



# BHARAT HEAVY ELECTRICALS LIMITED

## TRANSMISSION BUSINESS GROUP

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TYPE OF DOC.	<b>TECHNICAL SPECIFICATION</b>			SIGN		
TITLE				NAME	<b>AS</b>	<b>JK</b>
<b>765kV Current Transformer</b>				DATE		
				GROUP	<b>TBEM</b>	W.O. No
CUSTOMER	<b>POWERGRID</b>					
PROJECT	<p><b>1. Substation Package SS-01</b> for (i) 765/400/220kV Bikaner-III Pooling Station including 400kV class Bus Reactor at Bikaner-II S/s; (ii) Extension of 765kV Neemrana-II S/s for termination of 765 kV D/c line Neemrana-II–Bikaner-III T/L and (iii) Extension of 400kV Bikaner-II S/s for termination of 400kV Bikaner-II Bikaner-III</p> <p><b>2. Substation Package SS-06T</b> for Establishment of 765/400/220 kV Koppal-II (New) Pooling Station (AIS type)</p> <p><b>3. Substation Package SS-09T</b> for Extension of 765/400/220kV Koppal-II PS and Extension of 765kV Raichur SS</p> <p><b>4. 765kV SS New Pkg-SS-15T</b> for (i) Establishment of 765 kV switching station near Vataman (ii) Extn. of 765kV Halvad S/s for termination of 765 kV D/c Halvad- Vataman</p>					
<b>CONTENTS</b>						
<b>Section</b>	<b>Description</b>					<b>No of Sheets</b>
1	Scope, Bill of Quantity, Specific Technical Requirement					8
2	Equipment Specification					17
3	Project Details and General Technical Requirements					72
4	Guaranteed Technical Parameters.					4
5	Checklist					5
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## SECTION 1

### SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

#### 1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Current Transformers complete with accessories as listed in clause 5.0 below. This section covers the specific technical requirements of 765kV CT.

The specification comprises of following sections:

- Section-1: Scope, Specific Technical Requirements & Quantities
- Section-2: Equipment Specification
- Section-3: Project Details & General Technical Requirements
- Section-4: Guaranteed Technical Particulars
- Section-5: Checklist

In case of any conflict between various sections, **order of precedence** shall be in the same order as listed above.

**Note:** The terms used in this specification namely, "Employer/Purchaser" refers to POWERGRID & "Contractor/Sub-contractor/manufacturer" refers to successful bidder.

#### 2.0 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

**Name of Customer:** POWERGRID Corporation of India Ltd (PGCIL)

**Name of the Projects:**

- a) 765/400/220kV Bikaner-III S/s
- b) Extension of 765kV Neemrana-II S/s
- c) 765/400/220kV Koppal-II S/s
- d) Extension of 765/400/220kV Koppal-II S/s
- e) Extension of 765 Raichur S/s
- f) 765kV Vatman S/s
- g) Extension of 765kV Halvad S/s

Refer Section - 3 for Project Details and General Specifications.

#### 3.0 SPECIFIC TECHNICAL REQUIREMENTS

a. **Technical Parameters of 765kV CT:**

S. N	Description of parameters	Data for Bikaner, Neemrana, Koppal	Data for Vatman, Halvad
1.	Max. System Voltage	800kV	800kV
2.	Rated frequency	50 Hz	50 Hz
3.	System Fault Level	50kA for 1 Sec	50kA for 1 Sec
4.	Min. Creepage Distance	20000mm	24800mm

CTs must have adequate provision for taking oil samples from the bottom of the CT without exposure to atmosphere. Manufacturer shall recommend the frequency at which oil samples should be taken and norms for various gases in oil after being in operation for different durations. Manufacturer should also indicate the total quantity of oil which can be withdrawn from CT for gas analysis before refilling or further treatment of CT becomes necessary.

Manufacturer/Contractor shall supply 2 nos. of oil sampling device for every 20 nos. of oil filled CT supplied with a minimum of 2 nos. of oil sampling device for each substation.

**Note: FOR PGCIL VATMAN & HALVAD, creepage is 31mm/kV.**

**For Site having Creepage of 31mm/kV**

**The minimum weight of the zinc coating shall be 900 gm/sq.m for all items having thickness of 6mm and above. Also the all applicable factor required for coastal area/creepage of 31mm/kV shall be applicable as per specified in specification.**

**b. 765kV CT Parameters:**

Refer - Section II, Table –IIA

**For detailed Technical requirements refer Section-2 of the Technical Specification.**

**4.0 TECHNICAL PRE-QUALIFYING REQUIREMENTS:**

**(i)** The manufacturer whose 765/400/220/132kV\* equipment(s) are offered, must have manufactured, type tested (as per IS/IEC or equivalent standard) and supplied 715/345/220/132kV\* or higher voltage class equipment(s), which are in satisfactory operation# for at least two (2) years as on 22.02.2024.

OR

**(ii)** The manufacturer, who have established manufacturing and testing facilities in India for the offered equipment(s) and not meeting the requirement stipulated in (i) above, can also be considered provided that:

a) 715/345/220/132kV\* or higher Voltage class equipment(s) must have been manufactured in the above Indian works & type tested (as per IS/IEC standard) as on 22.02.2024.

b) Manufacturer has manufactured, type tested (as per IS/IEC or equivalent standard) and supplied equipment(s) of 345kV or above voltage class (applicable for 765kV\* Equipment)/220kV or above voltage class (applicable for 400kV\* equipment) /132kV or above voltage class (applicable for 220kV\* equipment) / 66kV or higher voltage class (applicable for 132kV\* equipment), which are in satisfactory operation# for at least two (2) years as on 22.02.2024.

c) Warranty obligations for additional warranty of two (2) years over & above the warranty period as specified in the bidding documents shall be applicable for the entire quantity of the offered equipment(s) to be supplied under the contract. Further, contractor shall furnish performance guarantee for an amount of 3% of the ex-works cost of the equipment(s)\* for

the additional warranty period in addition to the contract Performance guarantee to be submitted by the contractor.

OR

(iii) The manufacturer, who have established manufacturing and testing facilities in India for the offered equipment(s) based on technological support of a parent company or collaborator and not meeting the requirement stipulated in (i) above, can also be considered provided that:

a) 715/345/220/132kV\* or higher Voltage class equipment(s) must have been manufactured in the above Indian works & type tested (as per IS/IEC standard) as on 22.02.2024.

b) The parent company or collaborator meets the qualifying requirements stipulated under (i) given above.

A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply the 765/400/220/132kV\* Air Insulated Switchgear (AIS) Equipment(s)\* in India, shall be submitted.

c) The parent company/collaborator shall furnish performance guarantee for an amount of 3% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to contract performance guarantee to be submitted by the contractor

\*: voltage class of respective equipment as applicable.

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

## 5.0 **PRECOMMISSIONING AND COMMISSIONING:**

An indicative list of tests is specified in Section –II, 9.0

The bidder shall perform all pre-commissioning tests including any additional tests based on specialties of the items as per approved field Q.P / Instructions of equipment supplier without any extra cost to BHEL / Customer. The bidder shall arrange all special instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments for approval.

“Commissioning checks”, “installation checks”, “Site tests” wherever mentioned in the Specification shall be considered as pre-commissioning checks.

Note: The respective dates of commencement of erection, pre-commissioning and commissioning activity by BHEL will be intimated to the equipment manufacturer from time to time, so that arrangements for supervising the activity can be made accordingly by the manufacturer

(However, the travel, lodging and boarding expenses for each visit of the bidder’s engineers shall be borne by the bidder).

## 6.0 **TRAINING:**

The bidder shall impart training to Employer’s Personnel as mentioned in section-2.

The charges for tutorials & other training materials for the trainees shall be included in the prices quoted by bidder. No price implication shall be entertained at a later stage.

However, the travel lodging & boarding expenses of employer's personnel, if any shall be borne by Employer.

## **7.0 BILL OF QUANTITIES:**

As per annexure-A, Section-1.

## **8.0 TYPE TEST:**

- a. 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 6.0 of section II.
- b. 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 shall be applicable for all project with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab or reputed consultant.

The type test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the 22.02.2024. In case the test reports are of the test conducted earlier than 10 (ten) years prior to 22.02.2024, the bidder shall repeat these test(s) at no extra cost to BHEL.

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

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

In case type tests are to be conducted /repeated and deputation of Inspectors/Purchasers representative is required, then all expenses shall be borne by Bidder

## **9.0 PACKING:**

- 9.1 All equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and outdoor storage (for a minimum period of 6 months) at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should

be considered. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.

- 9.2** The Bidder shall include and provide for security, protection and packing the equipment so as to avoid loss or damage during transport by any mode.
- 9.3** All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the purchaser.
- 9.4** The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
- 9.5** Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.
- 9.6** Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- 9.7** All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- 9.8** Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- 9.9** Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.
- 10.0 DEVIATIONS:**

The bidder shall list all the deviation from the specification separately. Offers without specific deviation will be deemed to be totally in compliance with the specification and NO DEVIATION on any account will be entertained at a later date.

#### **11.0 MANUFACTURING QUALITY PLAN:**

Bidder has to follow POWERGRID approved Manufacturing Quality Plan, SAT /FAT procedure at contract stage.

#### **12.0 DRAWINGS and SCHEME:**

The documentation requirements detailed under Section-2 and 3 shall be submitted to BHEL at various stages of contract. Softcopy of the drawings and schemes are to be submitted at contract stage. Preparation of AS- BUILT drawings is also in the scope of the bidder.

#### **13.0 DOCUMENTS REQUIRED WITH TECHNICAL OFFER:**

- a) Clause-wise confirmation/ comments
- b) Bill of Materials
- c) Unpriced schedule of Unit Prices
- d) Filled-up Guaranteed Technical Particulars
- e) Catalogue and Technical Leaflets for the offered Equipments

**ANNEXURE-A**  
**PROJECT WISE BILL OF QUANTITY**

**A) 765kV BIKANER-III S/s**

S. No.	Description	Unit	Total Qty.
I a.	765kV,3000A ,50kA for 1sec with 120% extended current rating, 6 Core, 1ph Current Transformer complete in all respect.	No.	48
I b.	Supervision of Testing (or Pre-commissioning)	No.	48

**B) Extn. of 765kV NEEMRANA S/s**

S. No.	Description	Unit	Total Qty.
II a.	765kV,3000A ,50kA for 1sec with 120% extended current rating, 6 Core, 1ph Current Transformer complete in all respect.	No.	06
II b.	Supervision of Testing (or Pre-commissioning)	No.	06

**C) 765kV KOPPAL-II S/s**

S. No.	Description	Unit	Total Qty.
I a.	765kV,3000A ,50kA for 1sec with 120% extended current rating, 6 Core, 1ph Current Transformer complete in all respect.	No.	30
I b.	Supervision of Testing (or Pre-commissioning)	No.	30

**D) Extn. of 765kV KOPPAL-II S/s**

S. No.	Description	Unit	Total Qty.
II a.	765kV,3000A ,50kA for 1sec with 120% extended current rating, 6 Core, 1ph Current Transformer complete in all respect.	No.	18
II b.	Supervision of Testing (or Pre-commissioning)	No.	18



**E) Extn. of 765kV RAICHUR S/s**

S. No.	Description	Unit	Total Qty.
II a.	765kV,3000A ,50kA for 1sec with 120% extended current rating, 6 Core, 1ph Current Transformer complete in all respect.	No.	09
II b.	Supervision of Testing (or Pre-commissioning)	No.	09

**F) 765kV VATMAN S/s**

S. No.	Description	Unit	Total Qty.
I a.	765kV,3000A ,50kA for 1sec with 120% extended current rating, 6 Core, 1ph Current Transformer complete in all respect.	No.	48
I b.	Supervision of Testing (or Pre-commissioning)	No.	48

**G) Extn. of 765kV HALVAD S/s**

S. No.	Description	Unit	Total Qty.
II a.	765kV,3000A ,50kA for 1sec with 120% extended current rating, 6 Core, 1ph Current Transformer complete in all respect.	No.	12
II b.	Supervision of Testing (or Pre-commissioning)	No.	12

**NOTE:**

- 1) The Quantity is subject to change by +/-10%
- 2) Hardware (Nut, Bolts and washers) for mounting CT on structure - One (1) set for each CT to be included by the bidder in their offer.
- 3) Multiple visits are envisaged for Sl. No. Ib & IIb above for each site.
- 4) Prices for Oil Sampling & supply of oil sampling devices (as applicable) as per TS is deemed to be included in the prices quoted against Ia & IIa.
- 5) BHEL shall procure support structure, terminal clamps & connectors and Junction Box separately.
- 6) Dissolved Gas Analysis (DGA) shall be carried as per CI: 9.2 Section-II and prices for the same is deemed to be included in the offer. The sampling (including equipment for sampling) shall be under the scope of the bidder.  
BHEL shall cover the charges for sending the sample to laboratory and laboratory testing.

# SECTION-II

## EQUIPMENT SPECIFICATION

### SECTION-SWITCHGEAR-INST

#### INSTRUMENT TRANSFORMERS

#### 1.0 GENERAL:

- 1.1 The instrument transformers and accessories shall conform to the latest version of the standards specified below except to the extent explicitly modified in this specification and shall be in accordance with the requirements in Section-GTR.

Current Transformers (CT): IEC: **61869-1 & 61869-2** or IS: 2705 **Part-1 to 4**

Capacitive Voltage Transformers (CVT): IEC: **61869-1, 61869-5 & IEC-60358 or IS-3156 Part-1 to 4**

Inductive Voltage Transformers (IVT): IEC: **61869-1 & 61869-3 or IS-3156 Part-1 to 3**

- 1.2 The instrument transformers shall be designed for use in geographic and meteorological conditions as given in Section-GTR **and Section-Project.**

#### 2.0 CONSTRUCTION FEATURES:

The features and constructional details of instrument transformers shall be in accordance with requirements stipulated hereunder:

- a) Instrument transformers of ~~800kV/420kV/245kV/145kV/72.5~~ kV class, shall be oil filled/SF<sub>6</sub> gas filled, suitable for outdoor service and upright mounting on steel structures. ~~245kV, 420kV and~~ 800kV CT shall be with polymer insulator.
- b) Bushings/Insulators shall conform to requirements stipulated in Section-GTR. The bushing/insulator for CT shall be one piece without any metallic flange joint.
- c) Oil filling and drain plugs, oil sight glass shall be provided for CT & IVT. Oil sight glass shall be provided for electromagnetic unit of CVT. ***The Instrument transformer shall have cantilever strength of not less than 500 kg, 500 kg, 350 kg, 350 kg and 250 kg respectively for 800kV, 420kV, 245kV, 145kV and 72.5kV Instrument Transformers.*** For CVT/IVT with polymer housing, the cantilever strength shall not be less than 150kg. Oil filling and drain plugs are not required for SF<sub>6</sub> gas filled CT/IVT.
- d) Instruments transformers shall be hermetically sealed units. The details of the arrangements made for the sealing of instrument transformers shall be furnish during detailed engineering.

- e) Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.
- f) SF<sub>6</sub> gas filled CT/IVT shall be provided with a suitable SF<sub>6</sub> gas density monitoring device, with NO/NC contacts to facilitate the remote annunciation and tripping in case of SF<sub>6</sub> gas leakage. Provisions shall be made for online gas filling. Suitable rupture disc shall be provided to prevent explosion.
- g) The instrument transformers shall be complete with its terminal box and a common marshalling box for a set of 3 instrument transformers.
- h) The external surface of instrument transformer, if made of steel, shall be hot dip galvanized or painted as per Section-GTR. External surface of aluminum can have natural finish.
- i) The impregnation details alongwith tests/checks to ensure successful completion of impregnation cycle shall be furnished for approval.

## 2.2 **Terminal box/Marshalling Box:**

Terminal box/**Marshalling Box** shall conform to the requirements of Section-GTR.

## 2.3 **Insulating Oil/Gas:**

- a) Insulating oil to be used for instrument transformers shall be of EHV grade and shall conform to IS-335/IEC-60296 (required for first filling). Non-PCB based synthetic insulating oil conforming to IEC 60867 **shall** be used in the capacitor units of CVT.
- b) The SF<sub>6</sub> gas shall comply with IEC-60376, 60376A, 60376B & **IEC-60480** and shall be suitable in all respects for use in the switchgear under operating conditions.

## 2.4 **Name Plate:**

Name plate shall conform to the requirements of IEC incorporating the year of manufacture. The rated current & extended current rating in case of current transformers and rated voltage, voltage factor & **intermediate voltage** in case of voltage transformers shall be clearly indicated on the name plate.

## 3.0 **CURRENT TRANSFORMERS:**

- a) Current transformers shall have single primary either ring type or hair pin type and suitably designed for bringing out the secondary terminals

in a weather proof (IP-55) terminal box at the bottom. PF (**Tan delta**) terminal for measurement of tan delta and capacitance of the unit shall be provided. These secondary terminals shall be terminated to stud type non disconnecting terminal blocks inside the terminal box.

In case of inverted type (**Live Tank**) current transformers, the manufacturer shall meet following additional requirements:

- (i) **The primary conductor shall preferably be of bar type meeting the desired characteristics.**
  - (ii) The secondaries shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.
  - (ii) The lowest part of the insulation assembly **i.e. insulation at neck** shall be properly secured to avoid any risk of damage due to transportation stresses.
  - (iii) The upper part of insulation assembly resting on primary bar shall be properly secured to avoid any damage during transportation due to relative movement between insulation assembly & top dome.
  - (iv) **Bellows made of stainless steel shall be used at the top for hermetic sealing of CT.**
  - (v) Bidder/Manufacturer shall recommend whether any special storage facility is required for spare CT.
- b) Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.
  - c) Core lamination shall be of cold rolled grain oriented silicon steel or other equivalent alloys.  $\mu$  metal or nano-crystalline core can also be used for metering cores.
  - d) The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.
  - e) Facilities shall be provided at terminal blocks in the marshalling box for star delta formation, short circuiting and grounding of CT secondary terminals.
  - f) Current Transformer's guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
  - g) The rated extended currents for 800kV and 420kV class Current transformers shall be as given below:

Tap Ratio	800kV, 3000A	400kV, 3000A
	Rated extended currents in % of rated current	
500/1	200	200
1000/1	---	---
2000/1	180	180
3000/1	120 (200 for 15 min)	120

- h) The secondary winding shall be rated for 2A continuously.

Further, the intermediate tapping at 3000-2000 of metering core of 3000 A rated 400kV and 800kV CTs shall be suitable for using as 1000/1 ratio **also**. The Auxiliary reactor, **if used**, as referred at wiring diagram No.0000-000-T-E-L-028 shall be suitable for connecting to the selected taps. The requirements of 3000A CTs are given at TABLE II-A.

For 245/145/**72.5**kV class CTs, the rated extended primary current shall be 120% (or 150% if applicable) on all cores of the CTs.

- h) For 800/420/245/145/**72.5**kV Current Transformer, characteristics shall be such as to provide satisfactory performance of burdens ranging from 25% to 100% of rated burden over a range of 5% to 120% (or specified rated extended current whichever is higher) of rated current in case of metering CTs and up to the accuracy limit factor/knee point voltage in case of relaying CTs.
- i) The current transformer shall be suitable for horizontal transportation. It shall be ensured that the CT is able to withstand all the stresses imposed on it while transporting and there shall be no damage in transit. The Contractor shall submit the details of packing **and transportation** design to the Employer for review.
- j) For 800kV CTs, the instrument security factor at all ratios shall be less than ten (10) for metering core. For 420/245/145/**72.5**kV CTs, the instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably be inbuilt construction of the CTs. In case these are to be mounted separately these shall be mounted in the central marshalling box suitably wired upto the terminal blocks.
- k) The wiring diagram plate for the interconnections of the three single phase CTs shall be provided inside the marshalling box. A typical

wiring diagram no. 0000-000-T-E-L-028 (Sh.1 & 2) is enclosed herewith at Annexure-III of this specification.

