

**MODEL TECHNICAL SPECIFICATION**

**SECTION-SWITCHGEAR-INST**

**(INSTRUMENT TRANSFORMERS)**

**(REV. NO. 12)**

Following are the major changes made in the Technical specification, Section-Switchgear-INST with respect to previous revision:

Sr. No.	Clause no.	Major Modification
1.	1.1	References of IS/IEC standards updated.
2.	2.1	Cantilever strength requirement for Polymer CVT made same as for porcelain CVT.
3.	2.1	Cantilever strength for 245kV class made as per IS/IEC.
4.	Table-II-B & Table-II-C	Details of 800kV & 420kV class CT with 4000A current rating included.
5.	Table-II-I	Parameters for 52kV class CT & PT included.
6.	5.0	HV Terminals of Instrument Transformers shall be provided as per IS/IEC 62271-301.
7.	6.2	Seismic test applicable for 400kV and above only.
8.	6.2	Thermal Stability test applicable for (a) 145kV and above voltage and (b) 72.5kV CT with continuous current rating of 1000A and above.
9.	6.2	Transmitted Over voltage test is applicable for 72.5kV and above.
10.	6.2	Mechanical test is applicable for 72.5kV and above.
11.	6.3	DGA test of Oil as Routine test included.
12.	9.4	Latest revision of Pre-commissioning formats, as available on POWERGRID site, shall be referred.
13.	10.0	Provisions included regarding Defect liability for EMVT/IVT/PT also.
14.	Table-II-F1	Core details & Parameters for 245kV, 4000/1 CT added.
15.	Table-I-A to Table-II-I	Requirements of Tariff metering Instrument Transformers included.
16.	Table-I-E & Table-II-I	Core details of 72.5kV CT and PT for feeder application added.
17.	Table-I-E	Accuracy class of Metering core of 72.5kV PT changed to 0.2 from 0.5.
18.	Table-II-I	Accuracy class of Metering core of 72.5kV CT changed to 0.2S from 0.5.
19.	Table-I-E & Table-II-I	Core details & Parameters for 52kV CT and PT added.
20.	Table-II-H	Tapping of 600/1 added in Metering core of 145kV, 600A CT
21.	Table-II-J	Parameters for 36 kV Current Transformer (3000A & 300A) included.

**Note:** The above is the list of major changes with respect to previous revision (Rev. 11). However, the bidders are advised to read the entire section/chapter for other changes and quote accordingly.

**SECTION-SWITCHGEAR-INST**  
**INSTRUMENT TRANSFORMERS**

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## 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 Transformer (CT): **IS 16227: Part-1, IS 16227: Part-2** or IEC: 61869-1 & 61869-2

Capacitive Voltage Transformer (CVT): **IS 16227: Part-1, IS 16227: Part-5** or IEC: 61869-1, 61869-5 & IS 9348 / IEC-60358

**Electro-Magnetic Voltage Transformer (EMVT) or Inductive Voltage Transformer (IVT) or Potential Transformers (PT): IS 16227: Part-1, IS 16227: Part-3** or IEC: 61869-1 & 61869-3

- 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:

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

- a) Instrument Transformers of 800kV/420kV/245kV/145kV/72.5kV/52kV 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 the 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 & **EMVT/IVT/PT**. 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, **400** kg, 350 kg and 250 kg for 800kV, 420kV, 245kV, 145kV and 72.5kV Instrument Transformers respectively. Oil filling and drain plugs are not applicable for SF<sub>6</sub> gas filled Instrument Transformers.

- 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/**EMVT**/IVT/**PT** shall be provided with a suitable SF<sub>6</sub> gas density monitoring device with NO/NC contacts to facilitate remote annunciation and tripping in case of SF<sub>6</sub> gas leakage. 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 **three (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/**Stainless Steel** can have natural finish.

## 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 Oil value limits for mineral insulating oil shall conform to Table 3 of IEC 60422 after filling in new electrical equipment prior to energization.

- c) The SF<sub>6</sub> gas shall comply with IS 13072 & IS 17053 or IEC-60376 & IEC-60480 and shall be suitable in all respects for use in the switchgear under specified operating conditions.

#### 2.4 **Name Plate:**

Name plate shall conform to the requirements of IS/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 (CT):**

- 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. These secondary terminals shall be terminated to stud type non-disconnecting terminal blocks inside the terminal box. PF (Tan delta) terminal for measurement of tan delta and capacitance of the unit shall be provided for CT of 72.5kV and above voltage class.

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 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 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		420kV	
	4000A	3000A	4000A	3000A
	Rated extended currents in % of rated current			
500/1	---	200	---	200
1000/1	---	---	---	---
2000/1	200	180	200	180
3000/1	160	120	160	120
4000/1	120	---	120	---

Further, the intermediate tapping at 3000-2000 of metering core of 420kV and 800kV CTs shall be suitable for using as 1000/1 ratio also. The Auxiliary reactor, if used, as referred at **attached** wiring diagram, No.0000-000-T-E-L-028 shall be suitable for connecting to the selected taps.

For 245kV/145kV/72.5kV/52kV class CT, the rated extended primary current shall be 120% (or 150% if applicable) on all cores of the CT.

- h) The secondary winding shall be rated for 2A continuously.
- i) The CT 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.
- j) The Current Transformer of voltage class 420kV and 800kV shall be suitable for horizontal transportation. However, Current Transformers upto 245kV voltage class can also be transported vertically as per manufacturer's practice. 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.
- k) For 800kV CTs, the instrument security factor at all ratios shall be less than ten (10) for metering core. For 420kV/245kV/145kV/72.5kV/52kV 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.
- l) 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 here with at Annexure-III of this specification.
- m) The Current Transformers should be suitable for mounting on structure to be provided by the Contractor in accordance with stipulations of Section-Project/Section-Structures.
- n) The CT shall be designed so as to achieve the minimum risks of explosion in service.

- o) 800kV/420kV/245kV/145kV Current Transformers shall be suitable for high speed auto reclosing.

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

- a) 800kV Voltage Transformers shall be capacitor voltage divider type with electromagnetic units and shall be suitable for carrier coupling. **420kV/245kV/145kV/72.5kV/52kV Voltage Transformers shall be capacitor voltage divider type with electromagnetic units or Inductive (Electromagnetic) Voltage Transformer or Potential Transformer type as specified in BPS.**
- 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 **shall** 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 ferro-resonance oscillations.
- f) The accuracy of 0.2 on Secondary III (**Metering**) for CVT/**EMVT/IVT/PT** should be maintained throughout 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 structure 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 as per manufacturer's design shall also be acceptable.
- j) The wiring diagram for the interconnection of the three-single phase CVTs/EMVTs/IVTs/PTs 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 here with at Annexure-IV of this specification shall be followed.

