



**GUJARAT ENERGY TRANSMISSION
CORPORATION LTD.**

**SARADAR PATEL VIDYUT BHAVAN,
RACE COURSE, BARODA – 390 007.**

**TECHNICAL SPECIFICATION
FOR**

400 kV CURRENT TRANSFORMER

(with tariff-metering)

GETCO/E/04TS CT6/R6/Jun - 22

Blank

Blank

SECTION - I

TECHNICAL SPECIFICATIONS FOR 400 kV CURRENT TRANSFORMERS

1.0 SCOPE:

- 1.1** This section covers the design, manufacture, assembly, testing at the manufacturer's, supply and delivery of outdoor, Live/Dead tank type, oil impregnated paper, single phase Current Transformer, along with supporting structure as detailed in the enclosed schedule of requirement for relaying and metering services in three phase solidly ground system.
- 1.2** The bidder shall give assurance for trouble free and maintenance free performance for a period of 60 (sixty) months from the date of receipt at store, during which period, the CTs shall be repaired/reconditioned/replaced free of cost immediately in case of any trouble. Therefore, the bidder shall ensure that sealing of Instrument Transformer is properly achieved.
- 1.3** It is not the intent to specify completely herein all details of the design and construction of equipments. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the guarantee, who will interpret in a manner the meanings of drawings and specification and shall have the power to reject any work or material which in his judgment is not in accordance therewith. The equipment offered shall be complete with all components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply, irrespective of whether these are specifically brought out in this specification and/or the commercial order or not.

2.0 STANDARDS:

- 2.1** Unless otherwise specified elsewhere in this specification, the rating as well as performance and testing of the current transformers shall conform but not limited to the latest revisions and amendments available at the time of placement of order of all the relevant standards as listed hereunder.

2.1.1 CURRENT TRANSFORMERS:

SR. NO.	STANDARD NO.	TITLE
1	IS:2165	Insulation co-ordination for equipment of 100 KV and above
2	IS:16227(I & II)	Current Transformers
3	IS:2099	High voltage porcelain bushings
4	IS:3347	Dimensions of porcelain transformer bushings
5	IS:2071	Method of high voltage testing

6	IS:335	Insulating oil for transformers and switchgears
7	IEC 60529	Degrees of protection provided by enclosures (IP Code)
8	IEC-61869-1 to 3	Current Transformers
9	IEC-270	Partial discharge measurement
10	IEC-44(4)	Instrument transformer measurement of PDs
11	IEC-171	Insulation co-ordination
12	IEC-60	High voltage testing techniques
13	IEC-8263	Method for RIV test on high voltage insulators
14		Indian Electricity Rules 1956

- 2.2** Equipment meeting with the requirement of other authoritative Standards, which ensure equal or better performance than the standards mentioned above, shall also be considered. When the equipments offered by the Bidder conforms to other standards, salient points of difference between standard adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule. Four copies of such standards with authentic translation in English shall be furnished along with the bid.

3.0 CLIMATIC CONDITIONS:

- 3.1** Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions:

i)	Location in the state of	GUJARAT
ii)	Max. ambient air temp. (°C)	50
iii)	Min. ambient air temp. (°C)	3.5
iv)	Average daily ambient air temperature (°C)	35
v)	Maximum Relative humidity (%)	95
vi)	Average annual rainfall (mm)	1150
vii)	Max. wind pressure (Kg./sq. mtr.)	150
viii)	Max. altitude above mean (Meters) sea level.	Not exceeding 1000 mtrs.
ix)	Isoceraunic level (days/year)	15
x)	Seismic level (horizontal acceleration)	0.3 g

- 3.2** The equipment offered shall be suitable for continuous operation at their full rated capacity under the above conditions.

- 3.3** Since the sub-station may be near the sea-shore and/or in an industrial area, the equipment offered shall be suitable for heavily polluted atmosphere.

4.0 (A) PRINCIPAL PARAMETERS:

The current transformers covered in this specification shall meet the technical requirements listed hereunder.