- l) The Current Transformers should be suitable for mounting on lattice structure (for 800 kV) or pipe structure (for 420 kV and below) to be provided by the Contractor in accordance with stipulations of Section-Project/**Section-Structures**.
- m) The CT shall be designed so as to achieve the minimum risks of explosion in service. Bidder/Manufacturer shall bring out in his offer, the measures taken to achieve this.
- n) 800/420/245/145kV Current Transformers shall be suitable for high speed auto reclosing.

#### **4.0 ~~VOLTAGE TRANSFORMERS:~~**

- ~~a) 800/420/245/145kV Voltage Transformers shall be capacitor voltage divider type with electromagnetic units and shall be suitable for carrier coupling.~~
- ~~b) Voltage transformers secondaries shall be protected by HRC cartridge type fuses or MCBs for all the windings. In addition, fuses/MCBs shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the VTs shall be terminated to the stud type non-disconnecting terminal blocks in the individual phase secondary boxes via the fuse/MCBs.~~
- ~~c) CVTs shall be suitable for high frequency (HF) coupling required for power line carrier communication. Carrier signal must be prevented from flowing into potential transformer (EMU) circuit by means of a RF choke/reactor suitable for effectively blocking the carrier signals over the entire carrier frequency range i.e. 40 to 500 KHz. H.F. terminal of the CVT shall be brought out through a suitable bushing and shall be easily accessible for connection to the coupling filters of the carrier communication equipment, when utilized. Further, earthing link with fastener to be provided for HF terminal.~~
- ~~d) The electromagnetic unit comprising compensating reactor, intermediate transformer and protective and damping devices should have separate terminal box with all the secondary terminals brought out.~~
- ~~e) The damping device, which should be permanently connected to one of the secondary windings, should be capable of suppressing the ferroresonance oscillations.~~
- ~~f) The accuracy of 0.2 on secondary III for all CVTs/IVTs should be maintained through out the entire burden range upto 50 VA on all the windings without any adjustments during operation.~~

- ~~g) The Voltage Transformers shall be suitable for mounting on lattice structure (for 800kV) or Pipe structure (for 420kV and below) to be provided by the Contractor in accordance with stipulations of Section-Project/Section-Structures.~~
- ~~h) It should be ensured that access to secondary terminals is without any danger of access to high voltage circuit.~~
- ~~i) A protective surge arrester shall be provided, if required, to prevent breakdown of insulation by incoming surges and to limit abnormal rise of terminal voltage of shunt capacitor/primary winding, tuning reactor/RF choke etc. due to short circuit in transformer secondaries. Alternate arrangement shall also be acceptable.~~
- ~~j) The wiring diagram for the interconnection of the three single phase CVTs/IVTs shall be provided inside the marshalling box in such a manner that it does not deteriorate with time. Wiring diagram no.: 0000-000-T-E-L-029 enclosed herewith at Annexure-IV of this specification shall be followed.~~

## 5.0 TERMINAL CONNECTORS:

The terminal connectors shall meet the requirements as given in Section-GTR and technical parameters for the respective equipment as per Annexure-I and Annexure-II of this specification.

## 6.0 TESTS:

- 6.1 In accordance with the requirements in Section-GTR, Current Transformer and Voltage Transformer should have been type tested and shall be subjected to routine tests in accordance with **relevant IEC**.
- 6.2 The test reports of type tests, **as applicable, as per IEC-61869-2 for CT, IEC-61869-5/IEC-60358 for CVT, and IEC-61869-3 for IVT** and following additional tests shall be submitted for the Employer's review. **The type tests for which the procedure is under consideration as per abovesaid IEC is not required to be considered.**
  - a) **Current Transformers (CT):**
    - i) Corona test as per Annexure-A of Section-GTR **for 420kV and above voltage rating.**
    - ii) **RIV test as per IEC-61869 or as per Annexure-A of Section-GTR for 145kV and above voltage rating. However, RIV level shall be as specified at Annexure-II of this specification.**

- iii) Seismic withstand test as per Annexure-B of Section-GTR or **IEC-62271-2 (with Seismic acceleration requirement as per Annexure-I of this specification/Section-Project) for 145kV and above voltage rating.**
- iv) Thermal stability test, i.e. application of rated voltage and rated extended thermal current simultaneously by synthetic test circuit **for 145kV and above voltage rating** (not applicable for SF<sub>6</sub> filled CT).
- v) Thermal co-efficient test i.e. measurement of tan-delta as a function of temperature (at ambient and between 80°C & 90°C) and voltage (at 0.3, 0.7, 1.0 and 1.1 Um/√3) **for 145kV and above voltage rating** (not applicable for SF<sub>6</sub> filled CT).
- vi) Multiple chopped impulse test (not applicable for SF<sub>6</sub> filled CT) with the application of 600 chopped impulses **for 145kV and above voltage rating.**
- vii) **Transmitted over voltage test for 145kV and above voltage rating**
- viii) **Mechanical test (with minimum Cantilever load as per clause no. 2.1.c) for 145kV and above voltage rating**
- ix) **Internal Arc fault test for 145kV and above voltage rating** (not applicable for CT with Polymer Insulator)
- x) **Enclosure tightness test at low & high temperature for SF<sub>6</sub> filled CT of 145kV and above voltage rating**
- xi) **Gas dew point test for SF<sub>6</sub> filled CT**
- xii) **Corrosion test for 145kV and above voltage rating**

**b) ~~Capacitive Voltage Transformers (CVT):~~**

- i) ~~High frequency capacitance and equivalent series resistance measurement (as per IEC-60358)~~
- ii) ~~Seismic withstand test (as per Annexure-B of Section-GTR) or IEC-62271-2 (with Seismic acceleration requirement as per Annexure-II of this specification/Section-Project) for 145kV and above voltage class.~~
- iii) ~~Stray capacitance and stray conductance measurement of the low voltage terminal (as per IEC-60358)~~



- ~~iv) Corona test as per Annexure-A of Section-GTR for 420kV and above voltage rating.~~
  - ~~v) RIV test as per IEC-61869 or as per Annexure-A of Section-GTR for 145kV and above voltage rating. However, RIV level shall be as specified at Annexure-II of this specification.~~
  - ~~vi) Transmitted over voltage test for 145kV and above voltage rating~~
  - ~~vii) Mechanical test (with minimum Cantilever load as per clause no. 2.1.c) for 72.5kV and above voltage rating~~
  - ~~viii) Determination of Temperature coefficient for 145kV and above voltage rating~~
  - ~~ix) Tightness design test of capacitor units for 145kV and above voltage rating~~
  - ~~x) Corrosion test for 145kV and above voltage rating~~
- ~~c) Inductive Voltage Transformers (IVT):~~
- ~~i) Seismic withstand test (as per Annexure-B of Section-GTR) *or* IEC-62271-2 (with Seismic acceleration requirement as per Annexure-II of this specification/Section-Project) for 145kV and above voltage rating.~~
  - ~~ii) Corona test as per Annexure-A of Section-GTR for 420kV and above voltage rating.~~
  - ~~ii) RIV test as per IEC-61869 or as per Annexure-A of Section-GTR for 145kV and above voltage rating. However, RIV level shall be as specified at Annexure-II of this specification.~~
  - ~~iii) Multiple chopped impulse test with application of 600 chopped impulses for 145kV and above voltage rating (not applicable for SF<sub>6</sub> filled CT).~~
  - ~~iv) Transmitted over voltage test for 145kV and above voltage rating~~
  - ~~v) Mechanical test (with minimum Cantilever load as per clause no. 2.1.c) for 72.5kV and above voltage rating~~
  - ~~vi) Enclosure tightness test at low & high temperature for SF<sub>6</sub> filled CT of 145kV and above voltage rating~~
  - ~~vii) Gas dew point test for SF<sub>6</sub> filled CT~~

~~viii) Corrosion test for 145kV and above voltage rating~~

~~ix) Measurement of Capacitance and Dielectric dissipation factor for 145kV and above voltage rating~~

6.3 The current and voltage transformer shall be subjected to the following routine tests in addition to routine tests as per *relevant* IEC:

a) **CURRENT TRANSFORMERS:**

ROUTINE TESTS:

For Oil filled CT:

- i) Measurement of Capacitance.
- ii) Oil leakage test.
- iii) Measurement of tan delta at 0.3, 0.7, 1.0 and 1.1 Um/ $\sqrt{3}$ .

For SF<sub>6</sub> filled CT:

- i) Dew point measurement
- ii) SF<sub>6</sub> alarm/ lockout check.
- iii) SF<sub>6</sub> gas leakage test: Gas leakage rate shall be maintained within 0.2% per annum.

~~b) **VOLTAGE TRANSFORMERS:**~~

~~*Routine tests on CVT/IVT shall be done in line with IEC-61869-3/61869-5.*~~

7.0 **MANDATORY SPARES:**

Bidder shall include in his proposal mandatory spares as mentioned in the Bidding Documents.

8.0 **MAJOR TECHNICAL PARAMETERS:**

**Major technical parameters for 800kV/420kV/245kV/145kV/72.5kV Instrument Transformers are enclosed at Annexure-I and Annexure-II to this specification.**

9.0 **PRE-COMMISSIONING TESTS**

9.1 An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P./Instructions of the equipment Supplier or Employer without any extra cost to the Employer. **The Contractor shall arrange all instruments**

**required for conducting these tests alongwith calibration certificates at his own cost.**

## 9.2

### **Current Transformers**

- (a) Insulation Resistance Test for primary and secondary
- (b) Polarity test
- (c) Ratio identification test - checking of all ratios on all cores by primary injection of current
- (d) Dielectric test of oil (wherever applicable)
- (e) Magnetizing characteristics test
- (f) Tan delta and capacitance measurement
- (g) Secondary winding resistance measurement
- (h) Contact resistance measurement (wherever possible/accessible)
- (i) Test for SF<sub>6</sub> (for SF<sub>6</sub> filled CTs) – Dew point measurement, SF<sub>6</sub> alarm/lockout check
- (j) DGA test of oil

**Dissolved Gas Analysis (DGA) shall be carried out twice within the first year of service, first within the first month of commissioning/charging and second between six months to one year from the date of commissioning/charging.**

CTs/IVTs must have adequate provision for taking oil samples from the bottom of the CT/IVT without exposure to atmosphere. Manufacturer shall recommend the frequency at which oil samples should be taken and norms for various gases in oil after being in operation for different durations. Bidder/Manufacturer should also indicate the total quantity of oil which can be withdrawn from CT for gas analysis before refilling or further treatment of CT becomes necessary.

**Bidder shall supply 2 nos. oil sampling device for every 20 nos. oil filled CT supplied with a minimum of 2 nos. oil sampling device for each substation.**

## 9.3

### ~~**Inductive Voltage Transformers/Capacitive Voltage Transformers**~~

- ~~(a) Insulation Resistance test for primary (if applicable) and secondary winding~~
- ~~(b) Polarity test~~
- ~~(c) Ratio test~~
- ~~(d) Dielectric test of oil (wherever applicable)~~

- ~~(e) Tan delta and capacitance measurement of individual capacitor stacks~~
- ~~(f) Secondary winding resistance measurement~~

For pre-commissioning procedures and formats for Current Transformers, Doc.No.: CF/CT/04/R-4 dtd-01.04.2013 and for Voltage Transformers, CF/CVT/05/R-4 dtd-01.04.2011 under POWERGRID document no. D-2-01-03-01-04 will be the reference document. **This document will be available at respective sites and shall be referred by the contractor.**

## **10.0 Defect Liability**

**The actions required to be taken by contractor in case of defects observed in CT/CVT of ratings 145kV & above during the warranty period (defect liability period) shall be as per enclosed Annexure-V of this specification. Further, the replaced/repaired/refurbished equipment (or part of equipment) shall have Two (2) years warranty without prejudice to contractual warranty period (defect liability period).**

**TABLE-IIA****REQUIREMENTS FOR 800 KV CURRENT TRANSFORMER**

No. of Cores.	Core No.	Application	Current Ratio	Output Burden (VA)	Accuracy Class	Min. Knee Pt. Voltage (Vk)	Max. CT Sec. wdg. Resistance (in $\Omega$ )	Max. Excit. Current at Vk (in mA)
<b>6</b>	1	BUS DIFF. CHECK	3000/ 2000/ 500/1	-	<b>PX</b>	3000/ 2000/ 500	15/10/2.5	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap
	2.	BUS DIFF. MAIN	3000/ 2000/ 500/1	-	<b>PX</b>	3000/ 2000/ 500	15/10/2.5	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap
	3.	METERING	3000/ 2000/ 500/1	20	0.2S	-	-	-
	4.	METERING	3000/	20	0.2S	-	-	-
			2000/	20	0.2S	-	-	-
			500/1	20	0.2S	-	-	-
			3000/	20	0.2S	-	-	-
	5.	TRANSF DIFF./ LINE PROTN.	3000/ 2000/ 500/1	-	<b>PX</b>	3000/ 2000/ 500	15/10/2.5	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap
	6	LINE PROTN/LBB PROTN.	3000- 2000- 500/1	-	<b>PX</b>	3000/ 2000 500	15/10/2.5	20 on 3000/1 Tap,30 on 2000/1 Tap,120 on 500/1 Tap

**Note: 1. Protection cores shall be of accuracy class PX as per IEC 61869.**

**2. Metering Core shall be of accuracy class 0.2S as per IEC: 61869**

## Annexure-I

### MAJOR TECHNICAL PARAMETERS FOR CT

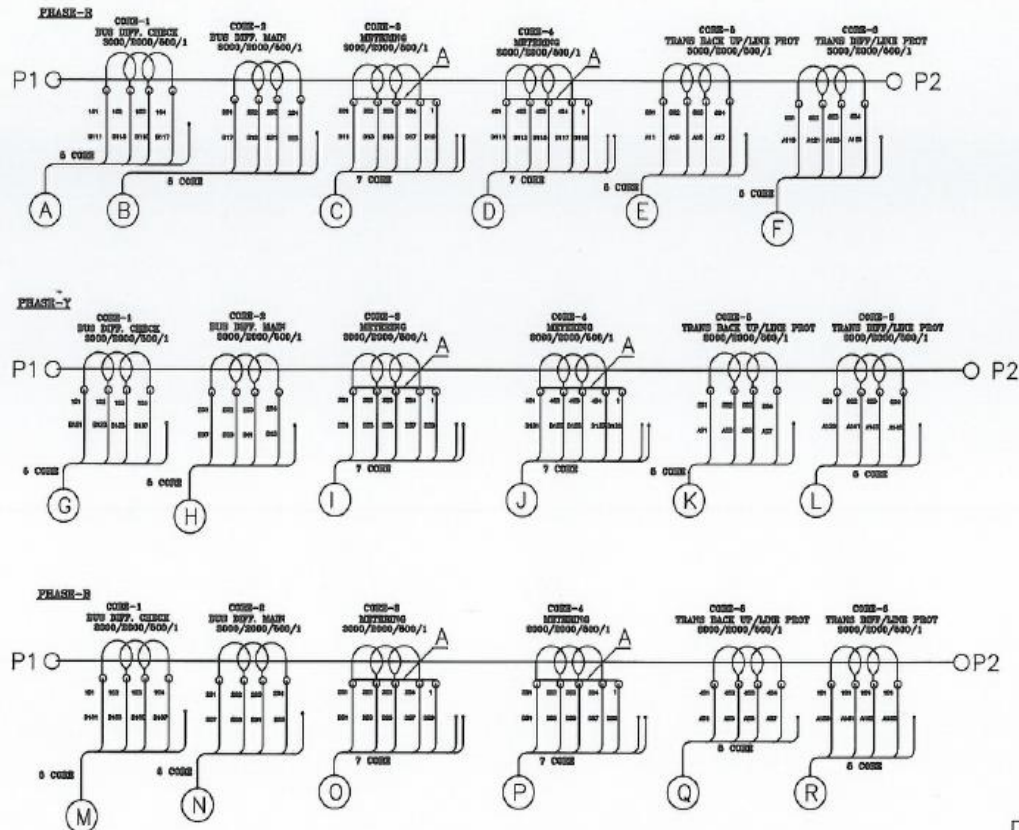
S. No.	Description	765kV system	400kV system	220kV system	132 kV system	66 kV System (for Tertiary loading)
1	Rated voltage, U <sub>m</sub> (kVrms)	800	420	245	145	72.5
2	Rated frequency (Hz)	50	50	50	50	50
3	No. of Poles	1	1	1	1	1
4	Design ambient temperature (°C)	50	50	50	50	50
5	Rated Primary Current (A)	3000	3000	1600	800/600	50
6	Rated extended primary current	120%	120%	120%/150%	120%/150 %	120%
7	Rated short time thermal withstand current	40kA/50kA (as applicable) for 1 sec	40kA/50kA/63kA (as applicable) for 1 sec	40kA/50kA (as applicable) for 1 sec	31.5kA for 1sec	25kA for 3sec
8	Rated dynamic current	100kAp/125kAp (as applicable)	100kAp/125kAp/ 157.5kAp (as applicable)	100kAp/125kAp (as applicable)	80kAp	63kAp
9	Temperature rise over design ambient temperature	As per IEC				
10	Rated Insulation levels					
a)	Full wave impulse withstand voltage (1.2/50 microsecond)					
i)	between line terminals and ground(kVpeak)	±2100	±1425	±1050	±650	±325
b)	Switching impulse withstand voltage (250/2500 microsecond) (dry and wet)					
i)	between line terminals and ground (kVpeak)	± 1550	± 1050	-NA-	-NA-	-NA-
c)	One minute power frequency dry withstand voltage (dry and wet)					
i)	between line terminals and ground (kVrms)	975 (dry only)	630 (dry only)	460	275	140
d)	One minute power frequency withstand voltage between secondary terminals & earth (kVrms)	5kV				

S. No.	Description	765kV system	400kV system	220kV system	132 kV system	66 kV System (for Tertiary loading)
11	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at (microvolts)	2500 at 508 kV rms	1000 at 266kV rms	1000 at 156kV rms	500 at 92kV rms	-NA-
12	Minimum Corona extinction voltage (kVrms)	508	320	-NA-	-NA-	-NA-
13	Seismic acceleration (Horizontal)	0.3g	0.3g	0.3g	0.3g	-NA-
14	Partial Discharge	As per IEC	As per IEC	As per IEC	As per IEC	As per IEC
15	Number of terminals	All terminals of control circuits are to be wired up to marshaling box plus 20% spare terminals evenly distributed on all TBs.				
16	Minimum Creepage distance (mm) *	20000	10500	6125	3625	1813
17	System neutral earthing	Effectively Earthed				

\*The values indicated are for specific creepage of 25mm/kV. In case of specific creepage of 31mm/kV is specified, the Minimum Creepage distance values shall be considered proportionately.

For other parameters, refer respective Table for the applicable voltage class of CTs.

### Annexure-III: Wiring Diagram of CT



NOTE

1. INTERPOLE CABLING (A) TO (R) 2.5 SQ.MM  
STRANDED FLEXIBLE ARMoured COPPER  
CABLE OF 1100V GRADE (FROM CT SEC TO  
MARSHALLING BOX).

