

KARNATAKA POWER TRANSMISSION LIMITED

SECTION- INSTRUMENT TRANSFORMERS

CONTENTS

1.0	GENERAL.....	3
2.0	CURRENT TRANSFORMERS:.....	5
3.0	VOLTAGE TRANSFORMERS:	7
4.0	INSULATORS/BUSHINGS.....	8
5.0	TERMINAL BOX/MARSHALLING BOX:	9
6.0	INSULATING OIL:	9
7.0	TERMINAL CONNECTORS:.....	9
8.0	NAME PLATE:.....	9
9.0	TESTS	10
10.0	TECHNICAL PARAMETERS.....	13
11.0	PRE-COMMISSIONING TESTS	17

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 the specification and shall be in accordance with the requirements in Section GTR.
- 1.2 Current transformers IEC: 61869- 1&2
- 1.3 Capacitive Voltage transformers IEC:61869 – 1&5
- 1.4 Inductive Voltage Transformers IEC:61869 – 1&3
- 1.5 The instrument transformers shall be complete with its terminal box and a common marshalling box for a set of 3 instrument transformers.
- 1.6 The instrument transformer tank along with top metallic's shall be hot dip galvanized. Spray galvanization as per IS-5905 with 250 micron thickness of Zinc followed by finishing coats of a suitable primer with sealer is also acceptable with approval of owner.
- 1.7 The impregnation details along with tests/checks to ensure successful completion of impregnation cycle shall be furnished for approval.
- 1.8 The instrument transformers shall be designed for use in geographic and meteorological conditions as given in Section GTR.
- 1.9 Terminal and polarity marks shall be indelibly marked on each VT and CT on the associated terminals and these marks shall be in accordance with relevant standards.
- 1.10 The secondary terminal box for the voltage transformers shall also include necessary HRC fuses for protecting the secondary circuit. Further, for the purpose of fuse supervision on remote panel both terminals of fuse shall be brought out to the terminal box.
- 1.11 Voltage and current transformers shall be provided with the following accessories:
 - a) H.V. connectors for the OWNER's conductor.
 - b) Two earthing terminals on tanks on opposite sides for connecting the OWNER's earthing conductors.

- c) Oil level gauge.
 - d) Filling and draining plugs.
 - e) Power factor testing terminal.
 - f) Facility for lifting bushings and tanks.
 - g) Insulating oil required for first filling plus 10% as spare. Dielectric loss factor of the transformer oil shall not exceed 0.005. Insulation oil shall comply with applicable standards.
 - h) Rating and diagram plate as per relevant standards.
- 1.12 Voltage and current transformers shall be given tropicalised treatment for satisfactory operation in hot and humid climate.
- 1.13 VT/CT internal assemblies shall be suitably braced to withstand stresses induced due to a seismic coefficient indicated in specifications.
- 1.14 No turns compensation shall be used in case of class 'PS' CTs. Turns compensation, if any, should be clearly brought out in the offer in Data Sheet-B.
- 1.15 In case of multi ratio CTs, the minimum specified requirements in respect of VA, accuracy, Knee Point Voltage (KPV) and maximum secondary resistance specified shall be met at all taps.
- 1.16 Magnetizing characteristics (extending well beyond KPV) and secondary impedance values shall be furnished for all protection cores.
- 1.17 In case of unearthed voltage transformers both the terminals of the primary winding shall be brought out through bushings rated for full line voltage. In case of earthed voltage transformers, the end of the primary winding intended to be earthed shall be brought out through a bushing and earthing connection shall be made outside. This is required to facilitate meggering of the primary winding for which the earth connection has to be removed. The neutral side bushings of the voltage transformers shall be rated for 1.1 kV class.