PRINCIPAL TECHNICAL PARAMETERS OF CURRENT TRANSFORMERS:

SR. NO.	ITEM	SPECIFICATION 400 KV CT	
1	Type of CT/Installation	Single Phase, Outdoor, Dead tank/Live tank, Oil filled, hermetically sealed / stainless steel bellow type	
2	Type of mounting	Structure mounted.	
3	Suitable for system Frequency	50 Hz	
4	Highest System Voltage (KV rms)	420	
5	Current Ratio P/S	2000-1000-500 / 1-1-1-1-1	3000-2000-1000-500 / 1-1-1-1
6	Ratio Taps	☐ On Secondary Side ☐	
7	Method of earthing the system to be connected to	☐ Effective earthed ☐	
8	Rated continuous thermal current (A)	120% for higher ratio taps and 200% for lower ratio taps	
9	Acceptable limit of temperature rise above the specified ambient temperature for continuous operation at rated current	☐ As per 16227 ☐	
10	Acceptable partial discharge level at 1.1 times the rated voltage	☐ Less than 10 Pico coulombs ☐	
11	Maximum radio interference voltage at 1.1 time the rated voltage	☐ Less than 1000 Micro Volts ☐	
12	250/2500 Microsecond lightning impulse withstand voltage (KVp) (Dry & Wet)	1,050	
13	1.2/50 Microsecond lightning impulse withstand voltage (KVp)	1,425	
14	1 minute dry power frequency withstand voltage primary (KV rms)	630	
15	Power frequency over voltage withstand requirement for secondary winding (KV rms for 1 min)	5 kV	
16	Min. creepage distance of porcelain house in (mm)	10,500	
17	Rated short time withstand current for 3 second duration (KA rms)	40	
18	Rated dynamic withstand current (kAp)	100	
19	Visual corona extinction voltage (KV rms)	320	
20	Seismic acceleration (Horizontal)	As specified against Clause 3.1	

		(x)
21	Mounting Dimensions*	600 X 600
*Mounting dimensions can be matched by using adaptor base plate		

4.0 (B) GENERAL TECHNICAL REQUIREMENTS:

4.1 COMMON FOR ALL CURRENT TRANSFORMERS:

- 4.1.1 The insulation of the current transformers shall be so designed that the internal insulation shall have higher electrical withstand capability than the external insulation. The designed dielectric withstands values of external and internal insulations shall be clearly

brought out in the guaranteed technical particulars. The dielectric withstand values specified in this specification are mean for fully assembled current transformers.

4.1.2 Porcelain Housing:

- 4.1.2.1 The details of location and type of joint, if provided on the porcelain, shall be furnished by the Bidder along with the offer. The housing shall be made of homogeneous, vitreous porcelain of high mechanical and dielectric strength, glazing of porcelains shall be of uniform brown or dark brown colour with a smooth surface arranged to shed away rain water or condensed water particles. (fog). The profile of porcelain shall be aerodynamic type as per IEC-815.

- 4.1.2.2 Details of attachment of metallic flanges to the porcelain shall be brought out in the bid.

- 4.1.3 The metal tanks shall have bare minimum number of welded joints so as to minimise possible locations of oil leakage. The metal tanks shall be made out of mild steel/stainless steel/aluminium alloy, depending on the requirement. Welding in horizontal plane is to be avoided as welding at this location may give way due to vibrations during transport resulting in oil leakage. Supplier has to obtain specific approval from purchaser for any horizontal welding used in the bottom tank.

4.1.4 Cleaning & Galvanising:

- 4.1.4.1 All ferrous parts of CTs including lifting hooks and adjustable arcing horns shall be hot dip galvanized. Before filling with oil or compound all ferrous parts shall be completely cleaned and free from dust scale and greases and all external rough surfaces on castings shall be filled by metal disposition. The interior of current transformer tank shall be cleaned of all scale and rust by sand blasting or other approved method. *These surfaces shall be hot dip galvanised or painted with oil resisting varnish or paint.*

- 4.1.4.2 *Any damage to galvanizing, during transport and erection shall be made good by thoroughly cleaning the damaged portion and by applying the full number of coats.*

- 4.1.4.3 All external MS surfaces shall be thoroughly cleaned and hot dip galvanized as per relevant IS .Any damage to galvanized surfaces during transport and erection shall be made good by thoroughly cleaning the damaged portion and by

applying the full number of coats of zinc rich paints.

4.1.5 Insulating Oil :

4.1.5.1 The quantity of insulating oil for first filling and the complete specification of the oil shall be stated in tender. The oil shall comply in all respects with the provisions of the latest edition of IS :335 or IEC Publication No.296 (as amended upto date) The oil shall have the following main characteristics or equivalent.(The requirement indicated is determined in accordance with the test methods adopted by IS:335).

Sr.No.	Characteristics	Requirements	Method of Test
1.	Appearance	The oil shall be clear and Transparent & free from suspended matter or sediment.	A representative sample of oil shall be examined in a 100mm thick layer, at ambient temperature of equivalent authoritative standard.
2.	Density at 27 Deg.C Max.	0.89g/cm ³	IS:1448 (P-16) 1967 or equivalent authoritative standard.
3.	Kinematics viscosity at 27 Deg. C Max.	27 CST	IS :1448 (P-25) 1960 or equivalent authoritative standard.
4.	Interfacial tension at 27 Deg.Min.	0.004 N/m	IS :1448 (P-25) 1960 or equivalent authoritative standard.
5	Flash point Pensky Marten (closed) Min.	140 Deg. C	IS :1448 (P-21) 1970 or equivalent authoritative standard.
6	Pour point Max	- 10 Deg. C	IS :1448 (P-10) 1970 or equivalent authoritative standard.
7	Neutralization value (Total acidity) Max.	0.03 Mg/KOH/g	IS :335 - 1972 Appendix -A or equivalent authoritative standard.
8	Corrosive sulphur (in terms of classification of copper strip	Non-corrosive.	IS :335 -1972 Appendix -A or equivalent authoritative standard.

9	Electric strength (break down voltage) Min. a) New untreated oil b) After treatment	30KV (rms) If the above value is not attained, the oil shall be treated 50 KV (rms)	IS :6792 -1972 or equivalent authoritative standard.
10	Dielectric dissipation factor (tan δ) at 90 Deg. C Max.	0.002	IS :6262 -1971 or equivalent authoritative standard.
11	Specific resistance (Resistivity) a) At 90 Deg. C Min. b) At 27 Deg. C Min.	35 x 10 ¹² Ohm/cm 1500 x 10 ¹² Ohm/cm.	IS :6103-1971 or equivalent authoritative standard.
12	Oxidation stability a) Neutralization value after oxidation max. b) Total sludge after oxidation Max.	0.40 mg/KOH/g 0.10 percent by weight	IS :335 -1972 Appendix -C or equivalent authoritative standard.
13	Ageing characteristic		
	after accelerated ageing a) Specific resistance (Resistivity) i) At 27 Deg. C Min. ii) At 90 Deg. C Min. b) Dielectric dissipation factor (tan δ) at 90 Deg.C Max. c) Total Slug acidity % by	2.5 x 10 ¹² Ohm/cm 2.5 x 10 ¹² Ohm/cm 0.2 0.05 max. mg. KOG/G	IS-6103 -1971 IS 6262-1971 IS-1448 -1967

	weight		
	d) Total slug value by weight.	0.05	
14	Water content Max.	50ppm	IS 2362 -1963 or equivalent authoritative standard

4.1.6 Prevention of Oil Leakages and Entry of Moisture:

4.1.6.1 The supplier shall ensure that the sealing of current transformer is properly achieved. In this connection the arrangement provided by the supplier at various locations including the following ones shall be described, supported by sectional drawings.

- i) