

	BHARAT HEAVY ELECTRICALS LIMITED TRANSMISSION PROJECTS ENGINEERING MANAGEMENT								
	DOCUMENT No.	TB-408-316-115		Rev. No.	01		Prepared	Checked	Approved
	TYPE OF DOC.	TECHNICAL SPECIFICATION				NAME	DS	JK	SKS
	TITLE LT DISTRIBUTION BOARD					SIGN			
						DATE	01.04.20	01.04.20	01.04.20
						GROUP	TBEM	W.O. No	
	CUSTOMER	POWER GRID CORPORATION OF INDIA LTD.							
PROJECT	Extension of Substation under Western Region System Strengthening Scheme (WRSS)-20.								
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	CONTENTS								
	S/N	Description						No. of Sheets	
	1.	SECTION-1: SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES Annexure QR Annexure-A						05 01 04	
	2.	SECTION-2: STANDARD TECHNICAL SPECIFICATION						20	
	3.	SECTION-3: PROJECT DETAILS & GENERAL SPECIFICATIONS						26	
	4.	SECTION-4: Annexure-A (Compliance Certificate) Annexure-B (Schedule of Technical Deviations)						01 01	
	Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
Distribution					To	TBMM	OFFICE COPY		
					Copies	03	01		

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

[1] SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of LT Distribution Board to site.

This section covers the scope, quantities, Specific Technical Requirements for LT Distribution Board as specified by the customer (Power Grid). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprises of following sections

- | | |
|-----------|--|
| Section-1 | Scope, project specific technical requirements & bill of quantities. |
| Section-2 | Standard Technical Specification for LT Switchgear |
| Section-3 | Project details & general technical Specifications for all the equipments under the project. |
| Section-4 | Annexures |
| | Annexure-A (Compliance Certificate) |
| | Annexure-B (Schedule of Technical Deviations) |

In case of any discrepancies between the requirements mentioned under different Sections of technical specifications, order of precedence shall be as follows:

Section-1 shall precede Section-2, Section-2 shall precede Section-3.

In general, no deviation from the requirements specified in various clauses of this specification shall be allowed and hence, a certificate to this effect shall have to be furnished along with the offer (**Annexure-A**), however bidder shall furnish list of conflicts/ ambiguities/ deviations (if any) in *Schedule of Technical Deviations* (**Annexure-B**). Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed. In case the deviations mentioned in the *Schedule of Technical Deviations* are not technically acceptable, the offer of the bidder will be liable to rejection.

[2] The LT Distribution Board is required for the following Project

Customer: Power Grid Corporation of India Ltd.

Project: Extension of following substation under Western Region System Strengthening Scheme (WRSS)-20.

(i) 400kV Khandwa Substation

The scope of supplies shall be as per commercial terms and conditions enclosed separately with the enquiry.

[3] SPECIFIC TECHNICAL REQUIREMENTS

S.No.	Parameter	
1.	Type of Panel	Double front type
2.	Voltage	415V
3.	Busbar Rating	400A
4.	Fault Level	20kA for 1s
4.	System	3 Phase, 4 wire system
5.	Cable entry	(1.) Bottom

		(2.) Top Keep both the options for cable entry.
6.	Mounting	Floor mounted, Fixed type

[4] GENERAL TECHNICAL REQUIREMENTS

- 4.1** The required LT board is only extension of existing board.
- 4.2** There no requirement of Breaker/ MCCB in incomer supply.
- 4.3** Please refer section-2 for detailed technical specification.
- 4.4** Panel shall be floor mounted.
- 4.5** The no. of outgoing and incoming feeders is as per Annexure-A.
- 4.6** The incomer terminal block shall be suitable for 3.5 X 300sq. mm cable.
- 4.7** Space for spare feeders shall be available in the boards.
- 4.8** Cables for incoming supply and outgoing feeders is not in bidder's scope.
- 4.9** Space heater and switch with socket shall be provided in the panel.
- 4.10** Bidder to submit detailed "guaranteed and technical particulars" and "detailed drawings" for LT switchgear during contract stage for approval.

[5] BILL OF QUANTITIES:

1	SUPPLY- DISTRIBUTION BOARD: 415V AC 3 PHASE, 20KA FOR 1S, 400A, 4 WIRE, AC DISTRIBUTION BOARD	No.	2
---	---	-----	---

- (a.) The above distribution board (2 numbers) shall be deployed for extension to existing ACDB Panel, one at Bus-1 extension & other at Bus-2 extension.
- (b.) Please refer Annexure- A for details of technical requirement

- (c.) Quantity Variation: Quantity of Panel may vary +/- 1 number during contract stage.

[6] QUALITY PLAN

Bidder to follow valid Powergrid approved Quality Plan as per Powergrid procedure. In case the bidder doesn't have Powergrid approved Quality Plan, Bidder to get approved its Quality Plan directly from the ultimate customer M/s Powergrid Corporation of India Limited within 30 days from the date of issue of PO.

[7] TECHNICAL QUALIFYING REQUIREMENT

Please refer Annexure QR.

[8] TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

Please refer Section-2 of technical specification for the details of type test requirement.

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.

The reports for all type tests as per technical specification shall be furnished by the bidder along with equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID (in the projects similar to present project) shall be applicable for all projects 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 as applicable) or witnessed by POWERGRID or

representative authorized by POWERGRID or Utility or representative of accredited test lab.

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within last 10 (ten) years from the date of NOA. In case the test reports are of the test conducted earlier than 10 (ten) years from the date of NOA, the contractor shall repeat these test(s) at no extra cost to BHEL / Powergrid.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes 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 and time implication to BHEL/Power grid.

The Bidder shall intimate BHEL with the detailed program about the type tests at least two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Note – Type test report shall be reviewed for approval in detailed engineering stage only. However, for evaluation purpose, the test reports are to be submitted along with the technical bid.

Note: NOA stands for *Notification of Award* issued by Powergrid to BHEL for the reference project. **Date of NOA is 29 July 2019.**

----- X -----

TECHNICAL QUALIFYING REQUIREMENT

The bidder 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 (ie Moulded Case Circuit Breakers) modules of the type offered which must be in satisfactory operation# as on the date of NOA (29 July 2019).