2.0 CURRENT TRANSFORMERS:

- 2.1 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 of size 8mm non disconnecting terminal blocks inside the terminal box. In case “Bar primary” inverted type current transformers are offered the manufacturer will meet following additional requirements:
- a) The secondaries shall be totally encased in metallic shielding providing a uniform equi- potential surface for even electric field distribution.
 - b) The lowest part of the insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses.
 - c) 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.
 - d) Nitrogen if used for hermetic sealing (in case of live tank design) should not come in direct contact with oil.
 - e) Bidder/Manufacturer shall recommend whether any special storage facility is required for spare CT.
- 2.2 Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.
- 2.3 Core lamination shall be of cold rolled grain oriented silicon steel or other equivalent alloys. The cores used for protection shall produce undistorted secondary current under transient conditions at all ratios with specified CT parameters. Mu metal or nano crystalline core can also be used for metering core.
- 2.4 The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.
- 2.5 Facilities shall be provided at terminal blocks in the marshalling box for star delta formation, short circuiting and grounding of CT secondary terminals.

- 2.6 Current transformer's guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
- 2.7 For 420/245 kV class CTs, the rated extended primary current of the CTs shall be 200% of rated primary on all except 3000/2000/1 tap ratio. On 3000/2000/1 tap ratio the rated extended primary current shall be 120%. However, at 2000/1, ratio the CT shall be thermally rated for 200% for 15 minutes and 120% continuous. For 245 kV class CTs, the rated extended primary current shall be 120% (or 150% if applicable) on all cores of the CTs as specified in the Section – Project.
- 2.8 The secondary windings shall be rated for 2A continuously. Further, the intermediate tapping at 3000-2000 and 2000-500 shall be suitable for using as 1000/1 and 1500/1 ratios. The Auxiliary reactor, if provided, shall be suitable for connecting to the selected taps.
- 2.9 For 420/245kV 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. However, the CT construction / metering core accuracy must meet the CEA guidelines on Metering, with the latest amendments as on date of manufacturing, compulsorily.
- 2.10 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 design to the Purchaser for review.
- 2.11 For 420/245kV 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 up to the terminal blocks.

- 2.12 Tan-delta point shall be brought out near bottom terminal box for measurement during routine maintenance, with Bay de-energised & suitably isolated.
- 2.13 The wiring diagram plate for the interconnections of the three single phase CTs shall be provided inside the marshalling box.
- 2.14 The current transformers should be suitable for mounting on lattice/ pipe support structure to be provided by the Contractor in accordance with stipulations of Section GTR.
- 2.15 The CT shall be designed as to achieve the minimum risks of explosion in service. Bidder/Manufacturer shall bring out in his offer, the measures taken to achieve this.
- 2.16 420/245kV current transformers shall be suitable for high speed auto reclosing.

3.0 VOLTAGE TRANSFORMERS:

- 3.1 420/245kV Voltage transformers shall be capacitor voltage divider type with electromagnetic units and shall be suitable for carrier coupling.
- 3.2 Voltage transformers secondaries shall be protected by HRC cartridge type fuses for all the windings. In addition fuses shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the CVTs shall be terminated to the stud type of size 8mm non - disconnecting terminal blocks in the individual phase secondary boxes via the fuse.
- 3.3 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. Details of the arrangement shall be furnished along with the bid. 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 utilised. Further earthing link with fastener to be provided for HF terminal.
- 3.4 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.

- 3.5 The damping device which should be permanently connected to one of the secondary windings, should be capable of suppressing the ferroresonance oscillations.
- 3.6 The accuracy of 0.2 on secondary III should be maintained throughout the entire burden range upto 100 VA for 400 & 245 kV CVTs on all the windings without any adjustments during operation.
- 3.7 420/245kV CVTs shall be suitable for mounting on Lattice support structure / tubular GI pipe in accordance with stipulations of Section GTR.
- 3.8 It should be ensured that access to secondary terminals is without any danger of access to high voltage circuit.
- 3.9 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. In case of an alternate arrangement, bidder shall bring out the details in the bid.
- 3.10 The wiring diagram for the interconnection of the three single phase CVTs shall be provided inside the marshalling box in such a manner that it does not deteriorate with time.