## **5.0 TERMINALS & CONNECTORS:**

HV Terminals of Instrument Transformers shall be provided as per IS/IEC 62271-301.

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 IS/IEC.
- 6.2 The test reports of type tests, as applicable, as per **IS 16227 Part-2/** IEC 61869-2 for CT, **IS 16227 Part-5/IS 9348/**IEC 61869-5/IEC-60358 for CVT and **IS 16227 Part-3/**IEC 61869-3 for **EMVT/IVT/PT** 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 standard 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 IS 16227 / 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-62271-300 (with Seismic acceleration requirement as per Section-Project) for **420kV** and above voltage rating.
- iv) Thermal stability test, i.e. measurement of tan-delta by application of rated voltage and rated extended thermal current simultaneously to check thermal run-a-way **for (a) 145kV and above voltage and (b) 72.5kV CT with continuous current rating of 1000A and above** (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 U<sub>m</sub>/√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 **72.5kV** and above voltage rating
- viii) Mechanical test (with minimum Cantilever load as per clause no. 2.1.c) for **72.5kV** 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 IS 9348/IEC-60358).
- ii) Seismic withstand test (as per Annexure-B of Section-GTR) or IEC-62271-300 (with Seismic acceleration requirement as per Section-Project) for **420kV** and above voltage class.
- iii) Stray capacitance and stray conductance measurement of the low voltage terminal (as per IS 9348/IEC-60358)
- iv) Corona test as per Annexure-A of Section-GTR for 420kV and above voltage rating.
- v) RIV test as per IS 16227/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) **Electro-Magnetic Voltage Transformer (EMVT)/ Inductive Voltage Transformers (IVT)/ Potential transformers (PT):**

- i) Seismic withstand test (as per Annexure-B of Section-GTR) or IEC-62271-300 (with Seismic acceleration requirement as per Section-Project) for **420kV** and above voltage rating.
- ii) Corona test as per Annexure-A of Section-GTR for 420kV and above voltage rating.
- iii) RIV test as per IS 16227/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.
- iv) Multiple chopped impulse test with application of 600 chopped impulses for 145kV and above voltage rating (not applicable for SF<sub>6</sub> filled **EMVT/IVT/PT**).
- v) Transmitted over voltage test for 145kV and above voltage rating
- vi) Mechanical test (with minimum Cantilever load as per clause no. 2.1.c) for 72.5kV and above voltage rating
- vii) Enclosure tightness test at low & high temperature for SF<sub>6</sub> filled **EMVT/IVT/PT** of 145kV and above voltage rating
- viii) Gas dew point test for SF<sub>6</sub> filled **EMVT/IVT/PT**.
- ix) Corrosion test for 145kV and above voltage rating
- x) 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 IS/IEC:

a) **CURRENT TRANSFORMERS:**

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  $U_m/\sqrt{3}$  and at 10kV.
- iv) DGA of oil after routine dielectric tests (Limiting values shall be as per IS 10593/IEC60599) applicable for 220kV and above.

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 test on CVT/EMVT/IVT/PT shall be done in line with **IS 16227/IEC61869** including DGA of oil after routine dielectric tests for EMVT/IVT/PT.

**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/52kV 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> gas (filled CTs) – Dew point measurement, SF<sub>6</sub> alarm/lockout check
- (j) DGA test of oil (Applicable for 220kV and above class CTs only unless specified in Section Project)

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 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. The price of the above sampling bottles is deemed to be included in cost of equipment.

### 9.3 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
- (g) **DGA test of oil (for EMVT/IVT/PT)** (Applicable for 220kV and above class VTs only unless specified in Section Project)

**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.

**EMVTs/IVTs/PTs must have adequate provision for taking oil samples from the bottom of the EMVT/IVT/PT 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 EMVT/IVT/PT for gas analysis before refilling or further treatment of EMVT/IVT/PT becomes necessary.**

**Manufacturer/Contractor shall supply 2 nos. of oil sampling device for every 20 nos. of oil filled EMVT/IVT/PT supplied with a minimum of 2 nos. of oil sampling device for each substation. The price of the above sampling bottles is deemed to be included in cost of equipment.**

- 9.4 For pre-commissioning procedures and formats for Current Transformers and Voltage Transformers, latest revision of POWERGRID controlled document will be the reference document. **The** 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/**EMVT/IVT/PT** of ratings 145kV & above during the warranty period (defect liability period) shall be as per enclosed Annexure-V (Revised) of this specification. Further, the replaced/repared/refurbished equipment (or part of equipment) shall have Two (2) years warranty without prejudice to contractual warranty period (defect liability period).

**TABLE-I-A**  
**REQUIREMENTS OF 800 KV CAPACITIVE VOLTAGE TRANSFORMER**

S.No.	PARTICULAR			
1.	Rated primary voltage (kV rms)	800		
2.	Type	Single phase Capacitor VT		
3.	No. of secondaries	3		
4.	Rated voltage factor	1.2 continuous		
		1.5 - 30 seconds		
5.	Phase angle error	± 10 minutes (For metering core)		
6.	Capacitance (pf)	4400/8800* (+10% /- 5%)		
7.	Core details	<b>Core-1</b>	<b>Core-2</b>	<b>Core-3</b>
	a) Voltage Ratio	$\frac{765/0.11}{\sqrt{3} \sqrt{3}}$	$\frac{765/0.11}{\sqrt{3} \sqrt{3}}$	$\frac{765/0.11}{\sqrt{3} \sqrt{3}}$
	b) Application	Protec- tion	Protec- tion	Meter- ing
	c) Accuracy	0.5&3P <sup>#</sup>	0.5&3P <sup>#</sup>	0.2
	d) Min. Output burden (VA)	50	50	50

Note 1: \* Capacitance value shall be as specified in BPS.

Note 2: <sup>#</sup> Accuracy class for Protection cores shall be 3P. However, accuracy of 0.5 class (as specified in IS/IEC for metering cores) shall be maintained at rated voltage.