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# as on the date of NOA#.

OR

Bidder must be manufacturer of the LT Switchboards of the type and rating being offered, should have PowerGrid approved and valid MQP (Manufacturing Quality Plan), and should have already supplied LT switchboard to PowerGrid as on the date of NOA #.

NOA: Date of NOA (Notification of Award) for reference project is 29.07.2019

PREPARED BY

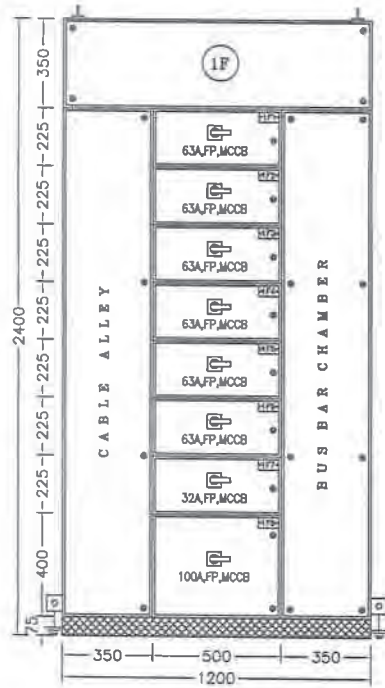
REVIEWED BY

APPROVED BY

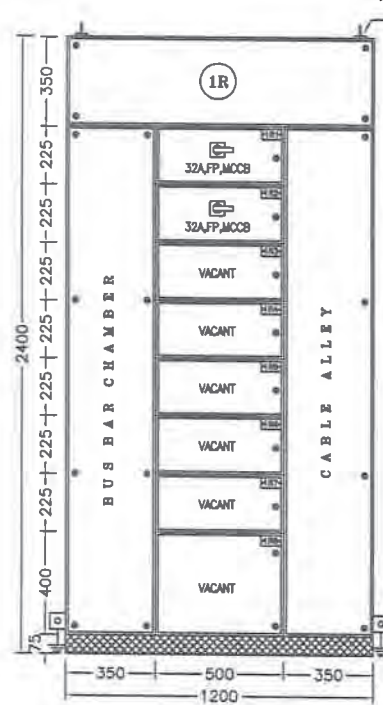
SECTION-1, ANNEXURE-A

- | | | | |
|---|--|--|---|
| 1. TYPE OF PRODUCT | : FLOOR MOUNTING, FIXED TYPE | 10. PAINTING
PRETREATMENT
PAINT TYPE
PAINT SHADE
EXTERIOR & INTERIOR | : 9 TANK PROCESS
: POWDER COATED
: SMOKE GREY (SHADE NO. 692 OF IS:5) |
| 2. CABLE ENTRY | : BOTTOM | 11. EARTH BUS BAR | : SUITABLE SIZE OF GI THROUGH OUT THE PANEL AND HAVING TWO HOLES ON EACH END FOR EARTH CONNECTION |
| 3. DEGREE OF PROTECTION
AS PER IS:13947 FOR
ENCLOSURE ONLY | : IP-54 FOR INDOOR | 12. GASKETS | : NEOPRANE GASKET SHALL BE PROVIDED AT ALL REMOVABLE DOORS & COVERS. |
| 4. SUPPLY VOLTAGE
(a) POWER VOLTAGE | : 415V $\pm 10\%$ 3 PH., 4 WIRE 50Hz FOR ACDB
: 220V DC, 2WIRE FOR 220V DCDB
: 48V DC, 2WIRE FOR 48V DCDB | 13. CURRENT DENSITY | : SOLID ALUMINIUM LINKS (@1A/sqmm) |
| (b) CONTROL SUPPLY | : 240V AC
: 110V AC
: 220V DC | 14. SPACE HEATER | : SPACE HEATER SHALL BE PROVIDED AT EACH CABLE ALLEY. |
| 5. FABRICATION
ENCLOSURE
DOORS/COVERS
GLAND PLATE
BASE CHANNEL
TYPE OF GLAND PLATE | : 2.0MM, CRCA ✓
: 1.6MM, CRCA
: 3.0MM, HR
: 75 MM.
: REMOVABLE UNDRILLED | 15. NAME PLATE | : NAME PLATE SHALL BE OF NON-RUSTING METAL OR 3PLY LAMICOID WITH WHITE ENGRAVED LETTERING ON BLACK BACK GROUND. |
| 6. MAIN BUS BAR
MATERIAL
SLEEVE | : ALUMINIUM OF E91E GRADE (IS-5082)
: HEAT SHRINKABLE PVC SLEEVES.
WITH RED,YELLOW,BLUE,BLACK,GREEN COLOURS | 16. SHROUDING | : ALL LIVE PARTS SHALL BE SHROUDED WITH WITH 2MM THICK HYLEM/ACRYLIC SHEET |
| 7. BUS BAR CLEARANCE
PHASE TO PHASE
PHASE TO NEUTRAL
PHASE TO EARTH | : 25 MM
: 25 MM
: 25 MM | | |
| 8. DOORS
FEEDER
BUSBAR CHAMBER | : HINGED AND LOCKABLE
: BOLTED | | |
| 9. CONTROL WIRING
C.T. CKT.
VOLTAGE CKT.
AC CIRCUIT
DC CIRCUIT
EARTH | : 2.5 SQ.MM. STRANDED CU. WIRE- 1100V GRADE (R/Y/B/BK)
: 1.5 SQ.MM. STRANDED CU. WIRE- 1100V GRADE (R/Y/B/BK)
: 1.5 SQ.MM. STRANDED CU. WIRE- 1100V GRADE (BLACK)
: 1.5 SQ.MM. STRANDED CU. WIRE- 1100V GRADE (GREY)
: 2.5 SQ.MM. STRANDED CU. WIRE- 1100V GRADE (GREEN) | | |