4.0 INSULATORS/BUSHINGS

- 4.1 Instrument transformers shall be of 420/245kV class, oil filled with shedded porcelain/composite bushings / Insulators suitable for outdoor service and upright mounting on steel structures. In case of 72.5kV, Voltage transformer shall be Electromagnetic type.
- 4.2 Insulators/Bushings shall conform to applicable standards and shall be made of homogeneous vitreous porcelain, the glazing of which shall be of uniform brown or dark brown colour.
- 4.3 Oil filled insulator/bushings shall be hermetically sealed to prevent ingress of moisture. Bidder/ Manufacturer shall furnish details of the arrangements made for the sealing of instrument transformers during detailed engineering. Bidder/Manufacturer shall also furnish the details of site tests to check the effectiveness of hermetic sealing

for approval. A cushion of nitrogen gas shall be provided to allow for expansion. Oil-filled condenser type insulator/bushing shall be used.

- 4.4 Bushings shall be provided with grading rings and arcing horns, if required.
- 4.5 Bushings/Insulators shall conform to requirements stipulated in Section GTR. The bushing/insulator for CT shall be one piece without any metallic flange joint.
- 4.6 The Instrument transformer shall have cantilever strength of not less than 500kg and 350kg for 420kV & 245kV instrument transformers respectively or as per the value obtained vide Section GTR, whichever is higher. Bushing shall be provided with Oil filling & Drain plugs.
- 4.7 Polarity marks shall indelibly be marked on each instrument transformer and at the lead terminals at the associated terminal block.

5.0 TERMINAL BOX/MARSHALLING BOX:

Terminal box shall conform to the Section GTR.

6.0 INSULATING OIL:

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 with specific approval from the owner, the proposal for which shall be submitted during detailed engineering stage.

7.0 TERMINAL CONNECTORS:

The terminal connectors shall meet the requirements as given in Section GTR.

8.0 NAME PLATE:

- 8.1 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 in case of voltage transformers shall be clearly indicated on the name plate. The rated thermal current in case of CT shall also be marked on the name plate.

- 8.2 The intermediate voltage in case of capacitor voltage transformer shall be indicated on the name plate.

9.0 TESTS

The current and voltage transformers should have been type tested as per IEC/IS and shall be subjected to routine tests in accordance with **IEC 61869-1 & 2/ IS : 2705 & IEC 61869-1,3 & 5/ IS : 3156** respectively

Type tested current and voltage transformers shall be offered. The type test reports shall be furnished for each rating called for in the bid. The type test reports shall not be older than FIFTEEN (15) years as on the last date of submission of bid.

a) For current and voltage transformers manufactured in India:

- i). The type tests on indigenous equipment for which testing facility is available in India, should have been conducted in any independent laboratories approved by the Government or the laboratories accredited by the National accreditation body of the country like Central Power Research Institute (CPRI), Electrical Research and Development Association (ERDA), etc.
- ii). The type tests on indigenous equipment, for which testing facility is not available in India, should have been conducted in a laboratory of foreign country accredited by National accreditation body of that country.
- iii). The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of NABL accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

b) For current and voltage transformers manufactured Abroad:

- i). Type tests on imported equipment should have been conducted in an Indian Laboratory or foreign laboratory accredited by National accreditation body of the country where the Type test has been conducted.
- ii). The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

In case of in-house type tested imported equipment of foreign OEM, the term “Purchasing Utility” covers the foreign Utility who has purchased that equipment

9.1 The test reports of the type tests and the following additional type tests shall also be submitted for the Purchaser’s review.

a) Current transformers:

- i. Corona test & Radio interference test.
- ii. Seismic withstand test.
- iii. Thermal stability test, i.e. application of rated voltage and rated extended thermal current simultaneously by synthetic test circuit.
- iv. 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 $U_m/\sqrt{3}$).
- v. Chopped impulse voltage withstand test on primary terminals.
- vi. Multiple chopped impulse test on primary terminals.
- vii. Measurement of capacitance and di-electric dissipation factor.
- viii. Transmitted overvoltage test.
- ix. Mechanical Test.

b) Voltage transformers:

- i. High frequency capacitance and equivalent series resistance measurement (as per IEC-358).
- ii. Seismic withstand test
- iii. Stray capacitance and stray conductance measurement of the low voltage terminal (as per IEC-358).
- iv. Determination of temperature coefficient test (as per IEC-358).