Note 3: For dedicated Metering (Tariff Metering) CVT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-I-B**  
**REQUIREMENTS OF 420 KV VOLTAGE TRANSFORMER**

S.No.	PARTICULAR			
1.	Rated primary voltage (kV rms)	420		
2.	Type	Single phase Electromagnetic or Capacitor VT		
3.	No. of secondaries	3		
4.	Rated voltage factor	1.2 continuous 1.5 - 30 seconds		
5.	Phase angle error	± 10 minutes (For metering core)		
6.	Capacitance (pf) (for CVT)	4400/8800* (+10% / - 5%)		
7.	Core details	<b>Core-1</b>	<b>Core-2</b>	<b>Core-3</b>
	a) Voltage Ratio	$\frac{400/0.11}{\sqrt{3} \sqrt{3}}$	$\frac{400/0.11}{\sqrt{3} \sqrt{3}}$	$\frac{400/0.11}{\sqrt{3} \sqrt{3}}$
	b) Application	Protection	Protection	Metering
	c) Accuracy	0.5&3P#	0.5&3P#	0.2
	d) Min. Output burden (VA)	50	50	50

Note 1: \* Capacitance value shall be as specified in BPS.

Note 2: # Accuracy class for Protection cores shall be 3P. However, accuracy of 0.5 class (as specified in IS/IEC for metering cores) shall be maintained at rated voltage.

Note 3: For dedicated Metering (Tariff Metering) CVT/EMVT/IVT/PT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-I-C**  
**REQUIREMENTS OF 245 KV VOLTAGE TRANSFORMER**

S.No.	PARTICULAR			
1.	Rated primary voltage (kV rms)	245		
2.	Type	Single phase Electromagnetic or Capacitor VT		
3.	No. of secondaries	3 cores		
4.	Rated voltage factor	1.2 continuous 1.5 - 30 seconds		
5.	Phase angle error	± 10 minutes (For metering core)		
6.	Capacitance (pf) (for CVT)	4400/8800* (+10% / - 5%)		
7.	Core details	<b>Core-1</b>	<b>Core-2</b>	<b>Core-3</b>
	a) Voltage Ratio	$\frac{220}{\sqrt{3}}/\frac{0.11}{\sqrt{3}}$	$\frac{220}{\sqrt{3}}/\frac{0.11}{\sqrt{3}}$	$\frac{220}{\sqrt{3}}/\frac{0.11}{\sqrt{3}}$
	b) Application	Protec- tion	Protec- tion	Meter- ing
	c) Accuracy	3P	3P	0.2
	d) Min. Output burden (VA)	50	50	50

Note 1: \* Capacitance value shall be as specified in BPS.

Note 2: For dedicated Metering (Tariff Metering) CVT/EMVT/IVT/PT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-I-D**  
**REQUIREMENTS OF 145 KV VOLTAGE TRANSFORMER**

S.No.	PARTICULAR			
1.	Rated primary voltage (kV rms)	145		
2.	Type	Single phase Electromagnetic or Capacitor VT		
3.	No. of secondaries	3 cores		
4.	Rated voltage factor	1.2 continuous 1.5 - 30 seconds		
5.	Phase angle error	± 10 minutes (For metering core)		
6.	Capacitance (pf) (for CVT)	8800 (+ 10% / -5%)		
7.	Core details	<b>Core-1</b>	<b>Core-2</b>	<b>Core-3</b>
	a) Voltage Ratio	$\frac{132/0.11}{\sqrt{3} \sqrt{3}}$	$\frac{132/0.11}{\sqrt{3} \sqrt{3}}$	$\frac{132/0.11}{\sqrt{3} \sqrt{3}}$
	b) Application	Protec- tion	Protec- tion	Meter- ing
	c) Accuracy	3P	3P	0.2
	d) Min. Output burden (VA)	50	50	50

**Note 1: For dedicated Metering (Tariff Metering) CVT/EMVT/IVT/PT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.**

**TABLE-I-E**  
**REQUIREMENTS OF 72.5KV/52KV VOLTAGE TRANSFORMER**

S.No.	PARTICULAR			
1.	Rated primary voltage (kV rms)	72.5/52 (as applicable)		
2.	Type	Single phase Electro-magnetic or Capacitive VT		
3.	No. of secondaries	2 cores		
4.	Rated Voltage Factor	1.2 continuous 1.5 – 30 seconds		
5.	Phase angle error	+ 20 minutes (For metering core)		
6.	<b>Core details for Tertiary loading (of ICT) application-72.5kV/52kV (as applicable)</b>			
	a) Voltage ratio	<b>Core-1</b> $\frac{33/0.11}{\sqrt{3} \sqrt{3}}$	<b>Core-2</b> $\frac{33/0.11}{\sqrt{3} \sqrt{3}}$	
	b) Application	Protection	Metering	
	c) Accuracy	3P	<b>0.2</b>	
	d) Output Burden (VA) (minimum)	10	10	
7.	<b>Core details for Feeder application-72.5kV</b>			
	a) Voltage ratio	<b>Core-1</b> $\frac{66/0.11}{\sqrt{3} \sqrt{3}}$	<b>Core-2</b> $\frac{66/0.11}{\sqrt{3} \sqrt{3}}$	<b>Core-3</b> $\frac{66/0.11}{\sqrt{3} \sqrt{3}}$
	b) Application	Protection	Protection	Metering
	c) Accuracy	3P	3P	<b>0.2</b>
	d) Output Burden (VA) (minimum)	10	10	10

Note 1: For dedicated Metering (Tariff Metering) CVT/EMVT/IVT/PT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-A**  
**REQUIREMENTS FOR 800 KV CURRENT TRANSFORMER (3000A)**

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	-	PX	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	-	PX	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 20 20	0.2S 0.2S 0.2S	- - -	-	- - -
	4.	METERING	3000/ 2000/ 500/1	20 20 20	0.2S 0.2S 0.2S	- - -	-	- - -
	5.	TRANSF DIFF./LINE PROT.N.	3000/ 2000/ 500/1	-	PX	3000/ 2000/ 500	15/10/2.5	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap
	6	LINE PROT.N/LBB PROT.N.	3000- 2000- 500/1	-	PX	3000/ 2000 500	15/10/2.5	20 on 3000/1 Tap,30 on 2000/1 Tap,120 on 500/1 Tap