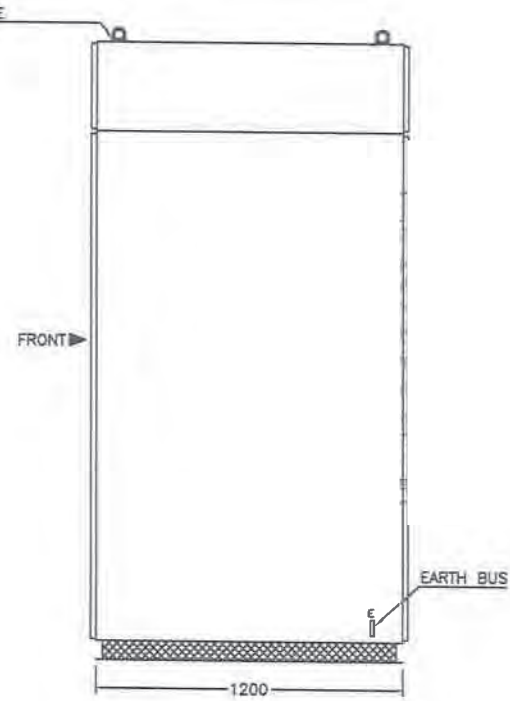
SECTION-1, ANNEXURE-A



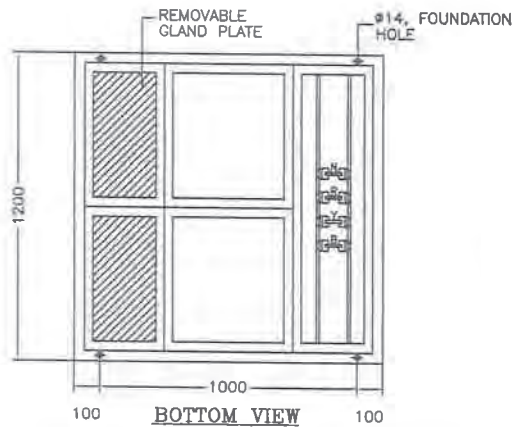
FRONT VIEW



REAR VIEW



SIDE VIEW

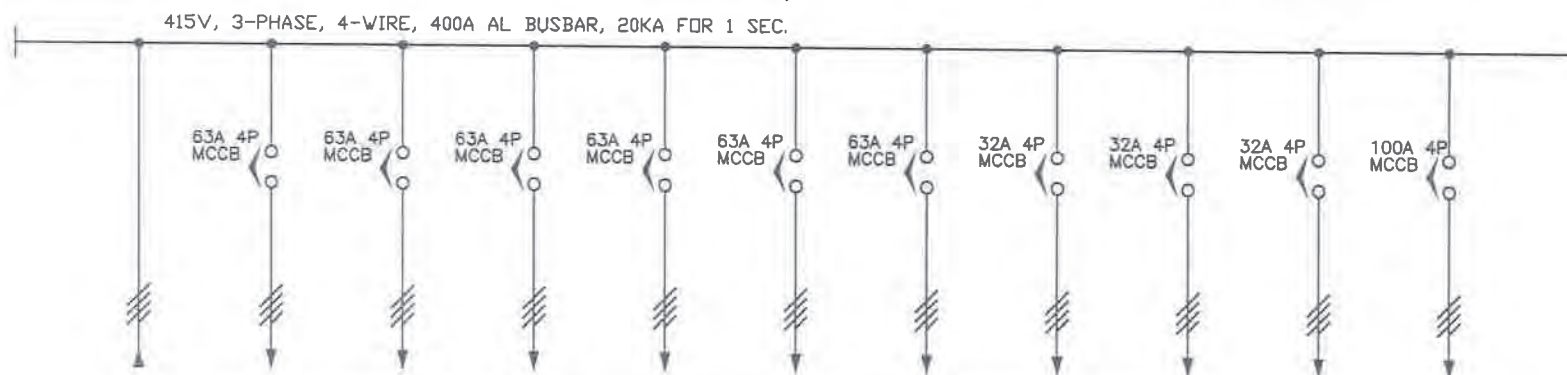


BOTTOM VIEW

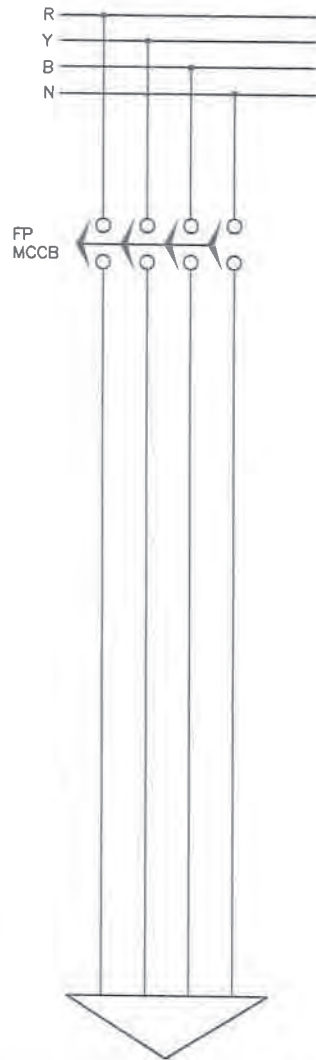
MAIN BUSBAR SIZES :-

PHASE	: 1X50X10 mm/EQ. AL
NEUTRAL	: 1X50X06 mm/EQ. AL
EARTH	: 1X25X05 mm/EQ. GI

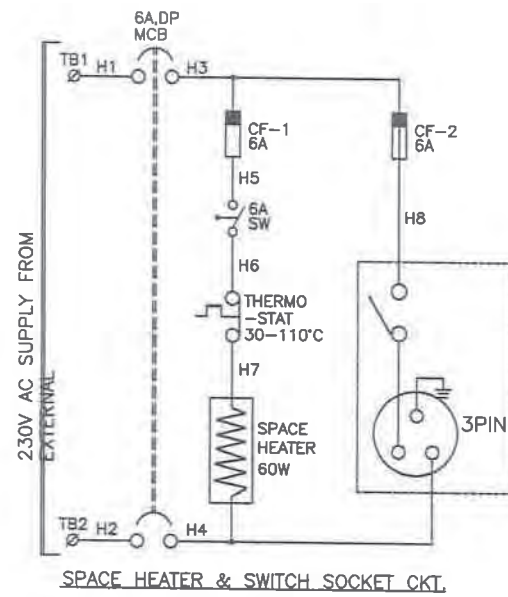
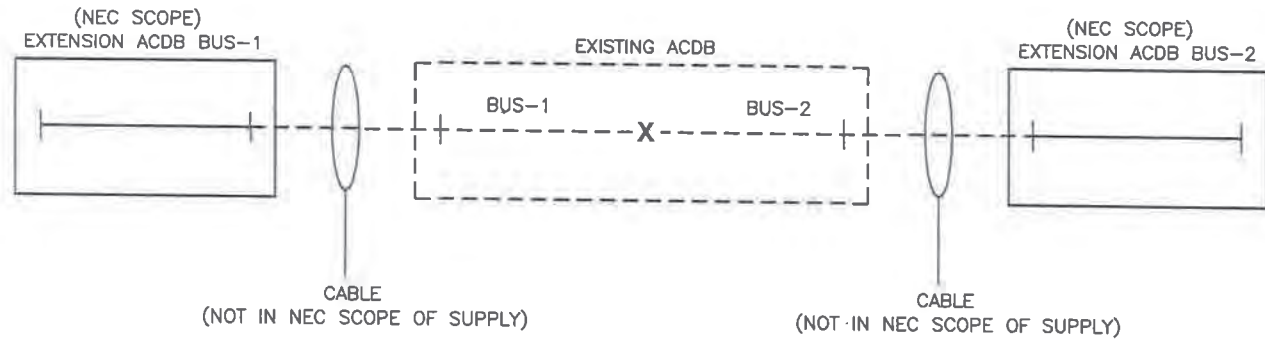
SECTION-1, ANNEXURE-A

[illegible]

SECTION-1, ANNEXURE-A



TYPICAL OUTGOING FEEDER
FOR FP MCCB



MODEL TECHNICAL SPECIFICATION

SECTION: LT SWITCHGEAR

Technical Specification, Section: LT Switchgear
C/ENGG/SPEC/LTSWGR Rev. No: 5

SECTION: LT SWITCHGEAR

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.***

SECTION-2

- 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

SECTION-2

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.

- 1.4.7. 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.

1.6. 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.

SECTION-2

- 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.

SECTION-2

- 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') |

SECTION-2

- (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 lamincoid 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**

SECTION-2

- 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.

SECTION-2

- 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**

SECTION-2

- 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.

1.24 **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

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*

SECTION-2

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

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

Sl	Particular	Details	
a)	Owner	POWER GRID	
b)	Customer	POWER GRID	
c)	Project Title	Substation package-SS 19: Extension of 765kV Solapur, 765kV Aurangabad, 765kV Wardha, 400kV Khandwa, 400kV Rajgarh, 400kV Champa, 400/220kV Itarsi & 400/220kV Jabalpur substations. Under Western Region System Strengthening Scheme (WRSS -20)	
d)	Location		
SL	Name of Substation	Name of State	Nearest Rail / Road Head
1	Solapur	Maharashtra	Solapur
2	Aurangabad	Maharashtra	Aurangabad
3	Wardha	Maharashtra	Wardha
4	Khandwa	M.P.	Khandwa
5	Rajgarh	M.P	Rajgarh
6	Champa	Chhattisgarh	Champa
7	Jabalpur	M.P.	Jabalpur
8	Itarsi	M.P.	Itarsi
e)	Transport Facilities	As above	
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	

Bharat Heavy Electricals Limited