- v. Chopped impulse voltage withstand test on primary terminals.
- vi. Multiple chopped impulse test on primary terminals.
- vii. Measurement of capacitance and di-electric dissipation factor.
- viii. Transmitted overvoltage test.
- ix. Mechanical Test.

c) Capacitor Voltage transformers:

- i. High frequency capacitance and equivalent series resistance measurement (as per IEC-358).
- ii. Seismic withstand test
- iii. Stray capacitance and stray conductance measurement of the low voltage terminal (as per IEC-358).
- iv. Determination of temperature coefficient test (as per IEC-358).
- v. Transmitted overvoltage test.
- vi. Mechanical tests.
- vii. Tightness design test on capacitor units.

9.2 The current and voltage transformer shall be subjected to the following routine/site tests in addition to routine tests as per IEC/IS.

a) Current transformers:

Routine tests:

- i. Measurement of Capacitance.
- ii. High voltage power frequency withstand test on Secondary Winding.
- iii. Over-voltage inter turn test (as per BS:3938).
- iv. Oil leakage test.

- v. Measurement of tan delta at 0.3, 0.7, 1.0 and 1.1 Um/ $\sqrt{3}$.
- vi. Measurement of partial discharge shall be carried out as per IEC.

b) Voltage Transformers:

Routine tests on Capacitive voltage transformer shall be done in line with IEC 61869-5.

- 9.3 The test equipment, meters, instruments etc. used for testing shall be calibrated at recognised test laboratories at regular intervals and valid certificates shall be made available to the OWNER'S representatives at the time of testing. The calibrating instruments used as standards shall be traceable to National/International standards.

10.0 TECHNICAL PARAMETERS

A. 420 kV CURRENT TRANSFORMERS :

A1	Rated Primary current	2000 A/3000A (as applicable)
A2	Rated short time thermal current for 1 sec.	40kA/50kA/63kA (as applicable)
A3	Rated dynamic current kA (peak)	100/125/157.5 (as applicable)
A4	Maximum temperature rise over design ambient temperature	As per IEC:61869-1
A5	One minute power frequency withstand voltage sec. terminal & earth	5 kV
A6	Number of terminals	All terminals of control to be wired upto marshaling box plus 20% spare terminals evenly distributed on all TBs.

A7	Type of insulation	Class A
----	--------------------	---------

Current Transformers shall also comply with requirements of Table-IIA.

B. 245kV CURRENT TRANSFORMER:

B.1	Rated Primary current	1600 /3000A (as applicable)
B.2	Rated short time thermal current	40 kA for 1 sec./50 kA for 1 (as applicable)
B.3	Rated dynamic current kA (peak)	100 / 125 (as applicable)
B.4	Maximum temperature rise over design ambient temperature	As per IEC:61869-1
B.5	One minute power frequency withstand terminal & earth	5 kV
B.6	Number of terminals	All terminals of control to be wired upto marshaling plus 20% spare terminals distributed on all TBs.
B.7	Type of insulation	Class A

Current transformers shall also comply with requirements of Table - IIB.

C. Technical Parameters for 72.5 kV Current Transformers

C.1	Rated Primary current	50
C.2	Rated extended current	120%
C..3	Rated short time current	25 kA for 3 sec.
C.4	Rated dynamic current	63 kAp
C.5	Maximum temperature rise over design ambient temperature	As per IEC-61869-1
C.6	One minute power frequency withstand voltage secondary terminal & earth	5 kV (rms)

C.7	Number of terminals	All terminals of control circuits are to be wired upto marshalling box plus 20% spare terminals evenly distributed on all TBs.
-----	---------------------	--

C.8	Type of insulation	Class A
-----	--------------------	---------

Current transformers shall also comply with requirements of Table – IIC.

D. 420 KV VOLTAGE TRANSFORMERS :

D.1	System fault level (for 1 second)	40kA/50kA/63 kA (as applicable)
D.2	of frequencies for which the accuracies are valid	96% to 102% for 99% to 101% for
D.3	High frequency capacitance for entire carrier frequency	Within 80% to 150% of capacitance
D.4	Equivalent series resistance over the entire carrier range	Less than 40 ohms.
D.5	Stray capacitance and stray conductance of the LV terminal over entire carrier frequency range	As per IEC:358
D.6	One minute power frequency withstand voltage :	
	i) Between LV(HF) terminal and earth terminal	10 kV (rms) for exposed terminals and 4 KV (rms) for terminals enclosed in a weather proof box
	ii) For secondary winding	3 kV (rms)
D.7	Maximum temperature rise over design ambient temperature	As per IEC:61869-2 or 61869-5

D.8	Number of terminals in control cabinet (interpole cabling is to be supplied by Purchaser)	All terminals of are wired upto marshaling box plus 12 terminals exclusively for Purchaser's use.
D.9	Rated Total Thermal burden (VA)	300 (100VA/winding)

Voltage Transformers shall also comply with requirements of Table-IA.

E. 245 KV VOLTAGE TRANSFORMERS :

E.1	System fault level(for 1 second)	40 kA / 50 kA (as applicable)
E.2	Standard reference range of frequencies the accuracies are valid	96% to 102% for protection and
E.3	High frequency capacitance for entire range	Within 80% to 150% of rated capacitance
E.4	Equivalent series resistance over the entire carrier range	Less than 40 ohms.
E.5	Stray capacitance and stray LV terminal over entire carrier frequency range	As per IEC:358
E.6	One minute power frequency withstand voltage :	
	i) Between LV(HF) terminal and earth	10 kV (rms) for exposed terminals and 4 KV (rms) for enclosed in a weather proof box
	ii) For secondary winding	3 kV (rms)
E.7	Maximum temperature rise over design ambient temperature	As per IEC:61869-2 or
E.8	Number of terminals in control cabinet cabling is to be supplied	All terminals of are wired upto marshaling box plus exclusively for Purchaser's

by Purchaser)

- | | | |
|-----|------------------------------------|---------------------|
| E.9 | Rated Total Thermal
burden (VA) | 300 (100VA/winding) |
|-----|------------------------------------|---------------------|

Voltage Transformers shall also comply with the requirements of Table-IB of this Chapter.

F. TECHNICAL PARAMETERS FOR 72.5 kV VOLTAGE TRANSFORMERS

- | | | |
|------|--|---|
| F.1. | System Fault level | 25kA for 3 second |
| F.2. | Standard reference range
of frequencies for which
the accuracies are valid | 96% to 102% for protection
and
99.5 to 101% for
measurement |
| F.3. | One minute power frequency
withstand voltage for secondary
winding | 3kV (rms) |
| F.4. | Maximum temperature rise over
design ambient temperature | As per IEC:61869-2 or
IEC:61869-5 |
| F.5. | Number of terminals in
control cabinet | All terminals of control
circuits are wired upto
marshalling box plus 20%
spare terminals evenly
distributed on all TBs |

Voltage Transformers shall also comply with the requirements of Table-IC of this Chapter.

11.0 PRE-COMMISSIONING TESTS

- 11.1 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 Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

11.2 **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) Magnetising characteristics test.
- f) Tan delta and capacitance measurement
- g) Secondary winding resistance measurement
- h) Contact resistance measurement (wherever possible/accessible).
- i) Test for SF6 (for SF6 filled CTs) – Dew point measurement, SF6 alarm/ lockout check.
- j) DGA test of oil.

- 11.3 Dissolved gas analysis to be carried out at the time of commissioning. CTs must have adequate provision for taking oil samples from the bottom of the CT without exposure to atmosphere. Bidder/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.

11.4 **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.
Secondary winding resistance measurement.

TABLE - IA
REQUIREMENTS OF 420 kV CAPACITIVE VOLTAGE
TRANSFORMERS

S.No.	PARTICULAR	
1.	Rated primary voltage (kV rms)	420
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 core	\pm 10 minutes (For metering)
6.	Capacitance (pf)	4400/8800 + 10% (As applicable) - 5%
		Secondary I Secondary II Secondary III
7.	Voltage Ratio (kV)	As per SLD
8.	Application	Protection Protection Metering
9.	Accuracy	3 P 3 P 0.2
10.	Output burden (VA) (minimum)	50 50 50

TABLE - IB
REQUIREMENTS OF 245 KV CAPACITIVE VOLTAGE
TRANSFORMERS

S.No.	PARTICULAR			
1.	Rated primary voltage (kV rms)	245		
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%		
		(As applicable) - 5%		
		Secon- Secon- Secon-		
		dary I dary II dary III		
7.	Voltage Ratio (kV)	220/0.11 220/0.11		
		220/0.11		
8.	Application	Protec- Protec- Meter-		
		tion tion ing		
9.	Accuracy	3 P 3 P 0.2		
10.	Output burden (VA) (minimum)	50 50 50		

TABLE - IC
Requirements of 72.5 kV Voltage
transformer

S.No.	PARTICULAR		
1.	Rated primary voltage(kVrms)	72.5	
2.	Type	Single phase Electro-magnetic or Capacitive VT	
3.	No. of secondaries	2	
4.	Rated Voltage Factor	1.2 continuous 1.5 – 30 seconds	
5.	Phase angle error	+ 20 minutes (For metering core)	
6.	Voltage ratio (kV)	Secondary I 33/_/3 / 0.11/_/3	Secondary II 33/_/3 / 0.11/_/3
7.	Application	Protection	Metering
8.	Accuracy	5P	0.2
9.	Output Burden (VA) (minimum)	10	10

TABLE - IIA

REQUIREMENTS FOR 420 KV CURRENT TRANSFORMERS RATED FOR 2000 A.

No. of Cores	Core No.	Appli- cation	Curren- t ratio	Output burden (VA)	Accurac- y class as per IEC:	Min. knee pt.volt- age Vk	Max. CT sec.wdg. resist- ance(ohm	Max. Excit- ation cur- rent at
5	1	BUS DIFF	2000- 1000/1	-	PS	2000/ 1000	10/5	30 on 2000/1 Tap; 60 on 1000/1 Tap
	2	BUS DIFF	2000- 1000/1	-	PS	2000/ 100	10/5	30 on 2000 60 on 1000 Tap
	3	METERING	2000- 1000- 500/1	20 20 20	0.2S 0.2S 0.2S	-		- - -
	4	TRANS. BACKUP/ LINE PROTN.	2000- 1000- 500/1	-	PS	4000/ 2000/ 1000	10/ 5/ 2.5	30 on 2000/1 Tap; 60 on 1000/1 Tap; 120 on 500/1 Tap
	5	TRANS. DIFF/ LINE PROTN	2000- 1000- 500/1	-	PS	4000/ 2000/ 1000	10 5 2.5	30 on 2000/1 Tap; 60 on 1000/1 Tap; 120 on 500/1 Tap

All relaying CTs shall be of accuracy class PS as per IS: 2705.

TABLE- IIA Cont'd**REQUIREMENTS FOR 420 KV CURRENT TRANSFORMERS RATED FOR 3000A.**

Core No.	Application	Ratio	Output Burden	Accuracy Class	Min knee point voltage	Max. CT Sec. wndg. Resistance (in Ω)	Max excitation current at V_k (in mA)
1	BUS DIFFERENTIAL	3000/ 2000/ 500/1	-	PS	3000/ 2000/	15	20@3000/1 tap; 30@2000/1 tap
2	BUS DIFFERENTIAL	3000/ 2000/ 500/1	-	PS	3000/ 2000/	15	20@3000/1 tap; 30@2000/1 tap
3	METERING	3000/ 2000/ 500/1	20 20 20	0.2S 0.2S 0.2S	- - -	15	- - -
4	TRANS. BACK-UP/ LINE PROTECTION	3000/ 2000/ 500/1	-	PS	3000/ 2000/ 500	15	20@3000/1 TAP; 30@2000/1 TAP; 120@500/1 TAP;
5	TRANS. DIFF./ LINE PROTECTION	3000/ 2000/ 500/1	-	PS	3000/ 2000/ 500	15	20@3000/1 TAP; 30@2000/1 TAP; 120@500/1 TAP;

All relaying CTs shall be of accuracy class PS as per IS: 2705.

**TABLE -
IIB
REQUIREMENTS FOR 245 KV CURRENT
TRANSFORMERS**

No.of Core	Core No.	Appli- cation	Current ratio	Output burden (VA)	Accuracy class as per IEC: 44-1	Min. pt.volt- age V _k	Max. CT sec.wdg. resist- ance(ohm	Max. ation cur- rent at V _k (in mA)
5	1	BUS DIFF	1600- 800/1	-	PS	1600/ 800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap
	2	BUS DIFF	1600- 800/1	-	PS	1600/ 800	8/	25 on 1600/1 Tap; 50 on 800/1 Tap
	3	METERING	1600- 800/1	20	0.2S	-	-	-
	4	TRANS. BACK UP/LINE PROTN.	1600- 800/1	-	PS	1600/ 800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap
	5	TRANS. DIFF/LINE PROTN	1600- 800/1	-	PS	1600/ 800	8/4	25 on 1600/1 Tap; 50 on 800/1 Tap

All relaying CTs shall be of accuracy class PS as per IS: 2705.

TABLE – IIB cont'd
REQUIREMENTS FOR 245 KV CURRENT TRANSFORMERS

No. of Core	Core No.	Appli- cation	Current ratio	Output burden (VA)	Accuracy class as per IEC: 44-1	Min. pt.volt- age Vk	Max. CT sec.wdg. resist- ance(ohm	Max. ation cur- rent at Vk (in mA)
5	1	BUS DIFF	3000- 2000/1	-	PS	3000/ 2000	15	25 on 3000/1 Tap; 50 on 2000/1 Tap
	2	BUS DIFF	3000- 2000/1	-	PS	3000/ 2000	15	25 on 3000 Tap; 50 on 2000 Tap
	3	METERING	3000- 2000/1	20	0.2S	-	-	-
	4	BACK UP	3000- 2000/1	-	PS	3000/ 15		25 on 3000/1 Tap;

All relaying CTs shall be of accuracy class PS as per IS: 2705.

TABLE – II C
REQUIREMENTS FOR 72.5 kV CURRENT TRANSFORMER

No. of Cores	Core No.	Application	Current Ratio	Output burden (VA)	Accuracy class & AL as per IEC 44-1	Remarks
2	1	O/C & E/F	50/1	10	5P10	
	2	Metering	50/1	10	0.2S	

**DATA TO BE FURNISHED BY THE VENDOR AFTER
AWARD OF CONTRACT**

Following to be furnished within 10 weeks of receipt of order.

1.0 VOLTAGE TRANSFORMER PARTICULARS

- 1.1 Binding dimensioned drawing of each VT including mounting dimensions.
- 1.2 Total weight of each VT:
(including weight of oil)
- 1.3 Quantity and weight of oil per VT (Litres & Kg)
- 1.4 Rating and diagram plate drawing.
- 1.5 Maximum shipping weight and volume and special instructions, if any, for shipping.

2.0 CURRENT TRANSFORMER PARTICULARS

- 2.1 Guaranteed dimensioned drawing of each CT including mounting dimensions.
- 2.2 Total weight of each CT :
(including weight of oil)
- 2.3 Quantity and weight of oil per CT (Litres & Kg)
- 2.4 Rating and diagram plate drawing.
- 2.5 CT characteristic curves with excitation current Vs sec. voltage for each core as measured in the case of protection CTs.
- 2.6 CT secondary resistance as measured in ohms.
- 2.7 Maximum shipping weight and volume.

3.0 **GENERAL**

- 3.1 Copies of routine and type tests certificates as specified in distribution schedule for the OWNER/ ENGINEER'S approval.
- 3.2 Copies of operation and maintenance manual as specified in the distribution schedule.
- 3.3 All test certificates shall be furnished before dispatch of equipment. No equipment shall be dispatched before approval of the test certificates by the OWNER/ENGINEER.
- 3.4 At least 10 days prior notice shall be given for witnessing of tests.