FOR TENDER PURPOSE ONLY

**POWER GRID CORPORATION  
OF INDIA LIMITED**  
( A Government of India Enterprise )

PROJECT : STANDARD

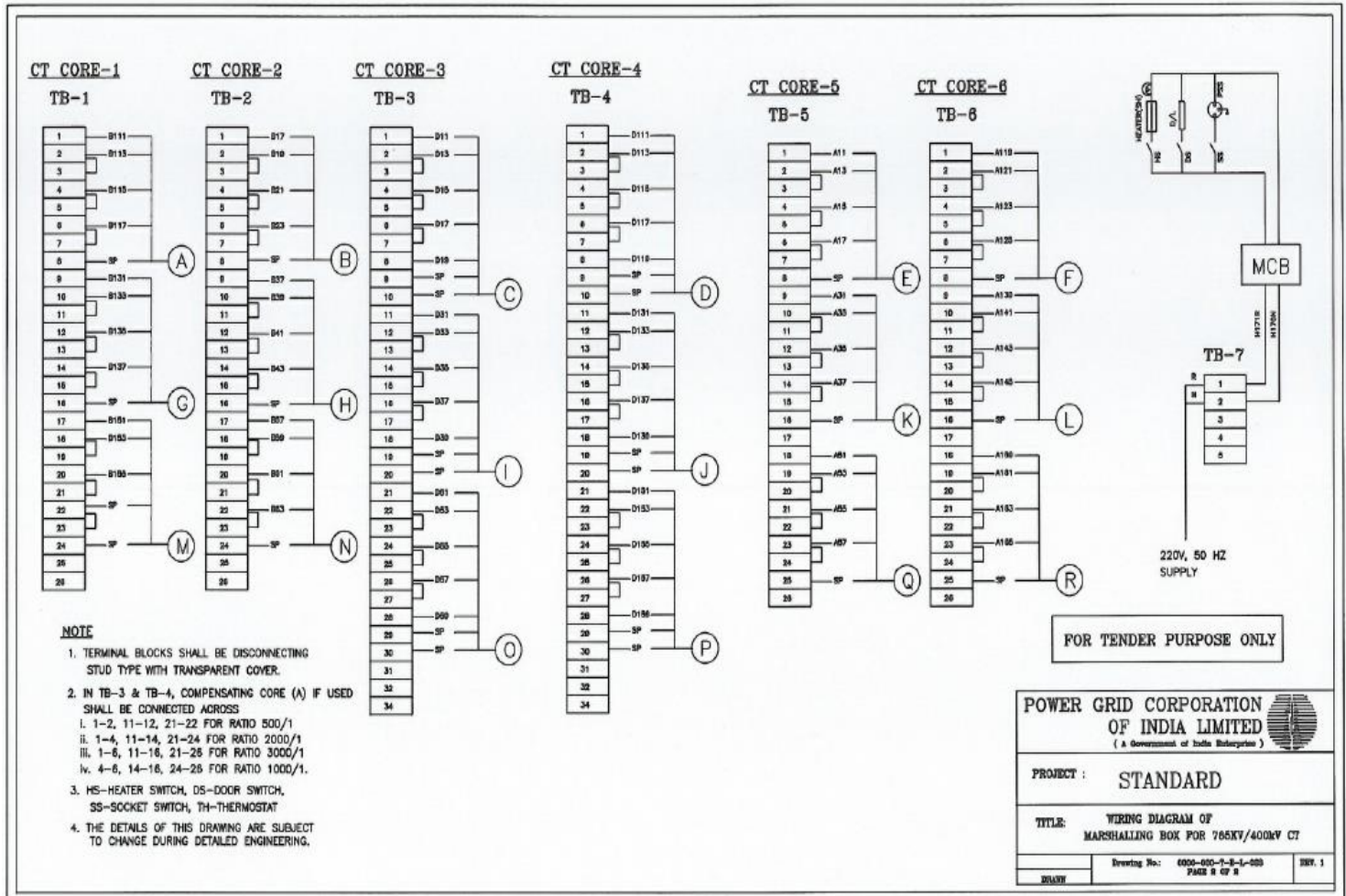
TITLE: WIRING DIAGRAM OF  
MARSHALLING BOX FOR 785KV/400KV CT

Drawing No.: 0000-000-7-X-1-CDS  
PAGE 1 OF 2

REV.  
1



### Annexure-III: Wiring Diagram of CT



**Annexure-V: Actions required in case of defects observed during warrantee period**

<b>Equipment</b>	<b>Nature of problem</b>	<b>Corrective measures to be taken by contractor</b>
CT (Oil filled)	<b>DGA Violation</b> H <sub>2</sub> > 300 ppm C <sub>2</sub> H <sub>2</sub> > 2 ppm	CT to be <b>refurbished</b> or replaced
CT (SF <sub>6</sub> filled)	a) SF <sub>6</sub> gas leakage b) High Dew point of SF <sub>6</sub> gas ( > -36 deg C at atm press)	a) Repair/ replacement b) Re-processing of gas and replacement of Gas in case of no improvement
CT (Oil filled)	<b>Violation of Tan delta</b> Tan Delta: >0.5% ( during pre-commissioning ) >0.7% ( in operation) or change w.r.t. to previous <b>year</b> value > 0.1%	Replacement of CT
CT & CVT	- Oil leakage - Low Oil level - Sec winding problem leading to open/ short circuit, saturation etc	Replacement or repair as per repair procedure approved by QA.
CVT	Secondary voltage drift: Upto ± 0.5 volts Healthy a) ± 0.5 <b>or beyond</b>	a) CVT to be replaced

**\*Replaced/Repaired/Refurbished Equipment (or part of equipment) shall have 2 years warranty without prejudice to contractual warranty period.**



**BHARAT HEAVY ELECTRICALS LIMITED**  
**TRANSMISSION BUSINESS ENGINEERING MANAGEMENT**

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DOCUMENT No.	<b>TB-424-316-000</b>	Rev. No.	<b>00</b>		Prepared	Checked	Approved	
TYPE OF DOC.	<b>TECHNICAL SPECIFICATION</b>			SIGN				
<b>TITLE</b> <b>GENERAL TECHNICAL REQUIREMENTS-SECTION 3</b>				NAME	DM	NK	SKS	
				DATE				
				GROUP	TBEM	W.O.	Awaited	
CUSTOMER	<b>Power Grid Corporation of India Limited</b> (POWERGRID)							
Station	<b>Bikaner-III/Bikaner-II Neemrana, Rajasthan</b>							
	<b>Koppal-II/ Raichur, Karnataka</b>							
	<b>AND Vatman, Halvad</b>							
<b>S.No.</b>	<b>Description</b>					<b>Sheet</b>		
1	Site Information					4		
2	General Technical Requirements					24		
3	Annexure -A					2		
4	Annexure -B					1		
5	Annexure -C					23		
6	Annexure -G					6		
7	Annexure -J					4		
8	Annexure -K (Rev. 01)					2		
9	Annexure- S1 (Size of control and Power cables)					4		
RevNo.	Date	Altered	Checked	Approved	REVISION DETAILS			
Distribution				To	TBEM	TBMM	TBQM	Supplier
				Copies	1	1	1	4



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

### Site Information -1

S.No.	Particular	Details
a)	Owner	Power Grid Corporation of India Limited (POWERGRID)
b)	Customer	Power Grid Corporation of India Limited (POWERGRID)
c)	Project Title	<b>Substation Package SS-01 for (i) 765/400/220kV Bikaner-III Pooling Station including 400kV class Bus Reactor at Bikaner-II S/s; (ii) Extension of 765kV Neemrana-II S/s for termination of 765 kV D/c line Neemrana-II–Bikaner-III T/L and (iii) Extension of 400kV Bikaner-II S/s for termination of 400kV Bikaner-II Bikaner-III T/L under “Transmission system for evacuation of power from Rajasthan REZ Ph-IV (Part-1) (Bikaner Complex)</b>
d)	Location	<b>Bikaner &amp; Neemrana, Rajasthan</b>
e)	Transport Facilities	Road/Train Nearest Rail Head For <b>Bikaner-III</b> -Bikaner Nearest Rail Head For <b>Bikaner-II</b> - Bikaner Nearest Rail Head For <b>Neemrana -II</b> - Alwar
SITE CONDITIONS		
f)	Max. ambient air temp.	50°C
g)	Min. ambient air temp.	0°C
h)	Max. design ambient temp.	50°C
i)	Costal area consideration	No
j)	Altitude above sea level	Less than 1000 meter above mean sea level (MSL)
k)	Seismic Zone	NBC2016
l)	Wind Zone	NBC2016
m)	Snow fall	NIL
Main Electrical Parameters:		
n)	Fault Levels:	765kV: 50kA for 1 Sec 400kV: 63kA for 1 Sec 220kV: 50kA for 1 sec
o)	Creepage Distance	25mm/kV for All Equipment i.e BPI/Bushings, CB, Isolator, CT, CVT, LA, WT, NCT etc. and for insulator string/ long rod insulators/ outdoor bushings - 31 mm/kV



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

### Site Information -2

Sl	Particular	Details																	
a)	Owner	Power Grid Corporation of India Ltd. (POWERGRID)																	
b)	Customer	Power Grid Corporation of India Ltd. (POWERGRID)																	
c)	Project Title	<i>Substation Package SS-09T for Extension of 765/400/220kV Koppal-II PS and Extension of 765kV Raichur SS under Transmission Scheme for integration of Renewable Energy Zone (Phase-II) in Koppal-II (Phase- B) in Karnataka</i>																	
d)	Location: Location of the Substation - The location of substation is indicated below																		
<table><tr><td>SL</td><td>Name of Substation</td><td>Name of State</td><td>Nearest Rail Head</td></tr><tr><td>1</td><td>Koppal-II PS</td><td>Karnataka</td><td><b>Koppal</b></td></tr><tr><td>2</td><td>Raichur SS</td><td>Karnataka</td><td><b>Raichur</b></td></tr><tr><td></td><td></td><td></td><td></td></tr></table>				SL	Name of Substation	Name of State	Nearest Rail Head	1	Koppal-II PS	Karnataka	<b>Koppal</b>	2	Raichur SS	Karnataka	<b>Raichur</b>				
SL	Name of Substation	Name of State	Nearest Rail Head																
1	Koppal-II PS	Karnataka	<b>Koppal</b>																
2	Raichur SS	Karnataka	<b>Raichur</b>																
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 emp.	50°C																	
d)	Design reference temp.	50°C																	
e)	Average Humidity	Max. 100%																	
	Special corrosion conditions	No																	
f)	Solar Radiation	As per applicable code, minimum 1.2kW/ Sqm																	
g)	Atmospheric UV radiation	High																	
h)	Altitude above sea level	Less than 1000 meter above mean sea level (MSL)																	
i)	Pollution Severity	Coastal Area consideration: NO																	
j)	Seismic Zone	As per IS 1893 (Part 1)																	
WIND DATA																			
k)	Wind Zone	NBC 2016																	



**General Technical Requirements- Section 3**  
**Doc. No. : TB-424-316-000 Rev 00**

	Average No. of thunderstorm days per annum	As per IS		
	Fault Level & current ratings:			
Sl. No.	Name of Substation	765kV	400kV	220kV
1.	765/400/220kV Koppal-II PS	50kA for 1 Sec	63kA for 1 Sec	50kA for 1 sec
2.	765/400kV Raichur SS	50kA for 1Sec	-	-
	Minimum Creepage Distance	25mm/kV		

The substation shall be designed considering current ratings as indicated below-

Sl. No	Description of bay	765/400/220kV Koppal-II PS			765/400kV Raichur S/S
		765kV	400kV	220 kV	765kV
1.	Bus Bar	4000A	4000A	3000A	4000A
2.	Line bay	3150A	3150A	1600A	3150A
3.	ICT bay	3150A	3150A	1600A	-
4.	Bus Reactor bay	3150A	3150A	-	-
5.	Bus Coupler bay	-	-	3000A	-
6.	Transfer Bus coupler bay	-	-	1600A	-
7.	Line Reactor bay	3150A	-	-	-
8.	Bus Sectionalizer Bay	-	-	3000A	-

Following switching schemes are proposed for the substations envisaged under this specification:

Name of s/s	765kV	400 kV	220 kV
-------------	-------	--------	--------

765/400/220kV Koppal-II PS	One & half breaker scheme	One & half breaker scheme	Double main & Transfer
765/400kV Raichur SS	One & half breaker scheme	-	-



**General Technical Requirements- Section 3**  
**Doc. No. : TB-424-316-000 Rev 00**

**Site Information -3**

S.No.	Particular	Details
a)	Owner	Power Grid Corporation of India Limited (POWERGRID)
b)	Customer	Power Grid Corporation of India Limited (POWERGRID)
c)	Project Title	<b><i>Substation Package SS01 for (a) Extn. of 765kV Sikar-II Substation, (b) Extn. of 765kV Khetri Substation; associated with “Transmission system for evacuation of power from REZ in Rajasthan (20 GW) under Phase III-Part D” through tariff based competitive bidding (TBCB) route prior to RfP bid submission by POWERGRID to BPC.”</i></b>
d)	Location	Sikar - II and Khetri, Rajasthan
e)	Transport Facilities	Road/Train Nearest Rail Head for <b>Sikar-II</b> project-Sikar Nearest Rail Head for <b>Khetri</b> project- Khetri
SITE CONDITIONS		
f)	Max. ambient air temp.	50°C
g)	Min. ambient air temp.	0°C
h)	Max. design ambient temp.	50°C
i)	Costal area consideration	No
j)	Altitude above sea level	Less than 1000 meter above mean sea level (MSL)
k)	Pollution Severity	High Pollution level
l)	Seismic Zone	As per IS – 1893
m)	Wind Zone	As per National Building Code (NBC) 2016
n)	Snow fall	NIL
Main Electrical Parameters:		
o)	Fault Levels:	765kV: 50kA for 1 s
p)	Creepage Distance	25mm/kV for All Equipment i.e BPI, CB, Isolator, CT, CVT, LA, WT, NCT etc. and 31 mm/kV for insulator string/ long rod insulators/ bushings.



## Site Information

S.No.	Particular	Details
a)	Owner	Power Grid Corporation of India Limited (POWERGRID)
b)	Customer	Power Grid Corporation of India Limited (POWERGRID)
c)	Project Title	<b>765kV SS New Pkg-SS-15T for</b> <b>(i) Establishment of 765 kV switching station near Vataman along with 2x330 MVAR (765 kV) Bus Reactor &amp; 2x330 MVAR (765 kV) Line Reactor (along with one spare unit of 110 MVAR) and 2x240 MVAR (765 kV) Line Reactor (along with one spare unit of 80 MVAR).</b> <b>(ii) Extn. of 765kV Halvad S/s for termination of 765 kV D/c Halvad- Vataman TL associated with "Transmission system for evacuation of additional 7 GW RE power from Khavda RE park under Phase-III Part B" through TBCB route</b>
d)	Location	Vataman and Halvad, Gujarat
e)	Transport Facilities	Road/Train Nearest Rail Head for <b>Vataman</b> project-Vataman Nearest Rail Head for <b>Halvad Extension</b> project- Halvad
SITE CONDITIONS		
f)	Max. ambient air temp.	50°C
g)	Min. ambient air temp.	0°C
h)	Max. design ambient temp.	50°C
i)	Costal area consideration	Yes
j)	Altitude above sea level	Less than 1000 meter above mean sea level (MSL)
k)	Pollution Severity	High Pollution level
l)	Seismic Zone	As per IS – 1893
m)	Wind Zone	As per National Building Code (NBC) 2016
n)	Snow fall	NIL
Main Electrical Parameters:		
o)	Fault Levels:	765kV: 50kA for 1 s
p)	Creepage Distance	31mm/kV for All Equipment i.e BPI, CB, Isolator, CT, CVT, LA, WT, NCT etc. ,insulator string/ long rod insulators/ bushings.





## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

### GENERAL TECHNICAL REQUIREMENTS - SECTION 3

#### 1.0 FOREWORD

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

The Supplier shall note that the standards mentioned herein are not mutually exclusive or complete in themselves, but are intended to complement each other, with minimum repetition, to define the requirements of the Specification. In the event of a conflict between requirements of any two clauses of the Specification/ documents or requirements of different codes/ standards specified, the more stringent requirement as per the interpretation of the owner shall apply, unless confirmed otherwise by the owner in writing based on a written request from the Supplier.

In case of conflicting requirements between this document (General Technical Requirement Section 3) and equipment specification (Section 1 & Section 2), equipment specification shall prevail.

When specific requirements stipulated in the Specification exceed or change those required by the applicable standards, the stipulations of the Specification shall take precedence.

Unless specifically agreed to by the Purchaser prior to Award of Contract, the Work shall be in accordance with the standards indicated and the requirements of the Specification. The Supplier shall be held responsible for any deviation.

In case of conflict between the various standards, the decision of owner shall be binding & final.

The following words and expressions shall have the meanings hereby assigned to them throughout this document

"Employer/Owner" means Power Grid Corporation of India Ltd.

"Purchaser" means Bharat Heavy Electricals Limited.

"Supplier/Manufacturer/Bidder" means the person or persons, firm or company assigned to execute the works as defined by the scope of supply, described here.

"Specification" refers to this document.

The supplier should be approved by Power Grid. If not, it is the responsibility of the vendor to be assessed and approved by Power Grid, before placement of order by BHEL. Any cost involved in vendor assessment/approval must be borne by the vendor himself.

#### 2.0 GENERAL REQUIREMENT

- 2.1 a) All equipment/materials/items, as applicable under present scope of works, shall be supplied by domestic manufacturers only with **minimum Local Content for individual items as listed annexure-K (rev.01)**

Any imported equipment/material/item/parts/component (comprising of embedded systems) to be supplied under the contract shall be tested in the certified laboratories to check for any kind of embedded malware/trojans/cyber threats and for adherence to Indian Standards as per the directions issued by Ministry of Power/Govt. of India from time to time. In case of such import from specified "prior reference" countries, the requirement of prior permission from the Govt. of India



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

including protocol for testing in certified and designated laboratories by Ministry of Power/Govt. of India shall also be complied with by the Bidder.

The bidder/contractor shall list out the products and components producing Toxic e-waste under the contract and shall furnish to the Employer the procedure of safe disposal at the time of closing of the contract.

- 2.1 b) The Supplier/Manufacturer 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 Bidder 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, 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 interchangeable with one another.
- 2.5 Deleted.
- 2.6 Deleted.

### 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 offered by the Bidder shall at least conform to the requirements specified under relevant IS standard. In case of discrepancy between IS and other international standard, provisions of IS shall prevail. The Bidder shall also note that the list of standards presented in Annexure-C is not complete. Whenever necessary, the list of standards shall be considered in conjunction with specific IS. If the IS standard is not available for an equipment/material, then other applicable International standard (IEC/Equivalent), as per the specification, shall be accepted.
- 3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.
- 3.4 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.
- 3.5 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



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

conforming to standards other than specified under Annexure-C /individual sections for various equipments shall be subject to Employer's approval.

### 4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- 4.1 Switching surge over voltage and power frequency over voltage is specified in the system parameters below. In case of the 400kV system, the initial value of the temporary overvoltages could be 2.0 p.u. for 1-2 cycles. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc under such over voltage conditions.
- 4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.
- 4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc. for the equipment.
- 4.4 The Bidder shall design terminal connectors of the equipment taking into account various forces as above at Sl.No.4.3 that are required to withstand.
- 4.5 The equipment shall also comply to the following:
- To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
  - All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

### 4.6 System Parameter

#### 765kV, 400kV & 220kV System

SL No	Description of parameters	765kV System	400kV System	220kV System
1.	System operating voltage	765kV	400kV	220kV
2.	Maximum operating voltage of the system (rms)	800kV	420kV	245kV
3.	Rated frequency	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3
5.	Rated Insulation levels			
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	2100kVp	1550kVp	1050 kVp
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	1550kVp	1050kVp	-
iii)	One minute power frequency dry withstand voltage (rms)	830kV	630kV	-
iv)	One minute power frequency dry and wet withstand voltage (rms)	-	-	460kV
6.	Corona extinction voltage	508kV	320kV	-

7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	2500 $\mu$ V at 508kV rms	1000 $\mu$ V at 266kV rms	1000 $\mu$ V at 156kV rms
8.	Minimum creepage distance - for Equipment other than Insulator string	20000 mm	10500 mm	6125 mm
	Minimum creepage distance - for Insulator String	24800 mm	13020 mm	7595 mm
9.	Min. clearances			
i.	Phase to phase	7600mm (for conductor conductor configuration) 9400mm (for rod -conductor configuration)	4000mm (for conductor conductor configuration) 4200mm (for rod -conductor configuration)	2100 mm
ii.	Phase to earth	4900mm (for conductor-structure) 6400mm (for rod-structure)	3500 mm	2100 mm
iii)	Sectional clearances	10300 mm	6500 mm	5000 mm
10.	Rated short circuit current for 1 sec. duration	50kA	63 kA	50kA
11.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed

## 66kV, 52kV and 33kV System

SL No	Description of parameters	66kV System	52 kV System	33 kV System
1.	System operating voltage	66kV	52kV	33kV
2.	Maximum operating voltage of the system(rms)	72.5kV	52kV	36kV
3.	Rated frequency	50Hz	50Hz	50Hz
4.	No. of phase	3	3	3
5.	Rated Insulation levels			
i)	Full wave impulse withstand voltage (1.2/50 microsec.)	325 kVp	250 kVp	170 kVp
ii)	One minute power frequency dry and wet withstand voltage (rms)	140kV	95kV	70kV
6.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	-	-	-



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

7.	Minimum creepage distance	1813 mm (2248mm for coastal area)	1300mm (1612 mm for coastal area)	900 mm (1116m m for coastal area)
8.	Min. Clearance			
i.	Phase to phase	750 mm	530mm	320 mm
ii.	Phase to earth	630 mm	480mm	320 mm
iii.	Sectional clearances	3100 mm	3100mm	2800 mm
9.	Rated short circuit current	25kA for 3 Sec*	25kA for 1 Sec	25 kA for 3 sec
10.	System neutral earthing	Effectively earthed	Effectively earthed	Effectively earthed

Notes:

1. The above parameters are applicable for installations up to an altitude of 1000m above mean sea level. For altitude exceeding 1000m, necessary altitude correction factor shall be applicable as per relevant IEC/IS.
2. The insulation and RIV levels of the equipments shall be as per values given in the Technical Specification of respective equipment.
3. Corona and radio interference voltage test and seismic withstand test procedures for equipments shall be in line with the procedure given at **Annexure-A** and **Annexure-B** respectively.
4. “\*” For tertiary loading Equipment’s fault level shall be 25kA for 3 Sec.