Project: Substation package-SS19: Extension of 765kV Solapur, 765kV Aurangabad, 765kV Wardha, 400kV Khandwa, 400kV Rajgarh, 400kV Champa, 400/220kV Itarsi & 400/220kV Jabalpur substations

Section -3 of Technical Specification**Doc No. TB-408-316-S03, Rev.0**

g)	Solar Radiation	1.2kW /sqmtr																											
h)	Atmospheric UV radiation	High																											
i)	Altitude above sea level	Less than 1000meter																											
j)	Pollution Severity	Normal 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	As per IS																											
	Average No. of thunderstorm days per annum	As per IS																											
	Main Electrical Parameters:																												
	Fault Levels:																												
<table><tr><th>SL</th><th>Name of Substation</th><th>Fault level</th></tr><tr><td>1</td><td>765kV Solapur</td><td>40kA for 1sec</td></tr><tr><td>2</td><td>765kV Aurangabad</td><td>40kA for 1sec</td></tr><tr><td>3</td><td>765kV Wardha</td><td>40kA for 1sec</td></tr><tr><td>4</td><td>400kV Khandwa</td><td>40kA for 1sec</td></tr><tr><td>5</td><td>400kV Rajgarh</td><td>40kA for 1sec</td></tr><tr><td>6</td><td>400kV Champa</td><td>50kA for 1sec</td></tr><tr><td>7</td><td>400/220kV Jabalpur</td><td>40kA for 1sec</td></tr><tr><td>8</td><td>400/220kV Itarsi</td><td>40kA for 1sec</td></tr></table>			SL	Name of Substation	Fault level	1	765kV Solapur	40kA for 1sec	2	765kV Aurangabad	40kA for 1sec	3	765kV Wardha	40kA for 1sec	4	400kV Khandwa	40kA for 1sec	5	400kV Rajgarh	40kA for 1sec	6	400kV Champa	50kA for 1sec	7	400/220kV Jabalpur	40kA for 1sec	8	400/220kV Itarsi	40kA for 1sec
SL	Name of Substation	Fault level																											
1	765kV Solapur	40kA for 1sec																											
2	765kV Aurangabad	40kA for 1sec																											
3	765kV Wardha	40kA for 1sec																											
4	400kV Khandwa	40kA for 1sec																											
5	400kV Rajgarh	40kA for 1sec																											
6	400kV Champa	50kA for 1sec																											
7	400/220kV Jabalpur	40kA for 1sec																											
8	400/220kV Itarsi	40kA for 1sec																											
	Minimum Creepage Distance	25mm/kV for all equipments i.e. BPI / Bushing, CB, Isolator, CT, CVT, LA, NCT etc. 31mm kV. For string insulators																											

ENCLOSED - "SECTION-GTR (GENERAL TECHNICAL REQUIREMENT) REV.14" FOR DETAILS OF GENERAL TECHNICAL SPECIFICATION.