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-B  
REQUIREMENTS FOR 800 KV CURRENT TRANSFORMER (4000A)**

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)
6	1	BUS DIFF. CHECK	4000/ 3000/ 2000/1	-	PX	4000/ 3000/ 2000	15/10/7.5	20 on 4000/1 TAP; 30 on 3000/1; 120 on 2000/1 tap
	2.	BUS DIFF. MAIN	4000/ 3000/ 2000/1	-	PX	4000/ 3000/ 2000	15/10/7.5	20 on 4000/1 TAP; 30 on 3000/1; 120 on 2000/1 tap
	3.	METERING	4000/ 3000/ 2000/1	20 20 20	0.2S 0.2S 0.2S	- - -	-	- - -
	4.	METERING	4000/ 3000/ 2000/1	20 20 20	0.2S 0.2S 0.2S	- - -	-	- - -
	5.	TRANSF DIFF./ LINE PROT.N.	4000/ 3000/ 2000/1	-	PX	4000/ 3000/ 2000	15/10/7.5	20 on 4000/1 TAP; 30 on 3000/1; 120 on 2000/1 tap
	6	LINE PROT.N/LBB PROT.N.	4000- 3000- 2000/1	-	PX	4000/ 3000 2000	15/10/7.5	20 on 4000/1 Tap,30 on 3000/1 Tap,120 on 2000/1 Tap

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-C  
REQUIREMENTS FOR 420 KV CURRENT TRANSFORMER (3000A)**

No. of cores	Core No.	Application	Ratio	Output Burden	Accuracy Class	Min. Knee Pt. Voltage (Vk)	Max. CT Sec. wdg. Resistance (in $\Omega$ )	Max. Excit. Current at Vk (in mA)
6	1	BUS DIFF. CHECK	3000/ 2000/ 500/1	-	PX	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	-	PX	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 20 20	0.2S 0.2S 0.2S	- - -	- - -	- - -
	4.	METERING	3000/ 2000/ 500/1	20 20 20	0.2S 0.2S 0.2S	- - -	- - -	- - -
	5.	TRANS. BACK UP/LINE PROTN.	3000/ 2000/ 500/1	-	PX	3000/ 2000/ 500	15/10/2.5	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap
	6.	TRANS. DIFF. /LINE PROTN.	3000/ 2000/ 500/1	-	PX	3000/ 2000/ 500	15/10/2.5	20 on 3000/1 TAP; 30 on 2000/1; 120 on 500/1 tap

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-D  
REQUIREMENTS FOR 420 KV CURRENT TRANSFORMER (4000A)**

No. of cores	Core No.	Application	Ratio	Output Burden	Accuracy Class	Min. Knee Pt. Voltage (Vk)	Max. CT Sec. wdg. Resistance (in $\Omega$ )	Max. Excit. Current at Vk (in mA)
6	1	BUS DIFF. CHECK	4000/ 3000/ 2000/1	-	PX	4000/ 3000/ 2000	15/10/5	20 on 4000/1 TAP; 30 on 3000/1; 120 on 2000/1 tap
	2.	BUS DIFF. MAIN	4000/ 3000/ 2000/1	-	PX	4000/ 3000/ 2000	15/10/5	20 on 4000/1 TAP; 30 on 2000/1; 120 on 500/1 tap
	3.	METERING	4000/ 3000/ 2000/1	20 20 20	0.2S 0.2S 0.2S	- - -	- - -	- - -
	4.	METERING	4000/ 3000/ 2000/1	20 20 20	0.2S 0.2S 0.2S	- - -	- - -	- - -
	5.	TRANS. BACK UP/LINE PROT.N.	4000/ 3000/ 2000/1	-	PX	4000/ 3000/ 2000	15/10/5	20 on 4000/1 TAP; 30 on 3000/1; 120 on 2000/1 tap
	6.	TRANS. DIFF. /LINE PROT.N.	4000/ 3000/ 2000/1	-	PX	4000/ 3000/ 2000	15/10/5	20 on 4000/1 TAP; 30 on 3000/1; 120 on 2000/1 tap

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-E**  
**REQUIREMENTS FOR 245 KV CURRENT TRANSFORMER (1600A)**

No.of Cores	Core No.	Appli- cation	Current ratio	Output burden (VA)	Accuracy class	Min. knee pt. volt- age (Vk)	Max. CT sec. wdg. resist- ance (ohms)	Max. Excit- ation cur- rent at Vk (in mA)
5	1	BUS DIFF CHECK	1600-800/1	-	PX	1600/800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap
	2	BUS DIFF MAIN	1600-800/1	-	PX	1600/800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap
	3	METERING	1600-800/1	20	0.2S	-	-	-
	4	TRANS. BACK UP/LINE PROT.N.	1600-800/1	-	PX	1600/800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap
	5	TRANS. DIFF/LINE PROT.N	1600-800/1	-	PX	1600/800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-F**  
**REQUIREMENTS FOR 245 KV CURRENT TRANSFORMER (2500A)**

No.of Cores	Core No.	Appli- cation	Current ratio	Output burden (VA)	Accuracy class	Min. knee pt. volt- age (Vk) (Volts)	Max. CT sec. wdg. resist- ance (ohms)	Max. Excit- ation cur- rent at Vk (in mA)
5	1	BUS DIFF	2500	-	PX	2500	12.5/8/4	16 on
		CHECK	1600			1600		2500/1 Tap
		800/1			800	25 on		
						1600/1 Tap		
						50 on		
	2	BUS DIFF	2500	-	PX	2500		16 on
		MAIN	1600			1600		2500/1 Tap
			800/1			800		25 on
								1600/1 Tap
								50 on
								800/1 Tap
	3	METERING	2500	20	0.2S	-	-	-
			1600					
			800					
	4	TRANS. BACK UP/LINE PROT.N.	2500-1600	-	PX	2500	12.5/8/4	16 on
			800/1			1600		2500/1
						800		Tap;
								25 on
								1600/1 Tap, 50 on
							800/1 Tap	
	5	TRANS. DIFF/LINE PROT.N.	2500-1600	-	PX	2500	12.5/8/4	16 on
			800/1			1600		2500/1
						800		Tap;
								25 on
								1600/1 Tap; 50 on
							800/1 Tap	

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-F1**  
**REQUIREMENTS FOR 245 KV CURRENT TRANSFORMER (4000A)**

No.of Cores	Core No.	Appli- cation	Current ratio	Output burden (VA)	Accuracy class	Min. knee pt. volt- age (Vk) (Volts)	Max. CT sec. wdg. resist- ance (ohms)	Max. Excit- ation cur- rent at Vk (in mA)
5	1	BUS DIFF CHECK	4000-3000-1000/1	-	PX	4000/3000/1000	20/15/5	20 on 4000/1 Tap 30 on 3000/1 Tap 60 on 1000/1 Tap
	2	BUS DIFF MAIN	4000-3000-1000/1	-	PX	4000/3000/1000	20/15/5	20 on 4000/1 Tap 30 on 3000/1 Tap 60 on 1000/1 Tap
	3	METERING	4000-3000-1000/1	20	0.2S	-	-	-
	4	TRANS. BACK UP/LINE PROT.N.	4000-3000-1000/1	-	PX	4000/3000/1000	20/15/5	20 on 4000/1 Tap; 30 on 3000/1 Tap, 60 on 1000/1 Tap
	5	TRANS. DIFF/LINE PROT.N.	4000-3000-1000/1	-	PX	4000/3000/1000	20/15/5	20 on 4000/1 Tap; 30 on 3000/1 Tap; 60 on 1000/1 Tap

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-G**  
**REQUIREMENTS FOR 145 KV CURRENT TRANSFORMER (800A)**

No.of Cores	Core No.	Appli-cation	Current ratio	Output burden (VA)	Accuracy class	Min. knee pt. volt-age Vk	Max. CT sec. wdg. resist-ance (ohms)	Max. Excit-ation cur-rent at Vk (in mA)
5	1	BUS DIFF CHECK	800-400/1	-	PX	800/400	8/4	25 on 800/1 Tap; 50 on 400/1 Tap
	2	BUS DIFF MAIN	800-400/1	-	PX	800/400	8/4	25 on 800/1 Tap; 50 on 400/1 Tap
	3	METERING	800-400/1	20	<b>0.2S</b>	-	-	-
	4	TRANS. BACK UP/LINE PROT.N.	800-400/1	-	PX	800/400	8/4	25 on 800/1 Tap; 50 on 400/1 Tap
	5	TRANS. DIFF/LINE PROT.N	800-400/1	-	PX	800/400	8/4	25 on 800/1 Tap; 50 on 400/1 Tap

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-H  
REQUIREMENTS FOR 145 kV CURRENT TRANSFORMER (600A)**

No.of Cores	Core No.	Appli- cation	Current ratio	Output burden (VA)	Accuracy class	Min. knee pt. volt- age Vk	Max. CT sec. wdg. resist- ance (ohms)	Max. Excit- ation cur- rent at Vk (in mA)
5	1	BUS DIFF CHECK	600-300/1	-	PX	600/300	6/3	30 on 600/1 Tap; 60 on 300/1 Tap
	2	BUS DIFF MAIN	600-300/1	-	PX	600/300	6/3	30 on 600/1 Tap; on 300/1 Tap
	3	METERING	600-300-150/1	20	0.2S	-	-	-
	4	TRANS. BACK UP/LINE PROTN.	600-300/1	-	PX	600/300	6/3	30 on 600/1 Tap; 60 on 300/1 Tap
	5	TRANS. DIFF/LINE PROTN	600-300/1	-	PX	600/300	6/3	30 on 600/1 Tap; 60 on 300/1 Tap

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-I****1. REQUIREMENTS FOR 72.5kV/52KV CURRENT TRANSFORMER  
(FOR TERTIARY LOADING OF ICT)**

No. of Cores	Core No.	Application	Current Ratio	Output burden (VA)	Accuracy class & ALF
2	1	O/C & E/F	50/1	10	5P10
	2	Metering	50/1	10	<b>0.2S</b>

**2. REQUIREMENTS FOR 72.5kV CURRENT TRANSFORMER  
(FOR SWITCHYARD)**

No. of cores	Core no.	Application	Current ratio	Output burden (VA)	Accuracy class	Minimum knee point voltage (V <sub>k</sub> )	Maximum CT secondary winding resistance	Maximum excitation current at V <sub>k</sub> (in mA)
<b>For 66kV Line Feeders</b>								
3	1	Distance/Differential	800-400-/1	-	PX	800/400	8/4	25/50
	2	Metering	800-400-/1	20	<b>0.2S</b>			
	3	O/C and EF	800-400-/1	-	PX		8/4	25/50
<b>For 66kV Transformer Feeders (160 MVA, 220/66kV Transformer)</b>								
3	1	Distance/Differential	1600-800-/1	-	PX	1600/800	8/4	12/25
	2	Metering	1600-800-/1	20	<b>0.2S</b>			
	3	O/C and EF	1600-800-/1	-	PX	1600/800	8/4	12/25
<b>For 66kV Bus Coupler Bay (if applicable)</b>								
3	1	Distance/Differential	3000-1500-/1	-	PX	3000/1500	12/8	6/12
	2	Metering	3000-1500-/1	20	0.2S			
	3	O/C and EF	3000-1500-/1	-	PX		12/8	6/12

Note 1: For dedicated Metering (Tariff Metering) CT, if applicable, two metering cores only with above parameters shall be provided unless otherwise specified elsewhere.

**TABLE-II-J**

**1. REQUIREMENTS FOR 36kV, 3000A (120% EXTENDED )NEUTRAL CURRENT TRANSFORMER (OUTDOOR TYPE) FOR BANK OF 765KV, 1-PH TRANSFORMER**

**LOCATION: COMMON NEUTRAL SIDE (FOR EACH THREE-PHASE BANK)**

No. of cores	Core no.	Application	Current ratio	Output burden (VA)	Accuracy class	Minimum knee point voltage (V <sub>k</sub> )	Maximum CT secondary winding resistance	Maximum excitation current at V <sub>k</sub> (in mA)
1	1	REF (High Impedance)	3000/1	-	PX	3000V	12	20 on 3000/1 tap

**2. REQUIREMENTS FOR 36kV, 300A (200% EXTENDED ) NEUTRAL CURRENT TRANSFORMER (OUTDOOR TYPE) FOR BANK OF 765KV, 1-PH REACTOR**

**LOCATION: COMMON NEUTRAL SIDE (FOR EACH THREE-PHASE BANK)**

No. of cores	Core no.	Application	Current ratio	Output burden (VA)	Accuracy class	Minimum knee point voltage (V <sub>k</sub> )	Maximum CT secondary winding resistance	Maximum excitation current at V <sub>k</sub> (in mA)
1	1	Earth Fault protection	300/1	-	PX	300V	1	40 on 300/1 tap