### 5.0 ENGINEERING DATA AND DRAWINGS

5.1 Deleted.

5.2 Deleted.

#### 5.3 Drawings

5.3.1 All drawings submitted by the Bidder 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 Bidder 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



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

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 Bidder's risk. The Bidder 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 Bidder's drawing or work by the Employer shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

5.6 All engineering data submitted by the Bidder 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	15 days
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)	Within 3 (three) weeks of receipt of resubmission
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-



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

- |      |  |                               |
|------|--|-------------------------------|
| 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 bidder 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) Deleted.
- (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 Bidder shall furnish to the Employer catalogues of spare parts.
- (6) Deleted.
- 5.8 Deleted.

## 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 Bidder.
- 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 fulfil 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





## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

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 Deleted.

6.1.6 The Bidder 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 Bidder shall apply all operational lubricants to the equipment installed by him.

6.1.7 All oil, grease and other consumables used in the Works/Equipment shall be purchased in India unless the Bidder 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 source of oil/grease /other consumables in the GTP/Drawings, 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. Onoff 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





## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

The degree of protection shall be in accordance with IS/IEC60947; IS/IEC/60529 . Type test report for of relevant 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, Customer Name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Employer. The rating plate of each equipment shall be according to IS/ 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 Bidder unless specifically excluded under the exclusions in these specifications and documents.

### 7.0 DESIGN IMPROVEMENTS / COORDINATION

7.1 Deleted.

7.2 Deleted.

7.3 The Bidder 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 Bidder has to coordinate designs and terminations with the agencies (if any) who are Consultants/Bidder for the Employer. The names of agencies shall be intimated to the successful bidders.

7.5 The Bidder 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 Bidder 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 Bidder's Works or at his Sub-Bidder'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.
- 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-Bidder'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 Bidder/his vendor's quality management and control activities.

### 8.2 Quality Assurance Documents

The Bidder 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.



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

- 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 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.
- Bidder 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:** Bidder 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.
- Level – II:** Bidder 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 Bidder and CIP/MICC will be issued by POWERGRID. Else, Bidder would submit their test reports/certificates to POWERGRID. CIP/MICC will be issued by POWERGRID based on review of test reports/ certificates.
- Level - III:** Bidder 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 Bidder and CIP will be issued by POWERGRID. Else, Bidder 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:** Bidder 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 Bidder 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



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

manpower in their Quality Control and Inspection department. Further, to assure quality of construction, Bidder 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 Bidder'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 Bidder shall obtain for the Employer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder'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 Bidder 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 Bidder shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing for each stage of 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 Bidder'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 Bidder 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. Bidder 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 Bidder 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 Bidder 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 Bidder shall minimize the number of inspection calls by offering optimum quantities in each inspection call at the respective manufacturer's works.
- 8.3.8 Bidder 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



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

available at the works of Contractor or their Sub-vendor before the material is offered for inspection.

- 8.3.9 Bidder 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 Bidder, 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 Bidder 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 Bidder's or Sub-Bidder'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 Bidder/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 Bidder's Test certificate by the Employer/IE. Bidder shall, on completion of all tests, submit test 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 Bidder or of any Sub-Bidder, the Bidder, 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. Bidder 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 Bidder 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.





## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

- 8.3.19 Bidder shall ensure that all possible steps are taken to avoid damages to the equipment during transport, storage and erection.
- 8.3.20 Deleted.
- 8.3.21 Bidder 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 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 Bidder's Works or at his Sub-Bidder's premises or at the Employer's site or at any other place of Work based on performance of Bidder/sub-bidder.

### 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 along with 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/representative authorized by POWERGRID/representative of Utility /representative of accredited test lab/ representative of The National Accreditation Board for Certification Bodies (NABCB) certified agency shall also be acceptable.
- Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within the years specified below from the date of NOA. In case the test reports are of the test conducted earlier than the years specified below from the date of NOA, the contractor shall repeat these test(s) at no extra cost to the Employer.

S.No	Name of Equipment	Validity of type test (in years )
1	Power Transformer	5
2	LT Transformer	5
3	Shunt Reactor	5
4	OLTC	10
5	Bushing of Power Transformers/Reactors	7
6	Fittings and accessories for Power transformers & Reactors	10
7	Circuit Breaker	10
8	Isolator	10
9	Lighting Arrester	10
10	Wave Trap	10
11	Instrument transformer	7
12	GIS & Hybrid GIS	10



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

13	LT Switchgear	10
14	Cable and associated accessories	10
15	Relays	7
16	Capacitors	10
17	Battery & Battery Charger	7
18	Conductor & Earth wire	10
19	Insulators ( Porcelain/Glass)	10
20	Composite Insulators	5
21	PLCC	5

Note :

For all other equipment's validity of type test shall be 10 years from date of NOA.

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.

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 except in the case of re-deputation if any, necessitated due to no fault of the Employer.

9.5 The list of makes of various items, for which Type test reports are not required to be submitted are specified at Annexure-J.

10.0 Deleted.

### 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 Bidder 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 Bidder 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/BHEL takes no responsibility of the availability of the wagons.



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

- 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

- 12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above. For items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq.m minimum.
- 12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- 12.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate or alternate approved treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- 12.2.4 The galvanized steel shall be subjected to four numbers of one minute dips in copper sulphate solution as per IS-2633.
- 12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.
- Coating thickness
  - Uniformity of zinc
  - Adhesion test
  - Mass of zinc coating
- 12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of touch-up zinc rich paint at site shall be allowed with approval of Engineer Incharge.

### 12.3 PAINTING

- 12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS6005 "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 Hot Phosphating shall be done for phosphating process under pretreatment of sheets 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
<b><u>Fire Protection System</u></b>			
1	Hydrant and Emulsifier system pipeline/NIFPS	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	
<b><u>Air Conditioning Plant</u></b>			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

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.



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

- 12.3.8 Band colour is required for Emulsifier system detection line only if both water and air detection lines are present at the same substation. Further, band colour shall be applied at an interval of 2 meters approx. along the length and minimum width of band shall be 25mm.

13.0 Deleted.

### 14.0 TOOLS

14.1 Deleted.

### 14.2 SPECIAL TOOLS AND TACKLES

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

### 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	$\pm 10\%$	$50 \pm 5\%$	3/4 Wire	Solidly Earthed.
240V	$\pm 10\%$	$50 \pm 5\%$	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  $\pm 10\%$ .

- 15.2 Pickup value of binary input modules of Intelligent Electronic Devices, Digital protection couplers, Analog protection couplers shall not be less than 50% of the specified rated station auxiliary DC supply voltage level.

### 16.0 SUPPORT STRUCTURE (ONLY OF CIRCUIT BREAKER)

- 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/polymer part of the bushing, porcelain/polymer enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

## 17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS (For Lightning Arrester & Wave Trap only)

- 17.1 All power clamps and connectors shall conform to IS:5561 or other equivalent international standard and shall be made of materials listed below :

Sl. No.	Description	Materials
a)	For connecting ACSR conductors/AAC conductors/ Aluminium tube	Aluminum alloy casting, conforming to designation <b>4600</b> of IS:617 and all test shall conform to IS:617
b)	For connecting equipment terminals mad of copper with ACSR conductors/AAC conductors/ Aluminium tube	Bimetallic connectors made from aluminum alloy casting, conforming to designation <b>4600</b> of IS:617 with 2mm thick bimetallic liner/strip and all test shall conform to IS:617
c)	For connecting G.I	Galvanised mild steel shield wire
d)	Bolts, nuts & plain washers	Electro-galvanised for sizes below M12, for others hot dip galvanised.
e)	Spring washers	Electro-galvanised mild steel suitable for atleast service condition-3 as per IS:1573

- 17.2 Necessary clamps and connectors shall be supplied for all equipment and connections. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.
- 17.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.
- 17.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.
- 17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner/strip of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic liner/strips shall be provided for Bi-metallic clamps.
- 17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 17.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of IPS AL tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- 17.8 Current carrying parts (500A and above) of the clamp/connector shall be provided with minimum four numbers of bolts preferably for 132kV and above.
- 17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 17.10 Power Clamps and connectors shall be designed to control corona as per requirement.



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

### 17.11 Tests

Clamps and connectors should be type tested on minimum three samples as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval. Type test once conducted shall hold good. The requirement of test conducted within last ten years, shall not be applicable.

- i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)
- ii) Short time current test
- iii) Corona (dry) and RIV (dry) test [for 132kV and above voltage level clamps]
- iv) Resistance test and Pullout strength test
- v) Cantilever Strength test on bus support clamps & connectors

### 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/IEC 61439-0, as applicable, and the clauses given below:

18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes, Out door ACDB cum DCDB panels 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.

Control cabinets, junction boxes, marshalling boxes & terminal boxes, out-door ACDB cum DCDB panels shall have adequate space/clearance as per guidelines/technical specifications to access/replace any component. Necessary component labelling to be also done on non-conducting sheet.

For CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES MARSHALLING BOXES

FOR OUTDOOR EQUIPMENT Junction Box, wire should be as per IS or equivalent IEC with FRLS grade.

Machine laid PU Foam gasket may be permitted for use in Control Cabinets etc.

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 with width more than 700 mm 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



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

- 18.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.
- 18.8 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/IEC60947 including application of 1kV rms for 1 (one) minute, after IP-55 test.

**19.0** Deleted.

### **20.0 TERMINAL BLOCKS AND WIRING**

- 20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.
- 20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non-breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But 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.



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

- 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 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, nondeteriorating 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

### 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 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 relevant IS 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.





## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

### 22.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS:

- 22.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.
- The bidder may also offer composite hollow insulators, conforming to IEC-61462.
- 22.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.
- 22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.
- 22.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- 22.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.
- 22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
- 22.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.
- 22.8 Void
- 22.9 Deleted.

### 23.0 MOTORS

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

#### 23.1 Enclosures

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



## General Technical Requirements- Section 3

Doc. No. : TB-424-316-000 Rev 00

### 23.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

### 23.3 Starting Requirements:

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

### 23.4 Running Requirements:

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

### 23.5 TESTING AND COMMISSIONING

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

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



**CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST**

**1. General**

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

**2. Test Levels:**

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

**3. Test Methods for RIV:**

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be carried out in accordance with relevant IEC of respective equipment or NEMA standard Publication No. 107-1964.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

**4. Test Methods for Visible Corona**

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped,

otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 3 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the three values at which visible corona (negative or positive polarity) disappears.

The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

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

**5. Test Records:**

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

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

**SEISMIC WITHSTAND TEST PROCEDURE**

The seismic withstanding test on the complete equipment (for 400kV and above) shall be carried out along with supporting structure. Seismic Withstand Test carried out using either lattice or pipe structure is acceptable.” **Seismic Calculations certified by NABL Labs shall also be acceptable**

The Bidder shall arrange to transport the structure from his Contractor’s premises/ POWERGRID sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Employer. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Employer.

The frequency range for the earthquake spectra shall be as per IEC-62271-300.

**LIST OF GENERAL STANDARDS AND CODES**

<b>CODES</b>	<b>TITLE</b>
--	India Electricity Rules
--	Indian Electricity Act
--	Indian Electricity (Supply) Act
--	Indian Factories Act
IS-5	Colors for Ready Mixed Paints and Enamels
IS-335	New Insulating Oils
IS-617	Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes
IS-1448 (P1 to P 145)	Methods of Test for Petroleum and its Products
IS-2071 (P1 to P3)	Methods of High Voltage Testing
IS-12063	Classification of degrees of protection provided by enclosures of electrical equipment
IS-2165 ; P1:1997, P2:1983	Insulation Coordination
IS-3043	Code of Practice for Earthing
IS-6103	Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids
IS-6104	Method of Test for Interfacial Tension of Oil against Water by the Ring Method
IS-6262	Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids
IS-6792	Method for determination of electric strength of insulating oils
IS-5578	Guide for marking of insulated conductors
IS-11353	Guide for uniform system of marking & identification of conductors & apparatus terminals.
IS-8263	Methods for Radio Interference Test on High voltage Insulators
IS-9224 (Part 1,2&4)	Low Voltage Fuses
IEC-60060 (Part 1 to P4)	High Voltage Test Techniques
IEC 60068	Environmental Test
IEC-60117	Graphical Symbols
IEC-60156	Method for the Determination of the Electrical Strength of Insulation Oils
IEC-60270	Partial Discharge Measurements
IEC-60376	Specification and Acceptance of New Sulphur Hexafluoride
IEC-60437	Radio Interference Test on High Voltage Insulators
IEC-60507	Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems
IEC-62271-1	Common Specification for High Voltage Switchgear & Control gear Standards
IEC-60815	Guide for the Selection of Insulators in respect of Polluted Conditions

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IEC-60865 (P1 & P2)	Short Circuit Current - Calculation of effects
ANSI-C.1/NFPA.70	National Electrical Code
ANSI-C37.90A	Guide for Surge Withstand Capability (SWC) Tests
ANSI-C63.21, C63.3	Specification for Electromagnetic Noise and Field Strength Instrumentation 10 KHz to 1 GHZ
C36.4ANSI-C68.1	Techniquet for Dielectric Tests
ANSI-C76.1/EEE21	Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings
ANSI-SI-4	Specification for Sound Level Meters
ANSI-Y32-2/C337.2	Drawing Symbols
ANSI-Z55.11	Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray
NEMA-107T	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-II	General Standards for Industrial Control and Systems Part ICSI-109
CISPR-1	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0.15 MHz to 30 MHz
CSA-Z299.1-1978h	Quality Assurance Program Requirements
CSA-Z299.2-1979h	Quality Control Program Requirements
CSA-Z299.3-1979h	Quality Verification Program Requirements
CSA-Z299.4-1979h	Inspection Program Requirements
<b>TRANSFORMERS AND REACTORS</b>	
IS:10028 (Part 2 & 3)	Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991)
IS-2026 (P1 to P4)	Power Transformers
IS-3347 (part 1 to Part 8)	Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres
IS-3639	Fittings and Accessories for Power Transformers
IS-6600	Guide for Loading of oil immersed Transformers
IEC-60076 (Part 1 to 5)	Power Transformers
IEC-60214	On-Load Tap-Changers
IEC-60289	Reactors
IEC- 60354	Loading Guide for Oil - Immersed power transformers
IEC-60076-10	Determination of Transformer and Reactor Sound Levels
ANSI-C571280	General requirements for Distribution, Power and Regulating Transformers
ANSI-C571290	Test Code for Distribution, Power and Regulation Transformers
ANSI-C5716	Terminology & Test Code for Current Limiting Reactors
ANSI-C5721	Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA
ANSI-C5792	Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
ANSI-CG,IEEE-4	Standard Techniques for High Voltage Testing
IEC 60076	Power transformers
IEC 60076-1	Part 1: General
IEC 60076-2	Part 2: Temperature rise
IEC 60076-3	Part 3: Insulation levels, dielectric tests and external clearances in air
IEC 60076-4	Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors
IEC 60076-3-1	Part 3-1: Insulation Levels and Dielectric Tests –External Clearances in Air
IEC 60076-5	Part 5: Ability to withstand short circuit
IEC 60076-6	Part 6: Reactors
IEC 60076-7	Part 7: Loading guide for oil-immersed power transformers
IEC 60076-8	Part 8: Application guide
IEC 60076-10	Part 10: Determination of sound levels
IEC 60076-10-1	Part 10-1: Determination of sound levels - Application guide
IEC 60076-11	Part 11: Dry-type transformers
IEC 60076-12	Part 12: Loading guide for dry-type power transformers
IEC 60076-13	Part 13: Self-protected liquid-filled transformers
IEC 60076-14	Part 14: Design and application of liquid-immersed power transformers using high-temperature insulation materials
IEC 60076-15	Part 15: Gas-filled power transformers
IEC 60076-16	Part 16: Transformers for wind turbine applications
IEC 60076-18	Part 18: Measurement of frequency response
IEC 60076-19	Part 19: Rules for the determination of uncertainties in the measurement of losses in power transformers and reactors
IEC 60076-21	Part 21: Standard requirements, terminology, and test code for step-voltage regulators
IEC 60044, BS 3938	Current transformers
IEC 60050	International Electrotechnical Vocabulary
IEC 60050(421)	International Electrotechnical vocabulary- Chapter 421 : Power Transformers and Reactors
IEC 60060	High Voltage test techniques
IEC 60060-1	General definitions and test requirements
IEC 60060-2	Measuring systems
IEC 60071	Insulation co-ordination
IEC 60071-1	Part 1: Definitions, principles and rules
IEC 60071-2	Part 2 : Application guide
IEC 60137	Bushing for alternating voltage above 1000V
IEC 60214	On-Load Tap changers
IEC 255-21-3	Relays vibration

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IEC 60270	Partial discharge measurements
IEC 60296	Specification for Unused Mineral Oil for Transformers and Switchgear
IEC 60422	Supervision and Maintenance guide for Mineral Insulating Oil in Electrical Equipment
IEC 60475	Method of Sampling Liquid dielectrics
IEC 60529	Classification of Degrees of Protection provided by Enclosures
IEC 60542	Application Guide for On-Load Tap-Changers
IEC 60567	Guide for the Sampling of Gases and of Oil from Oil-filled Electrical Equipment for the Analysis of Free and Dissolved Gases
IEC 60651	Sound Level Meters
IEC 61083	Digital Recorders and Software for High Voltage Impulse testing
IEC 61083-1	Part 1: Requirements for digital recorders in high voltage impulse tests
IEC 61083-2	Part 2: Evaluation of software used for the determination of the parameters of impulse waveforms
CISPR 16	Specification for radio disturbance and immunity measuring apparatus
CISPR 16-1	Radio disturbance and immunity measuring apparatus
CISPR-18	Radio Interference Characteristics of Power Lines and High Voltage Equipment
ISO 9001	Quality system-Model for Quality Assurance in Design /development
Cigre Publication 202	Guidelines for conducting design reviews for transformers 100 MVA and 123 kV and above. August 2002-Cigre Working Group 12.22
WG 12-15	Guide for Customers Specifications for Transformers 100 MVA and 123 kV and above
WG 12 19	Short Circuit Performance of Transformers.
BS-4360	Specification for weldable structural steel
BS-5135	Specification for arc welding of carbon and carbon manganese steels
BS-5500	Specification for unfired fusion welded pressure vessels
IS-3618	Specification for phosphate treatment of iron & steel for protection against corrosion
IS-6005	Code of practice for phosphating of Iron and Steel
ISO-8501	Preparation of steel surface before application of Paints and related product
IEC-60599	Mineral oil impregnated electrical equipment in service – guide to the interpretation of dissolved and free gases analysis
IS-10593	Method of evaluating the analysis of gases in oil filled electrical equipment in service
IS-2099	Bushings for alternating voltages above 1000 volts