PLEASE READ TERMINOLOGY AS FOLLOWS -

1. Read "GTR" as "Section-3 of technical specification"
2. Read "Powergrid" as "BHEL Powergrid".
3. Read "Employer" as "Powergrid".
4. Read "Contractor" as bidder

SECTION- GENERAL TECHNICAL REQUIREMENT (GTR)

INDEX

CLAUSE NO.	ITEM	PAGE NO.
1.0	Foreword	1
2.0	General Requirement	1
3.0	Standards	1
4.0	Services to be performed by the Equipment being furnished	2
5.0	Engineering Data and Drawings	5
6.0	Material/Workmanship	7
7.0	Design Improvements/Coordination	9
8.0	Quality Assurance Programme	9
9.0	Type Testing, Inspection & Inspection Certificate	15
10.0	Tests	16
11.0	Packaging & Protection	17
12.0	Finishing of Metal Surfaces	17
13.0	Handling, Storing & Installation	19
14.0	Tools	20
15.0	Auxiliary Supply	21
16.0	Support Structure	21
17.0	Clamps and Connectors including Terminal Connectors	22
18.0	Control Cabinets, Junction Boxes, Terminal Boxes & Marshalling Boxes for Outdoor Equipment	23
19.0	Disposal of packing material & waste from construction site	24
20.0	Terminal Blocks and Wiring	24
21.0	Lamps and Sockets	25
22.0	Bushings, Hollow Column Insulators, Support Insulators	26
23.0	Motors	26
24.0	Technical Requirement of Equipments	28
Annexure-A	Corona and Radio Interference Voltage (RIV) Test	2 sheets
Annexure-B	Seismic Withstand Test Procedure	1 sheet
Annexure-C	List of General Standards and Codes	23 sheets
Annexure-D	List of Drawings/Documents for second advance	2 sheets
Annexure-E	Comprehensive List of drawings	9 sheets
Annexure-F	Assessment report from Main Contractor for proposed sub-vendor's List of enclosures	1 sheet
Annexure-G	MQP & Inspection Level Requirement	3 sheets
Annexure-H	Specification of RTV coating on porcelain insulators	2 sheets
Annexure-I	Standard Drawing for open platform	1 sheet
Annexure- C1 Corona and Radio Interference Voltage (RIV) Test - 2 SHEET		

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

1.0 FOREWORD

The provisions under this section are intended to supplement requirements for the materials, equipments and services covered under other sections of tender documents and are not exclusive.

2.0 GENERAL REQUIREMENT

2.1 The contractor shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification during detailed engineering.

2.2 It is recognised that the Contractor may have standardised on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to Employer.

2.3 Wherever a material or article is specified or defined 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.

2.4 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 though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components which are minor in nature and incidental to the requirement but not specifically stated in the specification and bid price schedule, which are necessary for commissioning and satisfactory operation of the switchyard/ substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment provided, shall be inter-changeable with one another.

~~2.5 The Contractor shall also be responsible for the overall co-ordination with internal /external agencies; Supplier of Employer's supplied equipments, project management, training of Employer's manpower, loading, unloading, handling, insurance, moving to final destination for successful erection, testing and commissioning of the substation /switchyard.~~

~~2.6 The bidder shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and obtain Electrical Inspector's clearance before commissioning. Any additional items, modification due to observation of such statutory authorities shall be provided by the Contractor at no extra cost to the Employer.~~

3.0 STANDARDS

3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the originally scheduled date of bid opening) of standard specified under Annexure-C of this section, unless specifically mentioned in the specification.

3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

- 3.4 The Contractor 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.
- 3.5 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.
- 3.6 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-C/individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out during detailed engineering along with English language version of such standard. The equipment conforming to standards other than specified under Annexure-C/individual sections for various equipments shall be subject to Employer's approval.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

5.0 ENGINEERING DATA AND DRAWINGS

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 Employer, 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 Employer 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 Employer 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 Employer 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.

5.5 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 Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.6 All engineering data submitted by the Contractor after final process including review and approval by the Employer 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 Employer in Writing.

5.7 Approval Procedure

The following schedule shall be followed generally for approval and for providing final documentation.

- | | | |
|----|--|--------------------|
| i) | Approval/comments/
by Employer on initial
submission | As per L2 schedule |
|----|--|--------------------|

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.
iv)	Furnishing of distribution copies (2 hard copies to each substation and one scanned copy (pdf format)	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 to each 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/ operation manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	On completion of Engineering
(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 contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer 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 Contractor to the Employer.
- (5) The Contractor shall furnish to the Employer catalogues of spare parts.
- (6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

5.8 The list of major drawings/documents to be approved to qualify for second advance as per Section SCC, shall be as per **Annexure-D**.

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 Employer shall decide upon the question of similarity. When required by the specification or when required by the Employer 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 is to be understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

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 Employer.

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 Contractor 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 Contractor shall apply all operational lubricants to the equipment installed by him.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

- 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. If such is the case, he shall declare in the proposal, where such oil or grease is available. He shall help Employer in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

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.

6.2.2 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.

6.2.4 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall comply with following 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 IP-55 or higher degree of protection test, shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

- 6.3.1 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

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

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 Employer. The rating plate of each equipment shall be according to IEC requirement.

- 6.3.2 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 operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION

- 7.1 The bidder shall offer the equipment meeting the requirement of the technical specification. However, the Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the contractor & Employer 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 Contractor 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 Contractor has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Employer. The names of agencies shall be intimated to the successful bidders.
- 7.5 The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Employer (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 Contractor's Works or at his Sub-Contractor's premises or at the Employer's site or at any other place of Work as applicable, are in accordance with the specifications, the Contractor shall ensure suitable quality assurance programme to control such activities at all points necessary. A quality assurance programme of the Contractor shall be in line with ISO requirements & shall generally cover the following:
- a) The organisation structure for the management and implementation of the proposed quality assurance programme.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

- b) System for Document and Data Control.
- c) Qualification and Experience data of 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, fabrication and assembly control.
- f) System for Control of non-conforming products including deviation dispositioning, if any and system for corrective and preventive actions based on the feedback received from the Customers and also internally documented system for Customer complaints.
- g) Inspection and test procedure both for manufacture and field activities.
- h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.
- i) System for indication and appraisal of inspection status.
- j) System of Internal Quality Audits, Management review and initiation of corrective and Preventive actions based on the above.
- k) System for authorising release of manufactured product to the Employer.
- l) System for maintenance of records.
- m) System for handling, storage and delivery.
- n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and /or service rendered.
- o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records. In this regard, the Employer has already prepared Standard Field Quality Plan for transmission line/substation equipments as applicable, Civil/erection Works which is required to be followed for associated works.

