURE - I
SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

<u>S.No.</u>	<u>Page No.</u>	<u>Clause No.</u>	<u>Deviation</u>	<u>Reason / Justification</u>
--------------	-----------------	-------------------	------------------	-------------------------------

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date:

Tenderer's Stamp & Signature

**CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER
RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED**

PLEASE NOTE:

a) The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

b) The evaluation of bidder against technical requirement criteria specified under clause 1.4 of Section -I of technical specification shall be based on the documentary proof submitted by bidder along with the offer.

Hence bidder shall ensure the completeness of their offer in this regard.

BHEL ENQUIRY. NO:

BIDDER: OFFER REFERENCE:

EQUIPMENT: LT AC / DC Boards

S.No.	Qualifying criteria (clause 1.4 Section I)	Documentary proof required	Yes/No
1	Legend: * : voltage class of respective equipment as applicable. # : satisfactory operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark. The manufacturer whose LT Switchgear(s) are offered, must be a manufacturer of LT Switchboards of the type and rating being offered. He must have designed, manufactured, tested and supplied at least 50 nos. draw out circuit breaker panels, out of which at least 5 nos. should have been with relay and protection schemes with current transformer. He must have also manufactured at least 50 nos. MCC panels comprising of MCCBs (i.e. Moulded Case Circuit Breakers) modules of the type offered which must be in satisfactory operation#.	Documentary proof attached	
2	The Switchgear items (such as circuit breakers, fuse switch units, contactors etc.), may be of his own make or shall be procured from reputed manufacturers and of proven design,	Documentary proof attached	

DOC: TB-395-316-017 / SECTION 5

	atleast one hundred circuit breakers of the make and type being offered must have been in satisfactory operation#.		
--	--	--	--

DOC: TB-395-316-017 / SECTION 5

S. No.	Parameters	Data	Yes	Remarks
1.	Applicable Standards	IS 8623, IS 13947 PART II , IEC 60255 , IS 2026	Yes /	
2.	Type of Boards	Metal enclosed , indoor floor mounted , compartmentalized double front construction and free standing	Yes ✓	
3	Module type	All modules shall be fixed type except air circuit breaker module ,which shall be draw out type	Yes /	
4	Ingress Protection requirement	Shall be as per clause 1.15 of Section II	Yes /	
5	Lightning Transformer	Shall meet requirements mentioned in clause 1.1.10 b, 1.26.11 and as per LT AC & DC System SLD	Yes /	
6	Special tools & tackles	List of special tools and tackles (which are proprietary in nature) is attached	Yes /	
6	Offered Boards	Bidder has quoted for the AC / DC distribution boards in line with this specification	Yes	
7	Addition / deletion	Bidder has quoted addition/ deletion prices for each and every type of complete module (defined in section2)	Yes	
8	Automatic Control of Outdoor lighting	In line with clause 1.27 of Section2 , EL-Type module of 415V Main Lighting DB and ELDB shall be controlled by timer and contactor module to facilitate it operation automatically	Yes	
9	Automatic changeover	Automatic changeover as per clause 1.28 of Section 2 shall be met.	Yes	
10	Analogue Input for SAS interface	Bidder shall offer in line with clause 1.29 of Section-II	Yes ✓	
11	Digital Input for SAS interface	Bidder shall offer in line with clause 1.30 of	Yes ✓	

DOC: TB-395-316-017 / SECTION 5

		Section-II		
12.	Cubicle Colour finish	a) Interior : Smoke grey shade No. 692 of IS:5 b) Exterior : Smoke grey shade No. 692 of IS:5	Yes /	
13.	Type test reports	Type test reports furnished shall be in line with clause 1.21	Yes /	
14.	Type test	If type test reports are not acceptable to Powergrid /BHEL then above tests shall be conducted by the bidder free of cost	Yes /	
15	Conformation to the Minimum indicative requirement of Analog signals, Potential Free contacts & Command signals. Refer Signal Chart mentioned in SLD drawing.	This should be available at respective equipment for remote indication & control from Auxiliary BCU located in S/s control room.		