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS-3347 Part I to 8	Dimension for porcelain transformer bushing
DIN-42530	Bushing up to 1000kV from 250A-5000A for liquid filled Transformer
IS-2026 Part 1 to 5	Power transformer
IS-4691	Degrees of protection provided by enclosure for rotating electrical machinery
IEC-60034-5	Degrees of protection provided by integral design of rotating electrical machines(IP Code) classification
IS:325 / IEC -60034	Performance of cooling fan / oil pump motor
IS-13947 part 1 to 5	Specification for low voltage switchgear and control gear
IS:3400	Methods of test for vulcanised rubber
IS:7016 part 1 to 14	Methods of test for coated and treated fabrics
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks.
IS:3637	Gas operated Relays
IS:335	New Insulating oils – Specification
IEC-62271-203	Gas insulated metal enclosed switchgear for rated voltage above 52kV
IEC-61639	Direct connection between power transformers and gas-insulated metal enclosed switchgear for rated voltages of 52.5 kV and above.
IS:3400 / BS 903 / IS:7016	Air cell ( Flexible Air Separator)
IEC 60529 / IP : 55	Degree of protection for cooler control cabinet , MOLG, Cooling fan , oil pump, Buchholz Relay
IEC 60529 / IP : 56	Degree of protection for Pressure Relief Device
IEC 60529 / IP : 43	Degree of protection for Remote tap Changer cubicle (RTCC)
<b>CIRCUIT BREAKERS</b>	
IEC-62271-100	High-voltage switchgear and control gear - Part 100: Alternating current circuit-breakers
IEC-62271-101	High-voltage switchgear and control gear - Part 101: Synthetic testing
IEC-62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V
IEC-62271-110	High-voltage switchgear and control gear - Part 110: Inductive load switching
IEC-62271-109	High-voltage switchgear and control gear - Part 110: Inductive load switching
<b>CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS</b>	
IS-2705- (P1 to P4)	Current Transformers



**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS:3156- (P1 to P4)	Voltage Transformers
IS-4379	Identification of the Contents of Industrial Gas Cylinders
IEC-61869 (Part-1)	Instrument transformers - Part 1: General requirements
IEC-61869 (Part-2)	Instrument transformers - Part 2: Additional requirements for current transformers
IEC-61869 (Part-3)	Instrument transformers - Part 3: Additional requirements for inductive voltage transformers
IEC-61869 (Part-4)	Instrument transformers - Part 4: Additional requirements for combined transformers
IEC-61869 (Part-5)	Instrument transformers - Part 5: Additional requirements for capacitor voltage transformers
IEC-61869 (Part-6)	Instrument transformers - Part 6: Additional general requirements for low-power instrument transformers
IEC-61869 (Part-9)	Instrument transformers - Part 9: Digital interface for instrument transformers
IEC-61869 (Part-102)	Instrument transformers - Part 102: Ferroresonance oscillations in substations with inductive voltage transformers
IEC-61869 (Part-103)	Instrument transformers - The use of instrument transformers for power quality measurement
<b>BUSHING</b>	
IS-2099	Bushings for Alternating Voltages above 1000V
IEC-60137	Insulated Bushings for Alternating Voltages above 1000V
<b>SURGE ARRESTERS</b>	
IS-3070 (PART2)	Lightning arresters for alternating current systems : Metal oxide lightning arrestors without gaps
IEC-60099-4	Metal oxide surge arrestors without gaps
IEC-60099-5	Selection and application recommendation
ANSI-C62.1	IEE Standards for S A for AC Power Circuits
NEMA-LA 1	Surge Arresters
<b>CUBICLES AND PANELS &amp; OTHER RELATED EQUIPMENTS</b>	
IS-722, IS-1248	Electrical relays for power system
IS-3231, 3231 (P-3)	Protection
IS:5039	Distributed pillars for Voltages not Exceeding 1000 Volts
IEC-60068.2.2	Basic environmental testing procedures Part 2: Test B: Dry heat
IEC-60529	Degree of Protection provided by enclosures
IEC-60947-4-1	Low voltage switchgear and control gear
IEC-61095	Electromechanical Contactors for household and similar purposes
IEC-60439 (P1 & 2)	Low Voltage Switchgear and control gear assemblies
ANSI-C37.20	Switchgear Assemblies, including metal enclosed bus
ANSI-C37.50	Test Procedures for Low Voltage Alternating Current Power

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
	Circuit Breakers
ANSI-C39	Electric Measuring instrument
ANSI-C83	Components for Electric Equipment
IS: 8623: (Part I to 3)	Specification for Switchgear & Control Assemblies
NEMA-AB	Moulded Case Circuit and Systems
NEMA-CS	Industrial Controls and Systems
NEMA-PB-1	Panel Boards
NEMA-SG-5	Low voltage Power Circuit breakers
NEMA-SG-3	Power Switchgear Assemblies
NEMA-SG-6	Power switching Equipment
NEMA-5E-3	Motor Control Centers
1248 (P1 to P9)	Direct acting indicating analogue electrical measuring instruments & their accessories
<b>Disconnecting switches</b>	
IEC-62271-102	High-voltage switchgear and control gear - Part 102: Alternating current disconnectors and earthing switches
IEC-60265 (Part 1 & 2)	High Voltage switches
ANSI-C37.32	Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories
ANSI-C37.34	Test Code for high voltage air switches
NEMA-SG6	Power switching equipment
<b>PLCC and line traps</b>	
IS-8792	Line traps for AC power system
IS-8793	Methods of tests for line traps
IS-8997	Coupling devices for PLC systems
IS-8998	Methods of test for coupling devices for PLC systems
IEC-60353	Line traps for A.C. power systems
IEC-60481	Coupling Devices for power line carrier systems
IEC-60495	Single sideboard power line carrier terminals
IEC-60683	Planning of (single Side-Band) power line carrier systems
CIGRE	Teleprotection report by Committee 34 & 35
CIGRE	Guide on power line carrier 1979
CCIR	International Radio Consultative Committee
CCITT	International Telegraph & Telephone Consultative Committee
EIA	Electric Industries Association
<b>Protection and control equipment</b>	
IEC-60051: (P1 to P9)	Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories
IEC-60255 (Part 1 to 23)	Electrical relays
IEC-60297 (P1 to P4)	Dimensions of mechanical structures of the 482.6mm (19 inches)

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
	series
IEC-60359	Expression of the performance of electrical & electronic measuring equipment
IEC-60387	Symbols for Alternating-Current Electricity meters
IEC-60447	Man machine interface (MMI) - Actuating principles
IEC-60521	Class 0.5, 1 and 2 alternating current watt hour metres
IEC-60547	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments)
ANSI-81	Screw threads
ANSI-B18	Bolts and Nuts
ANSI-C37.1	Relays, Station Controls etc
ANSI-C37.2	Manual and automatic station control, supervisory and associated telemetering equipment
ANSI-C37.2	Relays and relay systems associated with electric power apparatus
ANSI-C39.1	Requirements for electrical analog indicating instruments
<b>MOTORS</b>	
IS-325	Three phase induction motors
IS-4691	Degree of protection provided by enclosure for rotating electrical machinery
IEC-60034 (P1 to P19:)	Rotating electrical machines
IEC-Document 2	Three phase induction motors
(Central Office) NEMA-MGI	Motors and Generators
<b>Electronic equipment and components</b>	
MIL-21B, MIL-833 & MIL-2750	Environmental testing
EC-60068 (P1 to P5)	Printed boards
IEC-60326 (P1 to P2)	Material and workmanship standards
IS-1363 (P1 to P3)	Hexagon head bolts, screws and nuts of product grade C
IS-1364 (P1 to P5)	Hexagon head bolts, screws and nuts of products grades A and B
IS-3138	Hexagonal Bolts and Nuts (M42 to M150)
ISO-898	Fasteners: Bolts, screws and studs
ASTM	Specification and tests for materials
<b>Clamps &amp; connectors</b>	
IS-5561	Electric power connectors
NEMA-CC1	Electric Power connectors for sub station
NEMA-CC 3	Connectors for Use between aluminium or aluminum-Copper Overhead Conductors
<b>Bus hardware and insulators</b>	
IS: 2121	Fittings for Aluminum and steel cored Al conductors for overhead

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
	power lines
IS-731	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V
IS-2486 (P1 to P4)	Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V
IEC-60120	Dimensions of Ball and Socket Couplings of string insulator units
IEC-60137	Insulated bushings for alternating voltages above 1000 V
IEC-60168	Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V
IEC-62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V
IEC-60273	Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V
IEC-61462	Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations
IEC-60305	Insulators for overhead lines with nominal voltage above 1000V-ceramic or glass insulator units for ac systems Characteristics of String Insulator Units of the cap and pin type
IEC-60372 (1984)	Locking devices for ball and socket couplings of string insulator units : dimensions and tests
IEC-60383 (P1 and P2)	Insulators for overhead lines with a nominal voltage above 1000 V
IEC-60433	Characteristics of string insulator units of the long rod type
IEC-60471	Dimensions of Clevis and tongue couplings of string insulator units
ANSI-C29	Wet process porcelain insulators
ANSI-C29.1	Test methods for electrical power insulators
ANSI-C92.2	For insulators, wet-process porcelain and toughened glass suspension type
ANSI-C29.8	For wet-process porcelain insulators apparatus, post-type
ANSI-G.8	Iron and steel hardware
CISPR-7B	Recommendations of the CISPR, tolerances of form and of Position, Part 1
ASTM A-153	Zinc Coating (Hot-Dip) on iron and steel hardware
<b>Strain and rigid bus-conductor</b>	
IS-2678	Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube
IS-5082	Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes
ASTM-B 230-82	Aluminum 1350 H19 Wire for electrical purposes

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
ASTM-B 231-81	Concentric - lay - stranded, aluminum 1350 conductors
ASTM-B 221	Aluminum - Alloy extruded bar, rod, wire, shape
ASTM-B 236-83	Aluminum bars for electrical purpose (Bus-bars)
ASTM-B 317-83	Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)
<b>Batteries</b>	
IS:1651	Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates)
IS:1652	Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates)
IS:1146	Rubber and Plastic Containers for Lead-Acid Storage Batteries
IS:6071	Synthetic Separators for Lead-Acid Batteries
IS:266	Specification for Sulphuric Acid
IS:1069	Specification for Water for Storage Batteries
IS:3116	Specification for Sealing Compound for Lead-Acid Batteries
IS:1248	Indicating Instruments
IS:10918	Vented type nickel Cadmium Batteries
IEC:60896-21&22	Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements
IEC: 60623	Vented type nickel Cadmium Batteries
IEC:60622	Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell
IEC:60623	Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell
IEC:60896-11	Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests
IEEE-485	Recommended practices for sizing of Lead Acid Batteries
IEEE-1115	Sizing of Ni-Cd Batteries
IEEE-1187	Recommended practices for design & installation of VRLA Batteries
IEEE-1188	Recommended practices for design & installation of VRLA Batteries
IEEE-1189	Guide for selection of VRLA Batteries
<b>Battery Charger</b>	
IS:3895	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS:4540	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment
IS:6619	Safety Code for Semiconductor Rectifier Equipment
IS:2026	Power Transformers

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS:2959	AC Contactors for Voltages not Exceeding 1000 Volts
IS:1248	Indicating Instruments
IS:2208	HRC Fuses
IS:13947 (Part-3)	Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC
IS:2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS:6005	Code of practice for phosphating of Iron and Steel
IS:3231	Electrical relays for power system protection
IS:3842	Electrical relay for AC Systems
IS:5	Colours for ready mix paint
IEEE-484	Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations
IEEE-485	Sizing large lead storage batteries for generating stations and substations
<b>Wires and cables</b>	
ASTMD-2863	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	PVC insulated cables for working voltages upto and including 1100 Volts
IS-1255	Code of practice for installation and maintenance of power cables, upto and including 33 kV rating
IS-1554 (P1 and P2)	PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V Part (2) for working voltage from 3.3 kV upto and including 11kV
IS:1753	Aluminium conductor for insulated cables
IS:2982	Copper Conductor in insulated cables
IS-3961 (P1 to P5)	Recommended current ratings for cables
IS-3975	Mild steel wires, formed wires and tapes for armouring of cables
IS-5831	PVC insulating and sheath of electric cables
IS-6380	Elastometric insulating and sheath of electric cables
IS-7098	Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts
IS-7098	Cross-linked polyethyle insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV
IS-8130	Conductors for insulated electrical cables and flexible cords
IS-1753	Aluminum Conductors for insulated cables
IS-10418	Specification for drums for electric cables
IEC-60096 (part 0 to p4)	Radio Frequency cables
IEC-60183	Guide to the Selection of High Voltage Cables

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IEC-60189 (P1 to P7)	Low frequency cables and wires with PVC insulation and PVC sheath
IEC-60227 (P1 to P7)	Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V
IEC-60228	Conductors of insulated cables
IEC-60230	Impulse tests on cables and their accessories
IEC-60287 (P1 to P3)	Calculation of the continuous current rating of cables (100% load factor)
IEC-60304	Standard colours for insulation for low-frequency cables and wires
IEC-60331	Fire resisting characteristics of Electric cables
IEC-60332 (P1 to P3)	Tests on electric cables under fire conditions
IEC-60502	Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV
IEC-754 (P1 and P2)	Tests on gases evolved during combustion of electric cables
<b>AIR conditioning and ventilation</b>	
IS-659	Safety code for air conditioning
IS-660	Safety code for Mechanical Refrigeration
ARI:520	Standard for Positive Displacement Refrigeration Compressor and Condensing Units
IS:4503	Shell and tube type heat exchanger
ASHRAE-24	Method of testing for rating of liquid coolers
ANSI-B-31.5	Refrigeration Piping
IS:2062	Steel for general structural purposes
IS:655	Specification for Metal Air Dust
IS:277	Specification for Galvanised Steel Sheets
IS-737	Specification for Wrought Aluminium and Aluminium Sheet & Strip
IS-1079	Hot rolled cast steel sheet & strip
IS-3588	Specification for Electrical Axial Flow Fans
IS-2312	Propeller Type AC Ventilation Fans
BS-848	Methods of Performance Test for Fans
BS-6540 Part-I	Air Filters used in Air Conditioning and General Ventilation
BS-3928	Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors)
US-PED-2098	Method of cold DOP & hot DOP test
MIL-STD-282	DOP smoke penetration method
ASHRAE-52	Air cleaning device used in general ventilation for removing particle matter
IS:3069	Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials



**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS:4671	Expanded Polystyrene for Thermal Insulation Purposes
IS:8183	Bonded Mineral Wool
IS:3346	Evaluation of Thermal Conductivity properties by means of guarded hot plate method
ASTM-C-591-69	Standard specification for rigid preformed cellular urethane thermal insulation
IS:4894	Centrifugal Fans
BS:848	Method of Performance Test for Centrifugal Fans
IS:325	Induction motors, three-phase
IS:4722	Rotating electrical machines
IS:1231	Three phase foot mounted Induction motors, dimensions of
IS:2233	Designations of types of construction and mounting arrangements of rotating electrical machines
IS:2254	Vertical shaft motors for pumps, dimensions of
IS:7816	Guide for testing insulation resistance of rotating machines
IS:4029	Guide for testing three phase induction motors
IS: 4729	Rotating electrical machines, vibration of, Measurement and evaluation of
IS:4691	Degree of protection provided by enclosures for rotating electrical machinery
IS:7572	Guide for testing single-phase ac motors
IS:2148	Flame proof enclosure for electrical apparatus
BS:4999(Part-51)	Noise levels
<b>Galvanizing</b>	
IS-209	Zinc Ingot
IS-2629	Recommended Practice for Hot-Dip galvanizing on iron and steel
IS-2633	Methods for testing uniformity of coating of zinc coated articles
ASTM-A-123	Specification for zinc (Hot Galvanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips
ASTM-A-121-77	Zinc-coated (Galvanized) steel barbed wire
<b>Painting</b>	
IS-6005	Code of practice for phosphating of iron and steel
ANSI-Z551	Gray finishes for industrial apparatus and equipment
SSPEC	Steel structure painting council
<b>Fire protection system</b>	
--	Fire protection manual issued by tariff advisory committee (TAC) of India
<b>HORIZONTAL CENTRIFUGAL PUMPS</b>	
IS:1520	Horizontal centrifugal pumps for clear, cold and fresh water
IS:9137	Code for acceptance test for centrifugal & axial pumps



**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS:5120	Technical requirement – Rotodynamic special purpose pumps
API-610	Centrifugal pumps for general services Hydraulic Institutes Standards
BS:599	Methods of testing pumps
PTC-8.2	Power Test Codes - Centrifugal pumps
<b>DIESEL ENGINES</b>	
IS:10000	Methods of tests for internal combustion engines
IS:10002	Specification for performance requirements for constant speed compression ignition engines for general purposes (above 20 kW)
BS:5514	The performance of reciprocating compression ignition (Diesel) engines, utilizing liquid fuel only, for general purposes
ISO:3046	Reciprocating internal combustion engines performance
IS:554	Dimensions for pipe threads where pressure tight joints are required on threads
ASME Power Test Code	Internal combustion engine PTC-17
--	Codes of Diesel Engine Manufacturer's Association, USA
<b>PIPING VALVES &amp; SPECIALITIES</b>	
IS:636	Non percolating flexible fire-fighting delivery hose
IS:638	Sheet rubber jointing and rubber inserting jointing
IS:778	Gun metal gate, globe and check valves for general purpose
IS:780	Sluice valves for water works purposes (50 to 300 mm)
IS:901	Couplings, double male and double female instantaneous pattern for fire fighting
IS:902	Suction hose couplings for fire-fighting purposes
IS:903	Fire hose delivery couplings branch pipe nozzles and nozzle spanner
IS:1538	Cast iron fittings for pressure pipes for water, gas and sewage
IS:1903	Ball valve (horizontal plunger type) including floats for water supply purposes
IS:2062	SP for weldable structural steel
IS:2379	Colour Code for the identification of pipelines
IS:2643	Dimensions of pipe threads for fastening purposes
IS:2685	Code of Practice for selection, installation and maintenance of sluice valves
IS:2906	Sluice valves for water-works purposes (350 to 1200 mm size)
IS:3582	Basket strainers for fire-fighting purposes (cylindrical type)
IS:3589	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter)
IS:4038	Foot valves for water works purposes
IS:4927	Unlined flax canvas hose for fire fighting

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS:5290	Landing valves (internal hydrant)
IS:5312 (Part-I)	Swing check type reflex (non-return) valves
IS:5306	Code of practice for fire extinguishing installations and equipment on premises
Part-I	Hydrant systems, hose reels and foam inlets
Part-II	Sprinkler systems
BS:5150	Specification for cast iron gate valves
<b>MOTORS &amp; ANNUNCIATION PANELS</b>	
IS:325	Three phase induction motors
IS:900	Code of practice for installation and maintenance of induction motors
IS:996	Single phase small AC and universal electric motors
IS:1231	Dimensions of three phase foot mounted induction motors
IS:2148	Flame proof enclosure of electrical apparatus
IS:2223	Dimensions of flange mounted AC induction motors
IS:2253	Designations for types of construction and mounting arrangements of rotating electrical machines
IS:2254	Dimensions of vertical shaft motors for pumps
IS:3202	Code of practice for climate proofing of electrical equipment
IS:4029	Guide for testing three phase induction motors
IS:4691	Degree of protection provided by enclosure for rotating electrical machinery
IS:4722	Rotating electrical machines
IS:4729	Measurement and evaluation of vibration of rotating electrical machines
IS:5572	Classification of hazardous areas for electrical (Part-I) installations (Areas having gases and vapours)
IS:6362	Designation of methods of cooling for rotating electrical machines
IS:6381	Construction and testing of electrical apparatus with type of protection 'e'
IS:7816	Guide for testing insulation for rotating machine
IS:4064	Air break switches
IEC DOCUMENT 2 (Control Office) 432	Three Phase Induction Motor
VDE 0530 Part I/66	Three Phase Induction Motor
IS:9224 (Part-II)	HRC Fuses
IS:6875	Push Button and Control Switches
IS:694	PVC Insulated cables
IS:1248	Indicating instruments
IS:375	Auxiliary wiring & busbar markings

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS:2147	Degree of protection
IS:5	Colour Relay and timers
IS:2959	Contactors
<b>PG Test Procedures</b>	
NFPA-13	Standard for the installation of sprinkler system
NFPA-15	Standard for water spray fixed system for the fire protection
NFPA-12A	Standard for Halong 1301 Fire Extinguishing System
NFPA-72E	Standard on Automatic Fire Detectors
--	Fire Protection Manual by TAC (Latest Edition)
NFPA-12	Standard on Carbon dioxide extinguisher systems
IS:3034	Fire of industrial building
--	Electrical generating and distributing stations code of practice
IS:2878	CO <sub>2</sub> (Carbon dioxide) Type Extinguisher
IS:2171	DC (Dry Chemical Powder) type
IS:940	Pressurised Water Type
<b>D.G. SET</b>	
IS:10002	Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes
IS:10000	Method of tests for internal combustion engines
IS:4722	Rotating electrical machines-specification
IS:12063	Degree of protection provided by enclosures
IS:12065	Permissible limit of noise levels for rotating electrical machines
--	Indian Explosive Act 1932
<b>Steel structures</b>	
IS-228 (1992)	Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P1 to 3)	Code of practice for use of structural steel in overhead transmission line towers
IS-806	Code of practice for use of steel tubes in general building construction
IS-808	Dimensions for hot rolled steel beam, column channel and angle sections
IS-814	Covered electrodes for manual arc welding of carbon of carbon manganese steel
IS-816	Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817	Code of practice for training and testing of metal arc welders. Part 1 : Manual Metal arc welding
IS-875 (P1 to P4)	Code of practice for design loads (other than earthquake) for buildings and structures
IS-1161	Steel tubes for structural purposes

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS-1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS-1363 (P1 to P3)	Hexagonal head bolts, screws & nuts of products grade C
IS-1364	Hexagon head bolts, screws and nuts of product grades A and B
IS-1367 (P1 to P18)	Technical supply condition for threaded steel fasteners
IS-1599	Methods for bend test
IS-1608	Method for tensile testing of steel products
IS-1893	Criteria for earthquake resistant design of structures
IS-1978	Line Pipe
IS-2062	Steel for general structural purposes
IS-2595	Code of practice for Radiographic testing
IS-3063	Single coil rectangular section spring washers for bolts, nuts and screws
IS-3664	Code of practice for ultrasonic pulse echo testing by contact and immersion methods
IS-7205	Safety code for erection of structural steel work
IS-9595	Recommendations for metal arc welding of carbon and carbon manganese steels
ANSI-B18.2.1	Inch series square and Hexagonal bolts and screws
ANSI-B18.2.2	Square and hexagonal nuts
ANSI-G8.14	Round head bolts
ASTM-A6	Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use
ASTM-A36	Specifications of structural steel
ASTM-A47	Specification for malleable iron castings
ASTM-A143	Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement
ASTM-A242	Specification for high strength low alloy structural steel
ASTM-A283	Specification for low and intermediate tensile strength carbon steel plates of structural quality
ASTM-A394	Specification for Galvanized steel transmission tower bolts and nuts
ASTM-441	Specification for High strength low alloy structural manganese vanadium steel
ASTM-A572	Specification for High strength low alloy colombium-Vanadium steel of structural quality
AWS D1-0	Code for welding in building construction welding inspection
AWS D1-1	Structural welding code
AISC	American institute of steel construction
NEMA-CG1	Manufactured graphite electrodes

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
<b>Piping and pressure vessels</b>	
IS-1239 (Part 1 and 2)	Mild steel tubes, tubulars and other wrought steel fittings
IS -3589	Seamless Electrically welded steel pipes for water, gas and sewage
IS-6392	Steel pipe flanges
ASME	Boiler and pressure vessel code
ASTM-A120	Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use
ASTM-A53	Specification for pipe, steel, black, and hot-dipped, zinc coated welded and seamless
ASTM-A106	Seamless carbon steel pipe for high temperature service
ASTM-A284	Low and intermediate tensile strength carbon-silicon steel plates for machine parts and general construction
ASTM-A234	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-S181	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	Forgings, carbon steel for piping components
ASTM-A307	Carbon steel externally threaded standard fasteners
ASTM-A193	Alloy steel and stainless steel bolting materials for high temperature service
ASTM-A345	Flat rolled electrical steel for magnetic applications
ASTM-A197	Cupola malleable iron
ANSI-B2.1	Pipe threads (Except dry seal)
ANSI-B16.1	Cast iron pipe flanges and flanged fitting. Class 25, 125, 250 and 800
ANSI-B16.1	Malleable iron threaded fittings, class 150 and 300
ANSI-B16.5	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B16.9	Factory-made wrought steel butt welding fittings
ANSI-B16.11	Forged steel fittings, socket-welding and threaded
ANSI-B16.14	Ferrous pipe plug, bushings and locknuts with pipe threads
ANSI-B16.25	Butt welding ends
ANSI-B18.1.1	Fire hose couplings screw thread
ANSI-B18.2.1	Inch series square and hexagonal bolts and screws
ANSI-B18.2.2	Square and hexagonal nuts
ANSI-B18.21.1	Lock washers
ANSI-B18.21.2	Plain washers
ANSI-B31.1	Power piping
ANSI-B36.10	Welded and seamless wrought steel pipe
ANSI-B36.9	Stainless steel pipe
<b>Other civil works standards</b>	

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS-269	33 grade ordinary portland cement
IS2721	Galvanized steel chain link fence fabric
IS-278	Galvanized steel barbed wire for fencing
IS-383	Coarse and fine aggregates from natural sources for concrete
IS-432 (P1 and P2)	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement
IS-456	Code of practice for plain and reinforced concrete
IS-516	Method of test for strength of concrete
IS-800	Code of practice for general construction in steel
IS-806	Steel tubes for structural purposes
IS-1172	Basic requirements for water supply, drainage and sanitation
IS-1199	Methods of sampling and analysis of concrete
IS-1566	Hard-drawn steel wire fabric for concrete reinforcement
IS-1742	Code of Practice for Building drainage
IS-1785	Plain hard-drawn steel wire for pre-stressed concrete
IS-1786	High strength deformed Steel Bars and wires for concrete reinforcement
IS-1811	Methods of sampling Foundry sands
IS-1893	Criteria for earthquake resistant design of structures
IS-2062	Steel for general structural purposes
IS-2064	Selection, installation and maintenance of sanitary appliances-code of practices
IS-2065	Code of practice for water supply in buildings
IS-2090	High tension steel bars used in pre-stressed concrete
IS-2140	Standard Galvanized steel wire for fencing
IS-2470 (P1 & P2)	Code of practice for installation of septic tanks
IS-2514	Concrete vibrating tables
IS-2645	Integral cement waterproofing compounds
IS-3025 (Part 1 to Part 48)	Methods of sampling and test (Physical and chemical) for water and waste water
IS-4091	Code of practice for design and construction of foundations for transmission line towers and poles
IS-4111 (Part 1 to P5)	Code of practice for ancillary structures in sewerage system
IS-4990	Plywood for concrete shuttering work
IS-5600	Sewage and drainage pumps
<b>National building code of India 1970</b>	
USBR E12	Earth Manual by United States Department of the interior Bureau of Reclamation
ASTM-A392-81	Zinc/Coated steel chain link fence fabric
ASTM-D1557-80	test for moisture-density relation of soils using 10-lb (4.5 kg)

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
	rame land 18-in. (457 mm) Drop
ASTM-D1586(1967)	Penetration Test and Split-Barrel Sampling of Soils
ASTM-D2049-69	Test Method for Relative Density of Cohesionless Soils
ASTM-D2435	Test method for Unconsolidated, (1982) Undrained Strengths of Cohesive Soils in Triaxial Compression
BS-5075	Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures
CPWD	Latest CPWD specifications
<b>ACSR MOOSE CONDUCTOR</b>	
IS:6745 BS:443-1969	Methods for Determination of Mass of zinc coating on zinc coated Iron and Steel Articles
IS:8263	Methods for Radio Interference
IEC:437-1973 NEMA:107-1964 CISPR	Test on High Voltage Insulators
IS:209, BS:3436-1961	Zinc Ingot
IS:398 Part - V IEC:209-1966	Aluminum Conductors for Overhead Transmission Purposes
BS:215(Part-II), IEC:209-1966	Aluminium Conductors galvanized steel reinforced extra high voltage (400 kV and above)
IS:1778, BS:1559-1949	Reels and Drums for Bare Conductors
IS:1521, ISO/R89-1959	Method for Tensile Testing of steel wire
IS:2629	Recommended practice for Hot dip Galvanising on Iron and Steel
IS:2633	Method for Testing Uniformity of coating of zinc Coated Articles
IS:4826/ ASTMA-472-729	Hot dip galvanised coatings on round steel wires
<b>GALVANISED STEEL EARTHWIRE</b>	
IS:1521, ISO/R:89-1959	Method for Tensile Testing of Steel Wire
IS:1778	Reels and Drums for Bare Conductors
IS:2629	Recommended practice for Hot Dip Galvanising on Iron and Steel
IS:2633	Methods for testing Uniformity of Coating of Zinc Coated Articles
IS:4826/ ASTM: A 475-72a BS:443-1969	Hot dip Galvanised Coatings on Round Steel Wires
IS:6745/ BS:443-1969	Method for Determination of mass of Zinc Coating on Zinc coated Iron and Steel Articles.
IS:209/ BS:3463-1961	Zinc ingot
IS:398 (Pt. I to P5:1992)/ BS:215 (Part-II	Aluminum Conductors for overhead transmission purposes



**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
<b>Lighting Fixtures and Accessories</b>	
IS:1913	General and safety requirements for electric lighting fittings
IS:3528	Water proof electric lighting fittings
IS:4012	Dust proof electric lighting fittings
IS:4013	Dust tight proof electric lighting fittings
IS:10322	Industrial lighting fittings with metal reflectors
IS:10322	Industrial lighting fittings with plastic reflectors
IS:2206	Well glass lighting fittings for use under ground in mines (non-flameproof type)
IS:10322	Specification for flood light
IS:10322	Specification for decorative lighting outfits
IS:10322	Luminaries for street lighting
IS:2418	Tubular fluorescent lamps
IS:9900	High pressure mercury vapour lamps
IS:1258	Specification for Bayonet lamp fluorescent lamp
IS:3323	Bi-pin lamp holder tubular fluorescent lamps
IS:1534	Ballasts for use in fluorescent lighting fittings. (Part-I)
IS:1569	Capacitors for use in fluorescent lighting fittings
IS:2215	Starters for fluorescent lamps
IS:3324	Holders for starters for tubular fluorescent lamps
IS:418	GLS lamps
IS:3553	Water tight electric fittings
IS:2713	Tubular steel poles
IS:280	MS wire for general engg. Purposes
<b>Conduits, Accessories and Junction Boxes</b>	
IS:9537	Rigid steel conduits for electrical wiring
IS:3480	Flexible steel conduits for electrical wiring
IS:2667	Fittings for rigid steel conduits for electrical wiring
IS:3837	Accessories for rigid steel conduits for electrical wiring
IS:4649	Adaptors for flexible steel conduits
IS:5133	Steel and Cast Iron Boxes
IS:2629	Hot dip galvanising of Iron & Steel
<b>Lighting Panels</b>	
IS:13947	LV Switchgear and Control gear(Part 1 to 5)
IS:8828	Circuit breakers for over current protection for house hold and similar installations
IS:5	Ready mix paints
IS:2551	Danger notice plates
IS:2705	Current transformers



**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS:9224	HRC Cartridge fuse links for voltage above 650V(Part-2)
IS:5082	Wrought aluminium and Al. alloys, bars, rods, tubes and sections for electrical purposes
IS:8623	Factory built Assemblies of Switchgear and Control Gear for voltages upto and including 1000V AC and 1200V DC
IS:1248	Direct Acting electrical indicating instruments
<b>Electrical Installation</b>	
IS:1293	3 pin plug
IS:371	Two to three ceiling roses
IS:3854	Switches for domestic and similar purposes
IS:5216	Guide for safety procedures and practices in electrical work
IS:732	Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts.)
IS:3043	Code of practice for earthing
IS:3646	Code of practice of interior illumination part II & III
IS:1944	Code of practice for lighting of public through fares
IS:5571	Guide for selection of electrical equipment for hazardous areas
IS:800	Code of practice for use of structural steel in general building construction
IS:2633	Methods of Testing uniformity of coating on zinc coated articles
IS:6005	Code of practice for phosphating iron and steel
	INDIAN ELECTRICITY ACT
	INDIAN ELECTRICITY RULES
<b>LT SWITCHGEAR</b>	
IS:8623 (Part-I)	Specification for low voltage switchgear and control gear assemblies
IS:13947 (Part-I)	Specification for low voltage switchgear and control gear, Part 1 General Rules
IS:13947 (part-2)	Specification for low voltage switchgear and control gear, Part 2 circuit breakers
IS:13947 (part-3)	Specification for low voltage switchgear and control gear. Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units
IS:13947 (part-4)	Specification for low voltage switchgear and control gear. Part 4 Contactors and motors starters
IS:13947 (part-5)	Specification for low voltage switchgear and control gear. Part 5 Control-circuit devices and switching elements
IS:13947 (part-6)	Specification for low voltage switchgear and control gear. Part 6 Multiple function switching devices
IS:13947 (part-7)	Specification for low voltage switchgear and control gear. Part 7 Ancillary equipments
IS:12063	Degree of protection provided by enclosures

## **SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)**

### **ANNEXURE-C**

<b>CODES</b>	<b>TITLE</b>
IS:2705	Current Transformers
IS:3156	Voltage Transformers
IS:3231	Electrical relays for power system protection
IS:1248	Electrical indicating instruments
IS:722	AC Electricity meters
IS:5578	Guide for Marking of insulated conductors of apparatus terminals
IS:13703 (part 1)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 1 General Requirements
IS:13703 (part 2)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 2 Fuses for use of authorized persons
IS:6005	Code of practice of phosphating iron and steel
IS:5082	Wrought Aluminum and Aluminum alloys for electrical purposes
IS:2633	Hot dip galvanising

Note: If any standard is expired or does not exist anymore than other standard which has substituted it, shall be applicable.

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****Annexure-G****MQP & INSPECTION LEVEL REQUIREMENT**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
A.01	LT Transformer /Power Transformer/ Reactor/ Converter Transformer/ Filter Reactor	MQP/ITP	IV
A.02	Bushing	MQP	IV
A.03	Insulating Oil	POWERGRID TS	III
A.04	Oil storage tank for transformers	MQP	III
A.05	Nitrogen injection based explosion prevention system	FAT/ITP	III
A.06	On Line oil drying system for transformers	POWERGRID TS	II**
A.07	On Line DGA and moisture monitoring system	POWERGRID TS	II**
A.08	Flow sensitive conservator isolation valve	POWERGRID TS	II**
A.09	Oil Filtration Machine	MQP	III
B.01	Circuit Breakers	MQP	IV
B.02	Current Transformers	MQP/ITP	IV
B.03	CVT/PT/IVT	MQP	IV
B.04	Isolators	MQP/ITP	IV
B.05	Surge Arrestors	MQP/ITP	III
B.06	Line Trap & Air Core Reactor	MQP/ITP	III
B.07	Point On switching device (CSD) for Circuit Breaker (wherever required)	FAT/ITP	IV
C.01	STATCOM including Valve, valve base electronics, DC capacitor, series reactor and all accessories	ITP	IV
C.02	Mechanically switched Reactor bank (3-ph) including all accessories (MSR Branches)	ITP	IV
C.03	Mechanically switched Capacitor bank (3-ph) including all accessories (MSC Branches)	ITP	IV
C.04	Harmonic Pass filters	ITP	IV
C.05	HT Capacitor	MQP	IV
D.01	Thyristor Valve	FAT/ITP	III
D.02	PLC Capacitors for HVDC	FAT/ITP	III
D.03	Valve Cooling system for	FAT/ITP	III

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
	HVDC		
D.04	AC/DC Filter Resistors	ITP	III
D.05	DC Current and Voltage measuring device for HVDC	FAT/ITP	III
D.06	Maintenance platform for valve hall	POWERGRID TS	II
D.07	Optical signal column for FSC	FAT/ITP	II
E.01	GIS including spares	MQP/ITP	IV
E.02	Dew Point Meter for GIS	POWERGRID TS	I*
E.03	Portable Partial Discharge monitoring system for GIS	POWERGRID TS	I*
E.04	Partial Discharge Monitoring System (Online) for GIS	ITP	III
E.05	PEB Structure and Puf Panels	MQP	III
F.01	Substation Automation system	FAT/MQP	III
F.02	Event Logger	POWERGRID TS	III
F.03	PLCC equipment Viz PLCC Terminal ,Carrier equipment, Protection Coupler , Coupling Device but excluding EPAX / HF Cable	MQP	III
F.04	Control & Relay Panels	MQP	III
G.01	EHV Cables	MQP/ITP	III
G.02	Power Cables & Control Cables	MQP	III
G.03	Cable Joints (11 kV and above)	POWERGRID TS	II
G.04	Cable Lugs & Glands / Clamps/Terminations	POWERGRID TS	I
H.01	LT Switchgear & ACDB/DCDB/MLDB/ELDB	MQP	III
H.02	Battery	POWERGRID TS	II
H.03	Battery Charger	MQP	III
H.04	UPS & Voltage Stabilizer	MQP/FAT	III
H.05	D. G. Set	FAT/ITP	III
H.06	Lighting Panel	POWERGRID TS	II
H.07	Lighting Poles	POWERGRID TS	II
H.08.1	Lighting Fixtures, Lighting Earthwire, Switches / sockets, Conduits, Lamps & fans including exhaust fans	POWERGRID TS	I
H.8.2	Solar based LEDs System including street light/pole solar panel, Inverter controller/LED fixture	FAT	III
H.09	MS/GI /PVC Pipes for cable	POWERGRID TS	I

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
	trenches and lighting		
H.10	Outdoor Receptacle	POWERGRID TS	I
H.11	Split A.C/window A.C./ precision AC/ Kiosk AC/ Cascade AC/ Tower AC	POWERGRID TS	I
H.12	Occupancy sensors for control of lighting	POWERGRID TS	I
H.13	Solar based street lighting pole including Solar Panel, Inverter, Controller, etc.	POWERGRID TS	III
H.14	Junction Box / Lighting Switch Boards / Bay MB / Portable Flood Light Panel	POWERGRID TS	II
H.15	Lighting transformer	POWERGRID TS	II
I.01	SF6 gas processing unit, SF6 gas Leakage detector, SF6 gas Analyzer	POWERGRID TS	I*
I.02	SF6 Gas	POWERGRID TS	I
I.03	Spark Gap	FAT/ITP	III
I.04	Time synchronizing Equipment (GPS Clock)	POWERGRID TS	I
I.05	Galvanized Cable trays	POWERGRID TS	II
I.06	Video Monitoring System	FAT/ITP	I
I.07	Public Address System (All Components)	POWERGRID TS	I
I.08	Building Management System (All components)	POWERGRID TS	I
I.09	Access Control System (All Components)	POWERGRID TS	I
I.10	Video Display system/ Video Projection system	POWERGRID TS	I
I.11	VESDA (smoke detector)	POWERGRID TS	I
I.12	High Mast Pole	MQP	III
J.01	Aluminium ladder	POWERGRID TS	I
J.02	Hume Pipes	POWERGRID TS	I
J.03	Castle Key	POWERGRID TS	I
J.04	Water Treatment plant (All components).	POWERGRID TS	I
J.05	Furniture	POWERGRID TS	I
J.06	DOL Starter	POWERGRID TS	I
J.07	Oil Sample Bottles and Syringe	POWERGRID TS	I
J.08	Test & Measuring Equipment, T&P	POWERGRID TS	I*
K.01	EOT Crane	POWERGRID TS	II

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
K.02	Boom Crane/Golf Cart/Platform Truck/Man Lift/ Fork Lift/ Lifts	POWERGRID TS	II
L.00	Fire Protection System		
L.001	Panels, Hydro pneumatic tank for fire protection system.	POWERGRID TS	III
L.002	Deluge valve, Strainers, MS/GI pipes, Pumps, motors, air compressor, and other valves, Diesel Engines	POWERGRID TS	II
L.003	Others	POWERGRID TS	I
M.00	HVAC SYSTEM		
M.001	Air Cooled Chiller	POWERGRID TS	III
M.002	Pump	POWERGRID TS	II
M.003	Air Handling Unit	POWERGRID TS	II
M.004	Fan Filter Unit With Centrifugal Blower	POWERGRID TS	II
M.005	Axial Flow Fan	POWERGRID TS	II
M.006	Main Climate Control Unit (Dehumidifier)	POWERGRID TS	I
M.007	Dampers	POWERGRID TS	II
M.008	Fire Dampers	POWERGRID TS	II
M.009	Pressure Gauge, Thermometers, Other Instruments / Sensors	POWERGRID TS	I
M.010	Grill, Diffuser, Jet Nozzle, Louvers etc	POWERGRID TS	I
M.011	Ducting	POWERGRID TS	III
M.012	M S Pipe	POWERGRID TS	II
M.013	Pipe Insulation Material	POWERGRID TS	I
M.014	Duct Insulation Material	POWERGRID TS	I
M.015	Underdeck Insulation Material	POWERGRID TS	I
M.016	Gate Valve & Non Return valve	POWERGRID TS	I
M.017	Y Strainer	POWERGRID TS	II
M.018	Ball Valve/ Motorised Butterfly Valve/ Balancing Valve	POWERGRID TS	I
M.019	Closed Expansion Tank	POWERGRID TS	II
M.020	Air Separator	POWERGRID TS	I
M.021	MCC /PLC /Electrical Panels	POWERGRID TS	III
M.022	Propeller Fan/ Conduit	POWERGRID TS	II
M.023	Air Filter/ Mixing Valve with Thermostat	POWERGRID TS	I

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
N.01	SDH Equipment	FAT/ITP	IV
N.02	Termination Equipment Primary/DI Multiplexer	FAT/ITP	IV
N.03	DACS	FAT/ITP	IV
N.04	Optical Amplifier	FAT/ITP	IV
N.05	FODP including pigtail, Joint Box, FDMS	FAT/ITP	II
N.06	IMPS	FAT/ITP	IV
N.07	Optical bypass switch	FAT/ITP	IV
N.08	Air Purifier	FAT/ITP	I
N.09	Patch cord & connector	FAT/ITP	I
N.10	NMS	FAT/ITP	IV
N.11	OPGW Cable	MQP/ITP/FAT	III
N.12	Hardware Fittings for OPGW cable	MQP/ITP	III
N.13	DCPS	FAT/ITP	III
N.14	Radio Links	FAT/ITP	III
N.15	SMPS based DC Power Supply (DCPS) system	FAT/ITP	III
N.16	WAMS (PMU & Accessories)	FAT/ITP	III
N.17	PUF Shelter	FAT/ITP	III
N.18	Aerial OFC/UGOFC/ADSS/FO Cable	FAT/ITP	III
N.19	DWDM	FAT/ITP	III
N.20	OTN	FAT/ITP	III
N.21	MPLS-TP Equipment	FAT/ITP	III
N.22	L2 Switch	FAT/ITP	III
N.23	IP-MPLS Router	FAT/ITP	III
N.24	HDPE Pipes	POWERGRID TS	II
N.25	Equipment Cabinets	POWERGRID TS	II
N.26	Main Distribution Frame	POWERGRID TS	I
N.27	Telephone system, EPAX, Telephone wires, Telephone sockets	POWERGRID TS	I
N.28	Fibre Optic Cable	MQP	III
N.29	Hardware Fittings for Fibre Optic cable	MQP	III
O.01	Re-rollers of MS/HT Angle Section and galvanized tower parts.	MQP	IV
O.02	Conductor	MQP	IV
O.03	Hardware fittings and Conductor & Earthwire Accessories	MQP	IV
O.04	Earth wire	MQP	IV

**SECTION-GENERAL TECHNICAL REQUIREMENTS (GTR)****Annexure-G**

Sl. No	Item / Equipment	Reference document for inspection	Inspection Level
O.05	Insulator	MQP	IV
O.06	Bolts & Nuts of Gr 8.8 / 8	MQP	IV
O.07	Mono Pole	MQP	IV
O.08	Foundation Bolts & Anchor Bolts	POWERGRID TS	III
O.09	D-shackle/ Hanger / Links and associated Special bolt/nuts	MQP	III
O.10	Span Marker, Obstruction lights and Wind Measuring Equipment	POWERGRID TS	III
O.11	MS ROD rolled by Approved Re-roller of POWERGRID	MQP	III
O.12	MS ROD rolled by Approved steel producers of POWERGRID	POWERGRID TS	I
O.13	Spring Washers & Pack washers	POWERGRID TS	II
O.14	Bolts & Nuts Gr up to 5.6/5	POWERGRID TS	II
O.15	ACD & Barbed wire for ACD/Bird guard	POWERGRID TS	II
O.16	Danger Plate /Phase Plate / Number Plate / Circuit plate	POWERGRID TS	I
O.17	Sub Station Structure (lattice/pipe type)	MQP	III
O.18	Clamps & Connectors (including equipment connectors)	MQP	III
O.19	MS/ GI Flat, rod type, pipe type and other earthing material.	POWERGRID TS	II
O.20	Aluminium Tube & Busbar materials	POWERGRID TS	II
O.21	Pipe Type & Counter Poise Earthing	POWERGRID TS	II
O.22	DTS System	POWERGRID TS	II
<p>For Equipment where requirement of MQP is envisaged, ITP/FAT will be followed If sourced from off shore. For items required in S/S or T/L or TELECOM/LD&amp;C , same inspection level as specified shall be followed for all the cases.</p> <p>* MICC for test and measuring equipment (inspection level I or II) shall be issued only after actual verification/ demonstration of satisfactory performance at site.</p> <p>** Though level-2 items, CIP/MICC can be issued also on review of TCs and visual inspection of these item.</p>			



# ANNEXURE-J

## LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED

Sl. No.	ITEM DESCRIPTION	MAKE
<b>A.</b>	<b><i>Substation Accessories [Type Testing is not envisaged]</i></b>	
1.	Out door receptacles	CGL/B&C/BCH/Sakti, Chennai/Indo Asian/AVAIDS
2.	Trefoil clamp	Moulded Fibre Glass Products, Calcutta
3.	Diesel Engine	Cummins/Ruston & Hornsby/Greaves Cotton/Kirloskar/Mahindra/Ashok Leyland
4.	Alternator	AVK/KIRLOSKAR/STAMFORD/ Leroy Somer
5.	Motors	KEC/Siemens/NGEF/Crompton/ABB
6.	Cable Glands	Sunil & Co./Arup/ Comet/QPIE
7.	Junction Box	Sarvana/ECS/C&S/Vikas/ Maktel/Unilac/Jasper/ Amara raja/AVAIDS
8.	EPAX	MATRIX, BPL
9.	ACSR Conductor (Bersimis/Moose/Zebra)	Sterlite/Apar/HVPL/Sharavathy/Hiren Aluminium Ltd./Smita/Deepak Cables/Polycab wires/Cabcon/JSK
10.	AAC Conductor (BULL)	Sterlite/Cabcon /JSK
11.	G.S. Earthwire	Sharavathy/Bharat Wire Ropes/Ramswarup
12.	Lighting Fixtures	Phillips/CGL/Bajaj /Havels
13.	Lighting Transformer	Gujarat-Plug-In
14.	Lighting Panels	Vikas/Makel/Nitya/AVAIDS
15.	MCCB/ACB/Protective relays of LT Switchgear Boards	All approved makes as per Compendium of Vendors
16.	EOT Crane	Reva
<b>B.</b>	<b><i>ACCESSORIES FOR TRANSFORMER &amp; REACTOR [Earlier approved type test reports is applicable and not required to be submitted]</i></b>	
17.	BUCHHOLZ RELAY [Upto 765kV Transformer & Reactor]	(i) M/S CEDESPE, ITALY [Model Type-EE 3 (Plug & Socket type)]/ (ii) M/s VIAT INSTRUMENTS PVT. LTD.KOLKATA [Model type-GOR-3M (Plug & Socket type)]
18.	PRESSURE RELIEF DEVICE [Upto 765kV Transformer & Reactor]	(i) M/S SUKRUT UDYOG, Pune [Model type-T-6-MS-15-SHB-PS (Plug & Socket type)] /
19.	MAGNETIC OIL LEVEL GAUGE [Upto 765kV Transformer & Reactor]	(i) M/S SUKRUT UDYOG PUNE [Model type-SO-HE-10-M-ATMS-PS (Plug & Socket type)], [Model Type:- SO-6-M-P-PS (Plug & Socket type)]/
20.	AIR CELL (FLEXIBLE AIR SEPARATOR) [Upto 765kV Transformer & Reactor]	Type test of following makes are not to be submitted (i) M/S PRONAL FRANCE / (ii) FUJIKURA,JAPAN / (iii) PRONAL ASIA, MALAYSIYA / (iv) SHENYANG HONGDA GENERAL RUBBER FACTORY /

# ANNEXURE-J

## LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED

Sl. No.	ITEM DESCRIPTION	MAKE
		(v) BAODING XINKE RUBBER PRODUCT INSTITUTE, CHINA / (vi) M/S ZENITH INDUSTRIAL RUBBER PRODUCTS PVT. LTD. THANE / (vii) M/S UNIRUB TECHNO PUNE
21.	OTI & WTI [Upto 765kV Transformer & Reactor]	(i) M/S PRESIMEASURE BANGALORE [Model type-1005A]
22.	OIL PUMP [Upto 765kV Transformer & Reactor]	(i) FLOWWELL PUMPS & METERS, BANGALORE [Model type-1220D, 1250D]
23.	COOLING FAN AND MOTOR ASSEMBLY [Upto 765kV Transformer & Reactor]	(i) M/S MARATHON LTD KOLKATA [Model Type:- 36M/K75-P8, 0.7kW, 725RPM, 22J/K37-P6, 0.25kW, 940RPM, AFF 915103, 0.625kW, 550RPM]
24.	Sudden Pressure Relay [Upto 765kV Transformer & Reactor]	(i) Qualitrol [Model/Drawing No.900-003-02 CS-46518, 900-003-32 CS-46369] / (ii) Shenyang KEQI Electrical Equipment Co. Ltd. [Model/Drawing No.SYJ9-50-25 <sup>TH</sup> ]
25.	BUCHHOLZ RELAY [Upto 400kV Transformer & Reactor]	(i) M/S CEDASPE, ITALY [Model type-EE3 (Plug & Socket type)]/ (ii) VIAT INSTRUMENTS [Model type-GOR-3M (Plug & Socket type)]
26.	PRESSURE RELIEF DEVICE [Upto 400kV Transformer & Reactor]	(i) M/S SKURUT UDYOG, PUNE [Model type-T-6-MS-15-SHB-PS (Plug & Socket type)]
27.	MAGNETIC OIL LEVEL GAUGE [Upto 400kV Transformer & Reactor]	(i) M/S SUKRUT UDYOG PUNE [Model type-SO-HE-10-M-ATMS-PS (Plug & Socket type)], [Model Type: SO-6-M-P-PS (Plug & Socket type)]/ (ii) M/S YOGYA ENTERPRISES, JHANSI [Model type-SO-10 (Plug & Socket type)]
28.	AIR CELL (FLEXIBLE AIR SEPARATOR) [Upto 400kV Transformer & Reactor]	Type test of following makes are not to be submitted (i) M/S THE RUBBER PRODUCTS MUMBAI / (ii) M/S UNIRUB TECHNO PUNE / (iii) M/S PRONAL FRANCE / (iv) M/S ZENITH INDUSTRIAL RUBBER PRODUCTS PVT. LTD. THANE / (v) SHENYANG HONGDA GENERAL RUBBER FACTORY, CHINA
29.	Sudden Pressure Relay [Upto 400kV Transformer & Reactor]	(i) Qualitrol [Model/Drawing No.900-003-02 CS-46518, 900-003-32 CS-46369] / (ii) VIAT INSTRUMENTS [Model/Drawing No.950 / (iii) Shenyang KEQI Electrical Equipment Co. Ltd. [Model/Drawing No.SYJ9-50-25 <sup>TH</sup> ]
30.	RIP Bushing (52kV, 3150A)	ABB Micafil, Switzerland [Model/Drawing No. 1ZCD073617 (Rev F)]
31.	RIP Bushing (420kV, 1250A)	ABB, SWEDEN [Model/Drawing No.1ZSC005378A0001 REV. K]
32.	RIP Bushing (245kV, 1250A)	ABB, SWEDEN [Model/Drawing No.1ZSC005416A0001 (Rev. D)]
33.	RIP Bushing (245kV, 2000A)	ABB, SWEDEN [Model/Drawing No.1ZSC005373A0001

**ANNEXURE-J****LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED**

Sl. No.	ITEM DESCRIPTION	MAKE
		(Rev. C)]
34.	RIP Bushing (420kV, 1250A)	HSP Germany [Model/Drawing No.327470]
35.	RIP Bushing (245kV, 2000A)	HSP Germany [Model/Drawing No.329260]
36.	RIP Bushing (52kV, 3150A)	HSP Germany [Model/Drawing No.329280]
37.	RIP Bushing (420kV, 1250A)	Izolyator, Russia [Model/Drawing No.686354.603]
38.	RIP Bushing (245kV, 2000A)	Izolyator, Russia [Model/Drawing No.686353.602]
39.	RIP Bushing (52kV, 3150A)	Izolyator, Russia [Model/Drawing No.686351.601]
40.	RIP Bushing (145kV, 1250A)	Izolyator, Russia [Model/Drawing No.686352.604]
41.	RIP Bushing (420kV, 1250A)	TRENCH, CHINA [Model/Drawing No.ECT 707 (C2)]
42.	RIP Bushing (245kV, 2000A)	TRENCH, CHINA [Model/Drawing No.ECT 617 (C3)]
43.	RIP Bushing (245kV, 1250A)	TRENCH, CHINA [Model/Drawing No.ECT 616 (C3)]
44.	RIP Bushing (145kV, 1250A)	TRENCH, CHINA [Model/Drawing No.ECT 516 (C3)]
45.	RIP Bushing (52kV, 1250A)	TRENCH, CHINA [Model/Drawing No.ECT 415 (C3)]
46.	RIP Bushing (52kV, 3150A)	TRENCH, CHINA [Model/Drawing No.ECT 419 (C3)]
47.	RIP Bushing (420kV, 1250A)	Xian China [Model/Drawing No.75706 (Rev 09)]
48.	RIP Bushing (245kV,2000A)	Xian China [Model/Drawing No.75618 (Rev 09)]
49.	RIP Bushing (52kV, 3150A)	Xian China [Model/Drawing No.75366 (Rev 03)]
50.	RIP Bushing (52kV, 3150A)	Xian China [Model/Drawing No.75332 (Rev 08)]
51.	OIP Bushing (800kV, 2500A)	ABB, SWEDEN [Model / Drawing No. GOE-2550-1600-2500-0.6-B, 1ZSC026186-AAM REV. H]
52.	OIP Bushing (420kV, 2500A)	ABB, SWEDEN [Model / Drawing No.GOE-1425-1150-2500-0.6, 1ZSC026186-AAL REV. F]
53.	OIP Bushing (800kV, 2500A)	TBEA, CHINA [Model / Drawing No.TBEA-500-765T-A0035-01, REV. 02]
54.	OIP Bushing (420kV, 2500A)	TBEA, CHINA [Model / Drawing No.TBEA-500-765T-A0035-02, REV. 02]
55.	OIP Bushing (420kV, 2500A)	TRENCH, CHINA [Model / Drawing No.OT-738-1 (C 5)]
56.	OLTC (500MVA, 765kV ICT)	MR Germany [Model/Drawing No. MI 1503 72.5/RC- 12231WR]
57.	OLTC (500MVA, 400kV ICT)	Easun MR, Chennai [Model/Drawing No. 3 x MI 1200 300/D 10.19.3W]
58.	OLTC (220kV & below rating transformer)	BHEL, Bhopal [Model/Drawing No.MIII 600 110/C 10.19.3W]
<b>C.</b>	<b>TESTING EQUIPMENT FOR TRANSFORMER &amp; REACTOR</b>	
59.	Oil BDV Test Kit	Baur [Model/Drawing No.DTA 100C]
60.	Oil BDV Test Kit	Megger [Model/Drawing No.OTS 100AF]

**ANNEXURE-J****LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED**

<b>Sl. No.</b>	<b>ITEM DESCRIPTION</b>	<b>MAKE</b>
61.	Online Dissolved Gas (Multi-gas) and Moisture Analyser	A Eberle GmbH & Co. KG [Model/Drawing No.HYDROCAL 1008]
62.	Online Dissolved Gas (Multi-gas) and Moisture Analyser	Ningbo Ligong Online Monitoring Technology Co. LTD [Model/Drawing No.MGA2000]
63.	Online Dissolved Gas (Multi-gas) and Moisture Analyser	GE Energy [Model/Drawing No.KELMAN TRANSFIX]
64.	Online Dissolved Gas (Multi-gas) and Moisture Analyser	Qualitrol Company LLC [Model/Drawing No.SERVERON TM 8]
65.	On line Insulating Oil Drying System	CEE DEE Vacuum Equipment Pvt. Ltd. [Model/Drawing No.TRANSDDRY CD-002]
66.	On line Insulating Oil Drying System	PTSS [Model/Drawing No.PTSS-TDS1GA6XS]
67.	Portable Dissolved Gas Analysis of Insulating Oil	GE Energy [Model/Drawing No. KELMAN TRANSPORT X]

**NOTES:-**

1. For sub-station accessories mentioned at Sr. No. A above, model specific separate approval of type test report is not required.
2. For Transformer/Reactor accessories & testing equipment mentioned at Sr. No. B & C above, wherever, model/drawing no. is specified separate approval of type test report and drawing/documents is not required, thus requirement of type test report validity of 10 years is not applicable.

Sl. No.	Power System Equipment	Minimum Local Content (%)
1	Power Transformers (up to 765 kV, including Generator Transformers)	60
2	Instrument Transformer (up to 765 kV)	60
3	Transformer Oil Dry Out System (TODOS)	60
4	Reactors up to 765 kV	60
5	Oil Impregnated Bushing (Up to 400kV)	60
6	Resin Insulated Paper (RIP) bushings (up to 145 kV)	50
7	Circuit Breakers (up to 765kV AC-Alternating Current)	60
8	Disconnectors, Isolators (up to 765kV AC)	60
9	Wave Trap (up to 765kV AC)	60
10	Oil Filled Distribution Transformers up to & including 33kV [Cold Rolled Grain Oriented (CRGO)/Amorphous, Aluminium/Copper wound]	60
11	Dry type Distribution Transformers up to & including 33kV (CRGO/Amorphous, Aluminium/Copper wound)	60
12	Conventional conductor	60
13	Accessories for conventional conductors	60
14	High Temperature/High Temperature Low Sag (HTLS) conductors (such as Composite core, GAP, ACSS, INVAR, AL59) and accessories	60
15	Optical ground wire (OPGW)- all designs	60
16	Fiber Optic Terminal Equipment (FOTE) for OPGW	50
17	OPGW related Hardware and accessories	60
18	Remote Terminal Unit (RTU)	50
19	Power Cables and accessories up to 33kV	60
20	Control cables including accessories	60
21	XLPE cables up to 220kV	60
22	Substation Structures	60
23	Transmission Line Towers	60
24	Porcelain (Disc/Long Rod) Insulators	60
25	Bus Post Insulators (Porcelain)	60
26	Porcelain Disc Insulators with Room Temperature Vulcanisation (RTV) coating	50
27	Porcelain Long Rod Insulators with Room temperature Vulcanisation (RTV) coating	50
28	Hardware Fittings for porcelain Insulators	60
29	Composite/Polymeric Long Rod Insulators	60
30	Hardware Fittings for Polymer Insulators	60
31	Bird Flight Diverter (BFD)	60
32	Power Line Carrier Communication (PLCC) system (up to 800kV)	60
33	Gas Insulated Switchgear (up to 400kV AC)	60
34	Gas Insulated Switchgear (above 400kV AC)	50
35	Surge/Lightning Arrester (up to 765kV AC)	60
36	Power Capacitors	60
37	Packaged Sub-station (6.6kV to 33kV)	60
38	Ring Main Unit (RMU) (up to 33kV)	60

39	Medium Voltage (MV) GIS panels (up to 33kV)	60
40	Automation and Control system/Supervisory Control and Data Acquisition (SCADA) system in Power system	50
41	Control and Relay panel (including Digital/Numerical relays)	50
42	Electrical motors 0.37kW to 1MW	60
43	Energy meters excluding smart meters	50
44	Control and Power cables and accessories (up to 1.1kV)	60
45	Diesel Generating (DG) set	60
46	DC system (DC Battery & Battery Charger)	60
47	AC and DC Distribution board	60
48	Indoor Air Insulated Switchgear (AIS) up to 33kV	60
49	Poles (PCC, PSCC, Rolled Steel Joist, Rail Pole, Spun, Steel Tubular)	60
50	Material for Grounding/earthing system	60
51	Illumination system	60
52	Overhead Fault Sensing Indicator (FSI)	50
53	Power Quality Meters	50
54	Auxiliary Relays	50
55	Load Break Switch	50
56	Cranes, EOT cranes, gantry crane & chain pulley blocks, etc	60
57	Elevator	60
Fire Protection and Detection system		
58	Motor driven fire water pumps	60
59	Diesel engine driven fire water pumps	60
60	Hydrant system	60
61	High velocity water spray system	60
62	Medium velocity water spray system	60
63	Foam Protection system	60
64	Inert gas flooding system	60
65	Fire tenders	60
66	Portable fire-extinguishers	60

**METHODOLOGY FOR SUPPLY, INSTALLATION & SIZING OF CABLES****Supply of 1.1kV grade Cables:**

- The quantities of various type of 1.1kV grade power and control cables shall be assessed by POWERGRID. The Sizes of 1.1 kV grade Control cables to be adopted for installation is enclosed at Appendix I . For Sizes of Power Cable, Clause 1.1.4 of Section Power and control Cable rev 06 is amended at Appendix-II

For Applications in addition to those specified, appropriate cable size shall be considered by the contractor with prior approval of Employer during execution stage

- Supply of 1.1kV grade power and control cables of various sizes shall be as per unit quantities mentioned in BPS.
- The Cables from Control Room/SPR/ACDB/DCDB/BMK to Equipment Marshalling box (MB)/Local control Cubical (LCC) shall be considered under the BPS item for supply of cables.
- The Interpole cables between AIS Instrument Transformer (CT/CVT), Surge Arrester and associated Junction Box shall be as per unit quantities mentioned in BPS.
- The Interpole cables between Circuit Breaker, Isolator and associated Marshalling box shall be deemed to be included in price of Equipment.

**Installation of 1.1kV grade Cables:**

- The quantity of Installation of cables is to be assessed by the contractor for the complete scope of work specified in Section project.
- The installation of 1.1kV grade power and control cables (including interpole cable of Equipment & illumination cables) shall be quoted in “LOT” basis.
- Supply and installation of Cable accessories like lugs, glands etc. for entire cabling work shall be deemed to be included in Installation charges of cables quoted by contractor in Bid price schedule.
- No variation shall be admissible on account of Installation of Cables/supply and installation of associated accessories, irrespective of variation (either positive or negative) in supply quantity of Cable specified in BPS.

**Extra Consumption of 1.1 kV Power and control cables.**

The Contractor shall make every effort to minimise wastage of the cables during installation. The Permitted Overall scarp/wastage shall be limited to 0.50% of actual supplied quantity for each size of cables. Any wastage more than the above limit shall be recovered from the contractor. All balance unused cables shall be returned to the employer by rewinding in separate drums for each size with discrete markings on drums.

Cut pieces of Cables having length less than following shall be considered for Scrap. The Contractor shall dispose of the scrap (if any), at their own cost :

**1.) Length less than 20 M**

- Control Cable ( 3C, 5C, 7C & 10 Core)
- Power Cable(2CX 6Sqmm,4CX6Sqmm, 4CX16Sqmm)

**2.) Length less than 50 M**

- Control Cable having more than 10 Cores
- Power Cable of sizes above 16 Sq mm

For Illumination purpose, ACP's shall be supplied as per BPS. From ACP to luminous all the required cables, accessories( including lugs and gland for cables between MLDB & ACP) , SLP/JB etc as required shall be assessed and supplied by the contractor. The price of these items shall be deemed to be included in price of luminaries.

**Appendix-I: Control Cable Sizes**

S.No.	From	To	Proposed Cable size
1.	CB MB	CRP panels	i) 10CX2.5Sq mm ii) 19CX1.5 Sq mm iii) 27CX 1.5 Sq mm
2.	CB MB	Earth switch MB	i) 3CX 2.5 Sqmm ii) 5C X2.5 Sq mm
3.	Isolator MB	Earth switch MB	10CX2.5Sq mm
4.	Isolator MB	CRP panels	19CX1.5 Sq mm
5.	CT	CT JB	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
6.	CT JB	CRP panels	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
7.	CVT	CVT JB	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
8.	CVT JB	CRP panels	i) 5C X2.5 Sq mm ii) 10C X2.5 Sq mm
9.	LA	LA JB	3C X2.5 Sq mm
10.	LA JB	CRP panels	5C X2.5 Sq mm
11.	Reactor MB/CMB ( for 1-Ph)	CRP panels	i) 3CX2.5Sq mm ii) 5CX2.5 Sq mm iii) 19CX 1.5 Sq mm iv) 27CX 1.5 Sq mm v) Paired Cables
12.	ICT MB/CMB ( for 1-Ph)	CRP panels	i) 3CX2.5Sq mm ii) 5CX2.5 Sq mm iii) 19CX 1.5 Sq mm iv) 27CX 1.5 Sq mm v) Paired Cables

Note:

- i) For Applications in addition to those specified, appropriate cable size shall be considered by the contractor with prior approval of Employer during execution stage.
- ii) GTP of 1.5 Sq mm Cable shall be submitted during detailed engineering stage for employers approval.
- iii) In case, more nos. of runs or larger sizes of cables are required between two points based on design calculations, same shall deemed to be included in the scope of bidder.



**Appendix-II Power cable sizes.**

S.No.	From	To	Existing Cable size	Cable type
1.	Main Switch Board	LT Transformer	2-1C X 630 mm <sup>2</sup> :For each phase 1-1C X 630 mm <sup>2</sup> : for neutral	XLPE
2.	Main Switch Board	AC Distribution Board	2-3½C X 300 mm <sup>2</sup>	XLPE
3.	Main Switch Board	Oil Filtration Unit	1-3½C X 300 mm <sup>2</sup>	XLPE
4.	Main Switch Board	Colony Lighting	1-3½C X 300 mm <sup>2</sup>	XLPE
5.	Main Switch Board	HVW pump LCP	1-3½C X 300 mm <sup>2</sup>	XLPE
6.	Main Switch Board	Main Lighting distribution board	2-3½C X 300 mm <sup>2</sup>	XLPE
7.	AC Distribution Board	D.G. Set AMF Panel	For 500 kVA DG set: 2-3½C X 300 mm <sup>2</sup> For 250 kVA DG set: 1-3½C X 300 mm <sup>2</sup>	XLPE
8.	AC Distribution Board	Emergency Lighting distribution board	3½C X 70mm <sup>2</sup> :For 765/400kV S/s 3½C X 35mm <sup>2</sup> :For 400/220kV S/s	PVC
9.	AC Distribution Board	ICT MB	3½C X 70mm <sup>2</sup> :For 765/400kV S/s 3½C X 35mm <sup>2</sup> :For 400/220kV S/s	PVC
10.	AC Distribution Board	Bay MB	3½C X 70mm <sup>2</sup> :For 765/400kV S/s 3½C X 35mm <sup>2</sup> For 400/220kV S/s	PVC
11.	Bay MB	AC Kiosk	1-4C X 16 mm <sup>2</sup>	PVC
12.	AC Distribution Board	Battery Charger 220 V	1-3½C X 70 mm <sup>2</sup>	PVC

13.	AC Distribution Board	Battery Charger 48 V	1-3½C X 35 mm	PVC
14.	DCDB	Battery	2-1C X 150 mm <sup>2</sup>	PVC
15.	DCDB	Battery Charger	2-1C X 150 mm <sup>2</sup>	PVC
16.	DCDB	Protection/PLCC panel	1-4C X 16 mm <sup>2</sup> : 765/400kV S/s 1-4C X 6 mm <sup>2</sup> : 400/220kV S/s	PVC
17.	Main Lighting DB	Lighting panels(Indoor)	1-3½C X 35 mm <sup>2</sup>	PVC
18.	Main Lighting DB	Lighting panels (outdoor)	1-3½C X 70 mm <sup>2</sup>	PVC
19.	Main Lighting DB	Receptacles (Indoor)	1-3½C X 35 mm <sup>2</sup>	PVC
20.	Main Lighting DB	Receptacles (Outdoor)	1-3½C X 70 mm <sup>2</sup>	PVC
21.	Lighting Panel	Sub lighting panels	These Cables shall be included in Price of item for Lighting fixture	PVC
22.	Lighting Panel	Street Lighting Poles	These Cables shall be included in Price of item for Lighting fixture	PVC
23.	Lighting Panel/ Sub lighting panels	Lighting Fixtures (Outdoor)	These Cables shall be included in Price of item for Lighting fixture	PVC
24.	Bay MB	Equipment	1-4C X 16 mm <sup>2</sup> : For CB 1-4C X 6 mm <sup>2</sup> : For Isolator/earths switch 1-2C X 6 : For CT/CVT	PVC
25.	ELDB	Lighting panel	3½C X 70mm <sup>2</sup> :For 765/400kV S/s 3½C X 35mm <sup>2</sup> :For 400/220kV S/s	

**765kV CURRENT TRANSFORMER**

**SECTION -IV**  
**GUARANTEED TECHNICAL PARTICULARS**

**CURRENT TRANSFORMER**

1.	Name and address of manufacturer	1.
2.	Manufacture's type designation	2.
3.	Standards applicable	3.
4.	Rated frequency (HZ)	4.
5.	Rated voltage Ur (KV)	5.
6.	Rated current	6.
	I) Rated continuous normal current (A)	I)
	ii) Rated extended primary Current (A)	ii)
7.	Short time thermal current withstand for 1 sec. (KA).	7.
8.	Dynamic current withstand (KA peak).	8.
9.	1.2/50 micro second impulse withstand voltage (KV peak)	9.
10.	250/2500 micro seconds switching surge withstand voltage (KV peak dry and wet)	10.
11.	One minute dry and wet power frequency withstand voltage (KV rms)	11.
12.	No. of cores per CT	12.
13.	Transformation ratio	13.
14.	No. of secondary turns (Nominal)	14.
15.	Rated output (VA) at different taps	15.
16.	Accuracy class	16.
17.	Knee point voltage (V) at different taps	17.

**765kV CURRENT TRANSFORMER**

**SECTION -IV**

**GUARANTEED TECHNICAL PARTICULARS**

18.	Secondary data	18.
a)	Secondary resistance at different taps.	a)
b)	Oversize factor and transient error under CO-t-CO duty condition of fault (100 ms)	b)
19.	Maximum exciting current	19.
a)	100% Kpv (mA)	
b)	25% kpv (mA)	
c)	20% kpv (mA)	
d)	10% kpv (mA)	
20.	Instrument security factor at different ratios	20.
21.	Radio interference voltage at 1.1 Ur/(SQRT 3) at 1.0 MHz (micro volts)	21.
22.	Whether auxiliary CT/reactors provided for metering winding.	22.
23.	Conona extinction voltage (KV rms)	23.
24.	Partial discharge level (pico coulombs)	24.
25.	Total creepage distance (mm)	25.
26.	Primary	26.
a)	No. of primary turms	a)
b)	Material and cross section of primary (cm <sup>2</sup> )	b)
c)	Whther bar type or ring type primary	c)
27.	Whether CT is suitable for transportation horizontally	27.

**765kV CURRENT TRANSFORMER**

**SECTION -IV**

**GUARANTEED TECHNICAL PARTICULARS**

28.	Composite error at rated burden and at	28.
a)	20% rated current	a)
b)	120% rated current	b)
29.	Composite error at 25% rated burden and at	29.
a)	20% rated current	a)
b)	120% rated current	b)
30.	Quantity of oil per CT (Litres)	30.
31.	Whether spark gap/surge arrester provided at the primary	31.
32.	Standard to which oil conforms generally	32.
33.	Characteristics of oil (prior to filling)	33.
a)	Breakdown voltage (KV)	a)
b)	Dielectric dissipation constant at 90° C	b)
c)	Water content (ppm)	c)
d)	Gas content (ppm)	d)
e)	Interfacial tension at 27° C (N/m)	e)
f)	Specific resistance	f)
	i) at 90 ° C (ohm - cm)	
	ii) at 27° C (ohm - cm)	
34.	Whether current transformers are hermetically sealed. If so, how.	34.
35.	Total weight (kg)	35.
36.	Transport weight (kg)	36.

**765kV CURRENT TRANSFORMER**

**SECTION -IV**

**GUARANTEED TECHNICAL PARTICULARS**

37.	Dimensional details	37.
	i) Overall height from mounting plane	i)
	ii) Height up to terminals from mounting plane	ii)
	iii) Mounting dimensions & diameter of mounting holes	
	iv) Terminal pad diameter and length	iv)
	v) Material of terminal pad	v)
	vi) Diameter of insulator at	vi)
	a) Top end	a)
	b) Bottom end	b)
38.	Temperature rise over an ambient temp. of 50° C (°C)	38.
39.	Transient over voltage withstand for	39.
	a) 30 seconds (KV peak)	a)
	b) 1 minute (KV peak)	b)
40.	Whether CT characteristic curves enclosed	40.
41.	Details of recommended support structure enclosed	41.
42.	Drawing showing clearance from earthed objects enclosed	42.
43.	Type test reports as per IEC enclosed	43.
44.	OGA drawing enclosed	44.
45.	Details of spark gap provided at the primary or secondary enclosed	45.

## SECTION – V

### CHECK LIST FOR 765kV CURRENT TRANSFORMER

Put a tick mark (√) on 'YES' if the specified requirement is met, or put a tick mark on 'NO', if the specified requirement is not met and give comments in the "Remarks" column.

Sl. No.	Parameters	Data	YES/NO	Remarks
1	Manufacturer's type designation	Bidder to furnish in Remarks Col.		
2	Type of CT			
	a) Insulation (As per clause 2.3 of section-II)	i. SF6	YES/NO	
		ii. Oil	YES/NO	
	b) Installation	Outdoor	YES/NO	
	c) Mounting	Upright	YES/NO	
	d) Tank design	i. Live tank	YES/NO	
		ii. Dead tank	YES/NO	
3	Standards Applicable	IEC: 61869-1 & 61869-2 or IS: 2705 Part-1 to 4, ANSI-C5713	YES/NO	
4	Rated Voltage (kV rms)	765KV	YES/NO	
5	Rated Primary Current	3000A	Yes/No	
6	Rated short time thermal current	As per Clause 3.0 of Section-I	YES/NO	
7	Rated dynamic current	As per section –II	YES/NO	
8	Max. Temperature rise over design ambient temperature	As per IEC	YES/NO	
9	One minute power frequency withstand voltage - Secondary Terminal and Earth	5KV	YES/NO	
10	Cantilever Strength	Not less than 500Kg	YES/NO	
11	Class of Insulation	A	YES/NO	
12	Core parameters	As per clause 3.0 b of Section –I.	YES/NO	

13	<b>External Surface</b>			
	<b>Steel</b>	i) Hot dip galvanized As per Section III	YES/NO	
		ii) Painted As per Section III	YES/NO	
14	<b>Insulator /Bushing</b>			
	a. Material			
	i. Shedded Polymer insulator		YES/NO	
	ii. Shedded Porcelain insulator	CT conforms to the internal arc fault test (internal fault protection class-2), as a special test as per IEC-61869, with at least 40 kA internal arc fault current.”	YES/NO	
	b. One-piece construction without any metallic flange joint		YES/NO	
15	<b>Specific requirements for Oil/SF6 CT's</b>			
	a. Oil filled CT's:			
	i. Grade of oil	EHV grade	YES/NO	
	ii. Standard to which oil conforms	IS-335 / IEC-60296	YES/NO	
	iii. Oil filling and drain plug provided.		YES/NO	
	iv. Oil sight glass provided		YES/NO	
	b. SF6 filled CT's:			
	i. Standard to which gas conforms	IEC-60376,60376A, 60376B	YES/NO	



	ii. Suitable SF6 gas density monitoring device		YES/NO	
	iii. NO/NC contacts available in SF6 gas density monitoring device for remote annunciation and tripping in case of SF6 leakage		YES/NO	
	iv. Provision for online gas filling		YES/NO	
	v. Suitable rupture disc provided to prevent explosion.		YES/NO	
16	<b>Hermetic Sealing</b>			
	a. Hermetically Sealed		YES/NO	
	b. Details of arrangement made for Hermetical sealing of the CT's are available and shall be furnished for approval at contract stage.		YES/NO	
	c. Details of Site test to check the effectiveness of the hermetic sealing are available and shall be furnished for approval at contract stage.		YES/NO	
17	Polarity of CT permanently marked		YES/NO	
18	<b>Impregnation details along with Test/Checks</b> : to ensure successful completion of impregnation cycle are available and shall be furnished for approval at contract stage		YES/NO	
19	Name Plate			
	As per IEC standards, and shall clearly indicate Year of manufacture, Rated current , Extended current rating & rated thermal current		YES/NO	
20	Terminal Box -Ingress Protection	IP 55	YES/NO	

21	In case of “Bar primary” inverted type CT	The CT conforms to the additional requirements specified under 3.0 a) of Section –II. Clauses .i,ii,iii,iv,v	YES/NO	
22	Rated extended current	As per 3.0 g) of Section –II.	YES/NO	
23	Packing & Transportation			
	a. CT suitable for horizontal transportation.		YES/NO	
	b. Details of packing design shall be furnished for review at contract stage .		YES/NO	
24	CT suitable for mounting on lattice support structure.		YES/NO	
25	CT suitable for High speed auto-reclosing.		YES/NO	
26	Details of measures taken to achieve minimum risk of explosion of the CT in service is <b>attached along with this offer.</b>		YES/NO	
27	The CT manufacturer meets the <b>Qualifying requirements</b> specified in Section-I , 4.0 of this Technical Specification.		YES/NO	
28	Valid Type test reports as per Section-II , 6.0 shall be submitted at contract stage.		YES/NO	
29	The list of equipments required for conducting pre commissioning shall be submitted for approval during contract stage		YES/NO	
30	Confirmation to clause 8.0 of Section –I pertaining to TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE		YES/NO	
31	List of Deviations if any , is attached along with offer		YES/NO	
32	List of all special tools and tackles as per Clause 7.0 of Section-I of this technical Specification shall be furnished during Contract stage.		YES/NO	
33	<b>Following Documents are attached along with the offer :</b>			

	<b>a. Filled Checklist.</b>		YES/NO	
	<b>b. Documents to support the qualifying requirements of the Equipment manufacturer ‘as per clause 4.0 of Section-I’ of this Technical Specification.</b>		YES/NO	
34	Bidder to confirm if Powergrid standard approved drawings/ Previous Powergrid approval for the offered CTs are available for approval extension.	If Yes, bidder shall submit the powergrid approval letters along with offer .	YES/NO	