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

8.2 Quality Assurance Documents

The Contractor shall ensure availability of the following Quality Assurance Documents:

- i) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication, and reports including radiography interpretation reports.
- ii) Welder and welding operator qualification certificates.
- iii) Welder's identification list, welding operator's qualification procedure and welding identification symbols.
- iv) Raw Material test reports on components as specified by the specification and in the quality plan.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

- v) The Manufacturing Quality Plan(MQP) indicating Customer Inspection Points (CIPs) at various stages of manufacturing and methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.
- vi) Factory test results for testing required as per applicable quality plan/technical specifications/GTP/Drawings etc.
- vii) Stress relief time temperature charts/oil impregnation time temperature charts, wherever applicable.

8.3 INSPECTION, TESTING & INSPECTION CERTIFICATE

- 8.3.1 Contractor shall procure bought out items from sub-vendors as per the list in "Compendium of Vendors" available on POWERGRID web-site www.powergridindia.com after ensuring compliance to the requirements/conditions mentioned therein. Contractor shall explore first the possibilities of procuring the bought out items from POWERGRID approved existing vendors. In case of their unavailability / non-response, Contractor may approach POWERGRID for additional sub-vendor approval. In that case, the assessment report of proposed sub vendor by Contractor along with the enclosures as per **Annexure-F** shall be submitted within 60 days of the award. The proposal shall be reviewed and approval will be accorded based on the verification of the document submitted and/or after the physical assessment of the works as the case may be. The physical assessment conducted by POWERGRID, if required, shall be on chargeable basis. Charges shall be as per the POWERGRID norms prevailing at that time, which shall be intimated by POWERGRID separately. If proposal for sub-vendor is submitted after 60 days, the Contractor's proposal normally will not be considered for current LOA. However, POWERGRID may process the case for developing more vendors for referred items, if found relevant. In all cases, It is the responsibility of the Contractor that Project activities do not suffer on account of delay in approval/non approval of a new sub-vendor.

The responsibility and the basis of inspection for various items & equipment is placed at **Annexure-G** along with the requirement of MQP (Manufacturing Quality Plan), ITP(Inspection & Test Plan), FAT(Factory Acceptance Test) which should be valid & POWERGRID approved and Level of inspection envisaged against each item.

Contractor shall ensure that order for items where MQP/ITP/FAT is required will be placed only on vendors having valid MQP/ITP/FAT and where the supplier's MQP/ITP/FAT is either not valid or has not been approved by POWERGRID, MQP shall be generally submitted as per POWERGRID format before placing order.

Items not covered under MQP/ITP/FAT shall be offered for inspection as per POWERGRID LOA/technical Specifications/POWERGRID approved data sheets/ POWERGRID approved drawings and relevant Indian/International standards.

Inspection Levels: For implementation of projects in a time bound manner and to avoid any delay in deputation of POWERGRID or its authorized representative, involvement of POWERGRID for inspection of various items / equipment will be based on the level below:

- Level -I:** Contractor to raise all inspection calls and review the report of tests carried out by the manufacturer, on his own, as per applicable standards/ POWERGRID specification, and submit to concerned POWERGRID inspection office/Inspection Engineer. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates of manufacturers.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

Level – II: Contractor to raise all inspection calls and carry out the inspection on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during inspection, the same would be intimated to Contractor and CIP/MICC will be issued by POWERGRID. Else, Contractor would submit their test reports/certificates to POWERGRID. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates.

Level - III: Contractor to raise inspection calls for both, stage (as applicable) & final inspection and carry out the stage inspections (if applicable) on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during stage inspection, the same would be intimated to Contractor and CIP will be issued by POWERGRID. Else, Contractor would submit the test reports / certificates of stage inspection after their own review and CIP will be issued by POWERGRID based on review of test reports / certificates. Final inspection will be carried out by POWERGRID and CIP/MICC will be issued by POWERGRID.

Level – IV: Contractor to raise inspection calls for both, stage (as applicable) & final inspections. POWERGRID will carry out the inspection for both stage & final inspection as per applicable standards/specification and CIP/MICC will be issued by POWERGRID.

- 8.3.2 Contractor shall ensure that to implement the above inspection levels, particularly for the quality control and inspection at sub-vendor's works, they would depute sufficient qualified & experienced manpower in their Quality Control and Inspection department. Further, to assure quality of construction, Contractor shall have a separate workforce having appropriate qualification & experience and deploy suitable tools and plant for maintaining quality requirement during construction in line with applicable Field Quality Plan (FQP).
- 8.3.3 The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Contractor's premises or Works and shall have the power at all reasonable times to ensure that proper Quality Management practices / norms are adhered to, inspect and examine the materials & workmanship of the Works, to carry out Quality/Surveillance Audit during manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works. The Contractor shall obtain for the Employer 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. The item/equipment, if found unsatisfactory with respect to workmanship or material is liable to be rejected. The observations for improvements during product/ process inspection by POWERGRID shall be recorded in Quality Improvement Register (available & maintained at works) for review & timely compliance of observations.
- 8.3.4 Contractor shall submit inspection calls over internet through POWERGRID website. The required vendor code and password to enable raising inspection call will be furnished to the main Contractor within 30 days of award of contract on submission of documents by Contractor. After raising the inspection calls, Contractor shall then proceed as per the message of that particular call which is available on the message board.
- 8.3.5 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which the Contractor shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing for each stage of

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

testing as identified in the approved quality plan as customer inspection point(CIP) for indigenous inspections. All inspection calls for overseas material shall be given at least forty five (45) days in advance. Such tests shall be to the Contractor's account except for the expenses of the Inspection Engineer. The Employer/inspector, unless witnessing of the tests is waived by Employer, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector three copies of tests, duly certified. Contractor shall ensure, before giving notice for type test, that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer. CIP/Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment or review of test reports as applicable. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved QP and test certificate will be furnished by the supplier for approval. CIP/MICC will be issued only after review and approval of the test reports.

- 8.3.6 Contractor shall generally offer material for inspection as per supply bar chart approved by POWERGRID and not before 30 days from schedule indicated in the bar chart. In case Contractor offers material(s) for inspection prior to 30 days from the scheduled date with necessary approval of POWERGRID, POWERGRID shall inspect the material and issue CIP only. However, in such an exceptional case, MICC shall be issued only as per provision of original / revised approved supply schedule.
- 8.3.7 Contractor shall minimize the number of inspection calls by offering optimum quantities in each inspection call at the respective manufacturer's works.
- 8.3.8 Contractor shall inspect the material themselves and only after they are fully convinced about the Quality, they shall offer the material for POWERGRID inspection and shall also ensure that relevant portion of LOA/NOA, approved drawing and data sheets along with applicable Quality Plans are available at the works of Contractor or their Sub-vendor before the material is offered for inspection.
- 8.3.9 Contractor shall ensure that material which has been cleared for dispatch after inspection will be dispatched within 30 days in case of domestic supplies and within 60 days in case of Off-shore supplies from the date of issuance of CIP. Material which is not dispatched within stipulated time as above will be reoffered for POWERGRID inspection or specific approval of POWERGRID QA&I shall be obtained for delayed dispatch.
- 8.3.10 The Employer or IE shall give notice in writing to the Contractor, of any objection either to conformance to any drawings or to 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 Employer/Inspection Engineer giving reasons therein, that no modifications are necessary to comply with the Contract.
- 8.3.11 All Test Reports and documents to be submitted in English during final inspection of equipment by POWERGRID or as and when required for submission.
- 8.3.12 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/Inspection Engineer(IE) shall issue a certificate to this effect within fifteen (15) days after completion of tests & submission of documents by Contractor/manufacturer but if the tests are not witnessed by the Employer/IE, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Employer/IE. Contractor shall, on completion of all tests, submit test

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

reports within Ten (10) days to POWERGRID IE. Failure of the Employer/IE 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 Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.

- 8.3.13 In all cases, where the Contract provides for tests whether at the premises or 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 Employer/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 Employer/Inspection Engineer or to his authorised representative to accomplish testing.
- 8.3.14 The inspection and acceptance by Employer 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, or if such equipment is found to be defective at a later stage.
- 8.3.15 The Employer 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.
- 8.3.16 The Employer reserves the right for getting any additional field tests conducted on the completely assembled equipment at site to satisfy that material complies with specifications.
- 8.3.17 Rework/ Re-engineering, if any, on any item/equipment shall be carried out only after mutual discussions and in accordance with mutually agreed procedure. Contractor shall submit Joint Inspection Report of equipments under Re-Work/Re-Engineering alongwith procedure for the same to POWERGRID for approval, before taking up the Re-Work/Re-Engineering, failing which POWERGRID reserves the right to reject the equipment.
- 8.3.18 Contractor may establish a field test Laboratory to execute Civil Construction testing requirements at site with the condition that all testing equipment shall be calibrated from POWERGRID approved accredited Testing laboratories, with calibration certificates kept available at site and all testing personnel employed in the Field Testing Laboratories to be qualified and experienced Engineers or testing to be carried out at POWERGRID approved Third Party Laboratories.
- 8.3.19 Contractor shall ensure that all possible steps are taken to avoid damages to the equipment during transport, storage and erection.
- 8.3.20 Contractor shall implement additional stringent quality checks and preparation during installation of GIS at site (if applicable) as per POWERGRID approved guidelines/Technical specifications.
- 8.3.21 Contractor shall ensure commissioning of all CSDs along with Circuit Breakers wherever applicable.
- 8.3.22 For EHV transformers/reactors:**
- Insulation oil shall be as per POWERGRID Technical specifications and same grade shall be used for impregnation of the active part & testing at the works of Transformer/Reactor Manufacturer and as well as for filling the Transformer/Reactors at site. Contractor to ensure that windings for Transformer/Reactors are made in air-conditioned environment. Core-coil assembly shall be performed in positive

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

pressurized dust controlled environment. Dust measurements shall be monitored regularly at Transformer / Reactor Manufacturer works. Contractor shall ensure that respective civil foundations & Fire walls for Transformer/Reactors units to be commissioned, shall be made ready at concerned sites before receipt of Transformer/Reactors units. All the requisite material for Neutral & Delta Bus formation required for charging of complete bank of 765KV class 1-ph Transformer/Reactor units shall be made available at the concerned sites before receipt of the Transformer/Reactor units at site.

- 8.3.23 The Employer reserves the right to increase or decrease their involvement in inspections at Contractor's Works or at his Sub-Contractor's premises or at the Employer's site or at any other place of Work based on performance of Contractor/sub-Contractor.

9.0 TYPE TESTING & CLEARANCE 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 Contractor alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all projects 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.

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within last 10 (ten) years from the date of NOA. In case the test reports are of the test conducted earlier than 10 (ten) years from the date of NOA, the contractor shall repeat these test(s) at no extra cost to the Employer.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes 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 Employer.