**Annexure-I**

**MAJOR TECHNICAL PARAMETERS FOR CURRENT TRANSFORMER**

S. No.	Description	765kV system	400kV system	220kV System	132 kV system	66kV/52kV System (for Tertiary loading)
1	Rated voltage, $U_m$ (kVrms)	800	420	245	145	72.5/52
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 IS/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/±250
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	140/95
d)	One minute power frequency withstand voltage between secondary terminals & earth (kVrms)	5kV				
11	Max. radio interference voltage	2500 at 508 kV rms	1000 at 266kV rms	1000 at 156kV rms	500 at 92kV rms	-NA-

S. No.	Description	765kV system	400kV system	220kV System	132 kV system	66kV/52kV System (for Tertiary loading)
	for frequency between 0.5 MHz and 2 MHz at (microvolts)					
12	Minimum Corona extinction voltage (kVrms)	508	320	-NA-	-NA-	-NA-
13	Seismic acceleration (Horizontal)	0.3g	0.3g	-NA-	-NA-	-NA-
14	Partial Discharge	As per IS/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	1813/1300
17	System neutral earthing	Effectively Earthed				

Note 1: \*The values indicated above are for specific creepage of 25mm/kV. In case, specific creepage of 31mm/kV is specified, the Minimum Creepage distance values shall be considered accordingly.

Note 2: For other parameters, refer respective Table for the applicable voltage class of CTs.

**MAJOR TECHNICAL PARAMETERS FOR VOLTAGE TRANSFORMER**

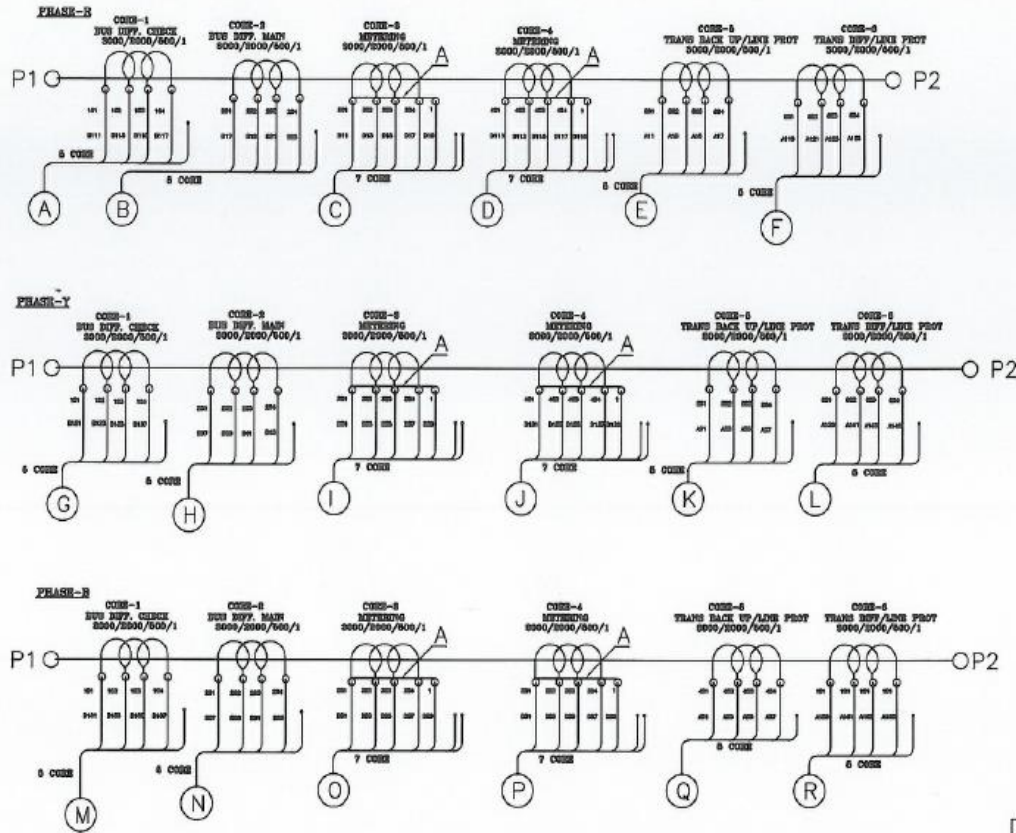
S. No.	Description	765kV system	400kV system	220kV System	132 kV system	66kV/52kV System	
1	Type (CVT/EMVT)	CVT	CVT/EMVT	CVT/EMVT	CVT/EMVT	CVT/EMVT	
2	Rated voltage, $U_m$ (kVrms)	800	420	245	145	72.5	
3	Rated frequency (Hz)	50	50	50	50	50	
4	No. of Poles	1	1	1	1	1	
5	Design ambient temperature ( $^{\circ}$ C)	50	50	50	50	50	
6	System fault level (kA)	40kA/50kA (as applicable) for 1 sec	40kA/50kA/63kA (as applicable) for 1 sec	40kA/50kA (as applicable) for 1 sec	40kA/31.5kA (as applicable) for 1 sec	25kA/3s or 31.5kA/1s (as applicable)	
6	Standard reference range of frequencies for which the accuracies are valid <b>(for CVT only)</b>	96% to 102% for protection and 99% to 101% for measurement					
7	High frequency capacitance for entire carrier frequency range (for CVT only)	Within 80% to 150% of rated capacitance					-
8	Equivalent series resistance over entire carrier frequency range (for CVT)	Less than 40 Ohms					-
9	Stray capacitance and stray conductance of HF terminal over entire carrier frequency range (for CVT)	As per IEC-60358					-
10	Temperature rise over design ambient temperature	As per IS/IEC					
11	Rated Insulation levels						
a)	Full wave impulse withstand voltage (1.2/50 microsecond)						
i)	between line terminals and ground (kVpeak)	$\pm 2100$	$\pm 1425$	$\pm 1050$	$\pm 650$	$\pm 325/\pm 250$	
b)	Switching impulse withstand voltage (250/2500 microsecond) (dry and wet)						

S. No.	Description	765kV system	400kV system	220kV System	132 kV system	66kV/52kV System
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	140/95
d)	One-minute power frequency withstand voltage between secondary terminals & earth					
i)	between LV (HF) terminal and earth terminal (kVrms)	10kVrms for exposed terminals and 4kVrms for terminals enclosed in a weather proof box				
ii)	For secondary winding	3kVrms				
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	-NA-	-NA-	-NA-
14	Partial Discharge	As per IS/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	Rated Total Thermal Burden (VA)	300 VA (100VA/winding)				20VA
17	System neutral earthing	Effectively Earthed				
18	Minimum Creepage distance (mm) *	20000	10500	6125	3625	1813/1300

Note 1: \*The values indicated above are for specific creepage of 25mm/kV. In case, specific creepage of 31mm/kV is specified, the Minimum Creepage distance values shall be considered accordingly.