The Contractor shall intimate the Employer the detailed program about the type tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

- 9.3 The Employer intends to repeat those type tests which are indicated in the price schedule and the same 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. The Employer 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.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

- 9.4 The Employer reserves the right to witness any or all the type tests. The Employer shall bear all expenses for deputation of Employer's representative(s) for witnessing the type tests.
- 9.5 **The list of makes of various items, for which Type test reports are not required to be submitted are specified in Compendium of Vendors (COV).**
- 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 Employer 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 Employer 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 arranged by the Contractor at his own cost.
- 10.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.
- 10.3.4 **PRECOMMISSIONING, COMMISSIONING, TRIAL-RUN & COMPLETION**
- As soon as the Facilities covered by these specifications are physically completed in all respects, the Pre commissioning, Commissioning, Trial-run and Completion of the Facilities, as mentioned below, shall be attained in accordance with the procedure given in the Conditions of Contract, Vol.-I of the Bidding Documents.
- (i) Pre commissioning : As per relevant Sections
- (ii) Commissioning : Charging of the Facilities at rated voltage.
- Further, wherever appearing in these specifications, the words-'commissioning checks', 'installation checks', 'site tests', 'performance guarantee tests for fire protection system', are to be considered as 'pre commissioning checks'.
- (iii) Trial-run : Operation of the Facilities or any part thereof by the Contractor immediately after the Commissioning for a continuous period of 72 (Seventy two) hours continuously. In case of interruption due to problem/failure in the respective equipment, the contractor shall rectify the problem and after rectification, continuous 72 (Seventy two) hours period start after such rectification.
- (iv) Completion : Upon successful completion of Trial-run.
- 'Guarantee Test(s)' and/or 'Functional Guarantees' are applicable only for Substation Automation System as specified in Section-'Substation Automation System.'
- 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.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**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 Employer, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer 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. Employer 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. 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

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

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 swaf 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 be matching with the existing panels in case of extension of a substation. Each coat of 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 contractor 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 during detailed engineering for Employer'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
<u>Fire Protection System</u>			
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	
<u>Air Conditioning Plant</u>			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

S.No.	PIPE LINE	Base colour	Band colour
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

The direction of flow shall be marked by → (arrow) in black colour.



Base Colour Direction of flow Band Colour

- 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. For stainless steel surfaces, no painting is envisaged.

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 Employer 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 must ensure that the open storage platform (as per Drawing No. C-ENGG-CVL-STD-PLATFORM-01, Rev.0) is constructed for storage of outdoor type equipment/material prior to commencement of delivery at site. Outdoor equipment shall be stored on open storage platform, properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress.
- However, all indoor equipments including control & protection panels, Communication equipments and operating mechanism boxes etc. of outdoor equipments shall be stored indoors.
- Storage of equipment on top of another one is not permitted if the wooden packing is used and there is possibility of equipment/packing damage. 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 Employer. 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

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

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 Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer 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 Contractor shall be fully responsible for the equipment/material until the same is handed over to the Employer 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 Employer, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- 13.8 Where material / equipment is unloaded by Employer before the Contractor arrives at site or even when he is at site, Employer 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 The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

13.13 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 Employer. 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

14.1 TOOLS & PLANTS (T&P)

The Contractor shall arrange all T&P (such as necessary supports, cranes, ladders, platforms etc.) for erection, testing & commissioning of the system at his own cost. Further, all consumables, wastage and damages shall be to the account of contractor.

All such T&P shall be taken back by the contractor after commissioning of the system.

14.2 SPECIAL TOOLS AND TACKLES

The contractor shall supply all special tools and tackles required for Operation and maintenance of equipment. The special tools and tackles shall only cover items which

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

are specifically required for the equipment offered and are proprietary in nature. The list of special tools and tackles, if any, shall be finalized during detail engineering and the same shall be supplied without any additional cost implication to the Employer.

14.3 FACILITIES TO BE PROVIDED BY THE EMPLOYER

- 14.3.1 Employer shall make available the auxiliary supplies at a single point in the substation on chargeable basis. The prevailing energy rates of the state shall be applicable. All further distribution from the same for construction supply shall be made by the contractor. However, in case of failure of power due to any unavoidable circumstances, the contractor shall make his own necessary arrangements like diesel generator sets etc. at his own cost so that progress of work is not affected and Employer shall in no case be responsible for any delay in works because of non-availability of power.
- 14.3.2 Employer shall make available construction water supply at a single point in the substation. All further distribution for the same shall be made by the Contractor. In case of non-availability or inadequate availability of water for construction work, the contractor shall make his own arrangement at his own cost and the Employer shall in no case be responsible for any delay in works because of non-availability or inadequate availability of water.

15.0 AUXILIARY SUPPLY

- 15.1 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 table:

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	-
110V	95V to 120V	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

- 16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter, 5.9 meter and 4.6 meter from plinth level for 765kV, 400kV, 220kV and 132kV 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 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.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

- 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 stainless steel of atleast 1.5 mm thick or aluminum enclosure of atleast 1.6 mm thick and shall be dust, water and vermin proof. Stainless steel used shall be of grade SS304 (SS316 for coastal area) or better. 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.
- 18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene/PU 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.
- Further, the gasketing arrangement shall be such that gaskets are pasted in slots (in door fabrication/gasket itself) in order to prevent ingress of dust and moisture inside the panels so that no internal rusting occurs in panels during the operation of the equipment.
- 18.6 All boxes/cabinets shall be designed for the entry of cables 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.

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

- 18.8 LED based illumination of minimum 9 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 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 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
- 18.13 The enclosure of bay marshalling kiosk, junction box, terminal box and control cabinets shall conform to IP-55 as per IS:13947 including application of 2KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.
- 19.0 DISPOSAL OF PACKING MATERIAL & WASTE FROM CONSTRUCTION SITE**
- After completion of the work, Contractor shall dispose-off all the packing & waste materials including empty conductor drums, cable drums, wooden containers, oil drums, gas cylinders and other waste/scrapped materials from construction site at his own cost and shall make the substation area properly cleaned.
- 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 the terminal blocks shall be non-disconnecting stud type except for the secondary junction boxes of Current Transformer and Voltage Transformer.
- 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, multilayer terminal arrangement is not allowed in any junction box (Common MB, Individual MB, JB etc.). There should be

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

sufficient space at both sides of terminals so that ferrule number of wires / TB numbers are clearly visible during wire removal or insertion.

- 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 mm copper flexible. |
| b) | All CT/PT circuits | Minimum of 4 nos. of 2.5 sq mm 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 Contractor 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 Lamps & Sockets

All lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

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, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker / switch fuse units. Selection of the main and Sub-circuit fuse

SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)

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.

ANNEXURE-A

COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation(s) with respect to specification other than those furnished in the 'schedule of technical deviations'.
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date:

Bidder's Stamp & Signature

ANNEXURE - B

SCHEDULE OF TECHNICAL DEVIATIONS

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

S.No.	Section/ Page No.	Clause No.	Deviation	Reason / Justification
-------	-------------------	------------	-----------	------------------------

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