Note 2: For other parameters, refer respective Table for the applicable voltage class of VTs.

### Annexure-III: Wiring Diagram of Current Transformer

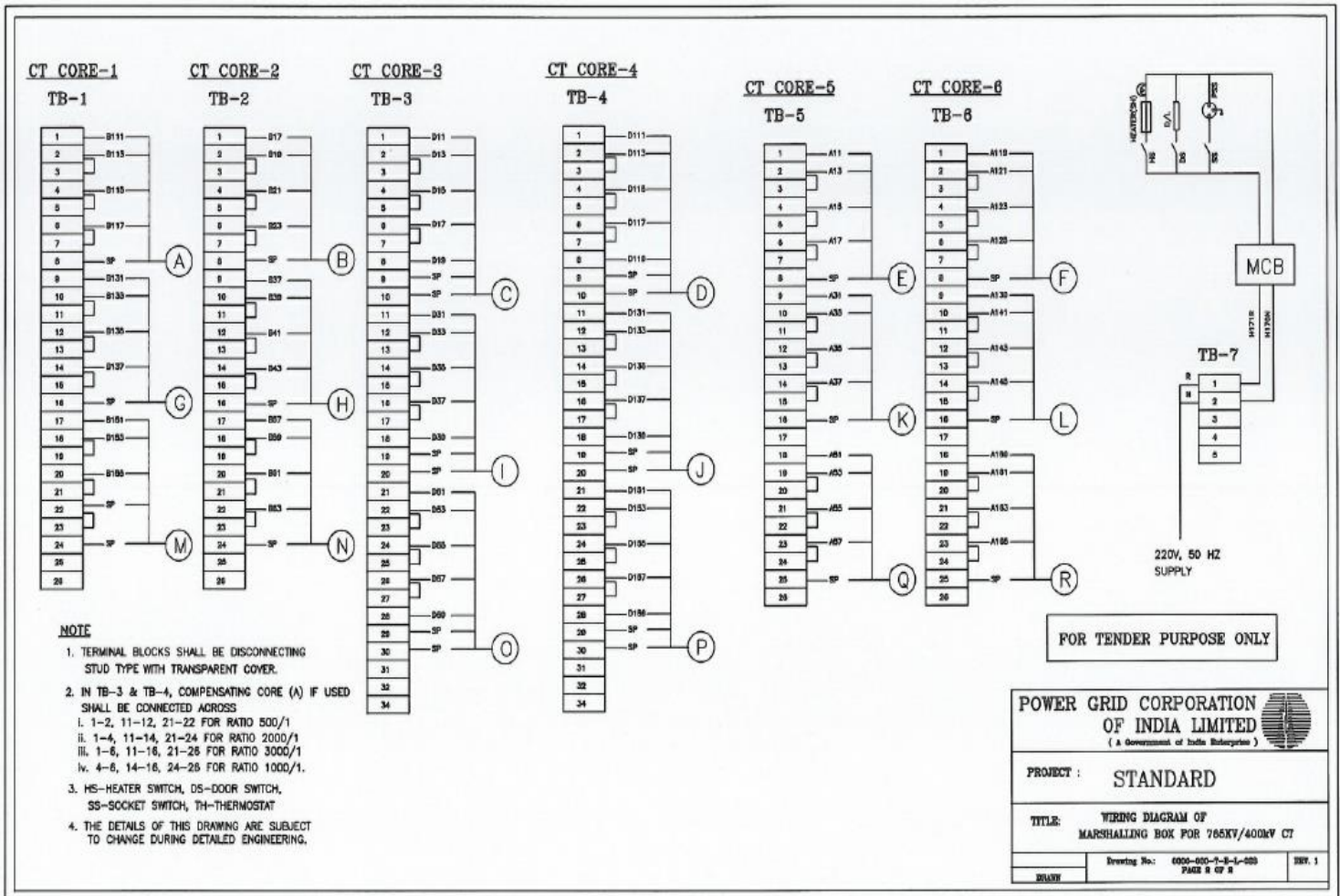


**NOTE**  
 1. INTERPOLE CABLING (A) TO (R) 2.5 SQ.MM STRANDED FLEXIBLE ARMoured COPPER CABLE OF 1100V GRADE (FROM CT SEC TO MARSHALLING BOX).

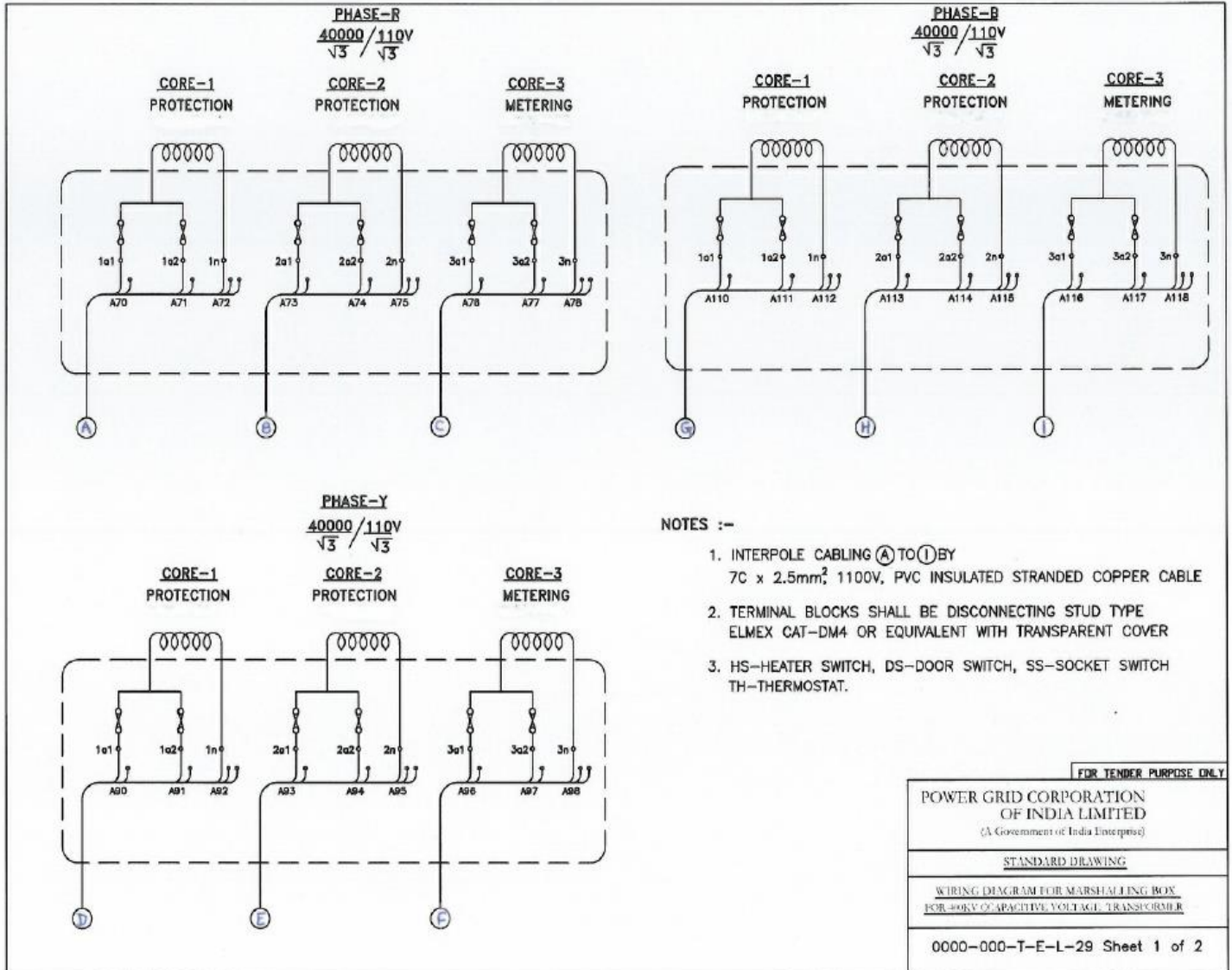
FOR TENDER PURPOSE ONLY

<b>POWER GRID CORPORATION OF INDIA LIMITED</b> ( A Government of India Enterprise )	
PROJECT : <b>STANDARD</b>	
TITLE: <b>WIRING DIAGRAM OF MARSHALLING BOX FOR 785KV/400KV CT</b>	
Drawing No.: <b>0000-000-7-2-1-GS</b>	REV. <b>1</b>
DATE	PAGE 1 OF 2

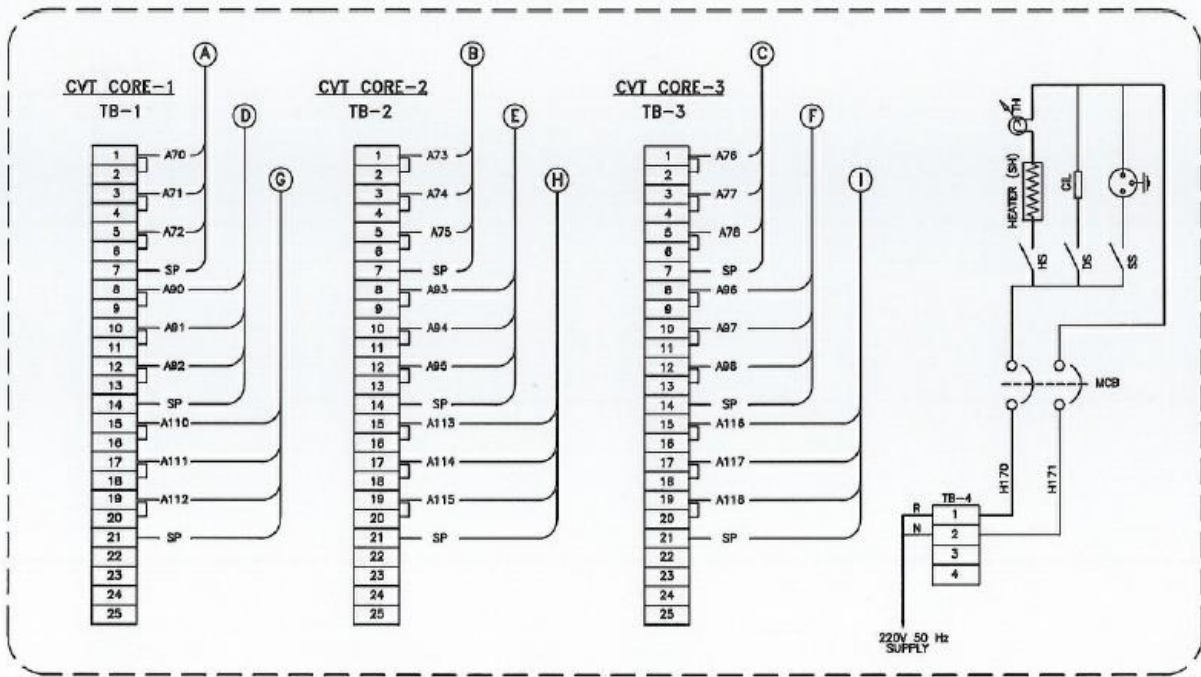
### Annexure-III: Wiring Diagram of Current Transformer



## Annexure-IV: Wiring Diagram of Voltage Transformer



## Annexure-IV: Wiring Diagram of Voltage Transformer



CVT MARSHALLING BOX

**NOTES :-**

1. INTERPOLE CABLING (A) TO (I) BY  
7C x 2.5mm, 1100V, PVC INSULATED STRANDED COPPER CABLE
2. TERMINAL BLOCKS SHALL BE DISCONNECTING STUD TYPE  
ELMEX CAT-DM4 OR EQUIVALENT WITH TRANSPARENT COVER
3. HS-HEATER SWITCH, DS-DOOR SWITCH, SS-SOCKET SWITCH  
TH-THERMOSTAT.

FOR TENDER PURPOSE ONLY

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

STANDARD DRAWING

WIRING DIAGRAM FOR MARSHALLING BOX  
FOR 400KV COMPACTIVE VOLTAGE TRANSFORMER

0000-000-T-E-L-29 Sheet 2 of 2

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

<b>Equipment</b>	<b>Nature of problem</b>	<b>Corrective measures to be taken by contractor</b>
CT/EMVT/IVT/PT (Oil filled)	<b>DGA Violation</b> H <sub>2</sub> > 300 ppm C <sub>2</sub> H <sub>2</sub> > 2 ppm	Refurbished or replaced
CT/EMVT/IVT/PT (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/EMVT/IVT/PT (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 year value > 0.1%	Replacement
CT/EMVT/IVT/PT & 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 or beyond	a) CVT to be replaced

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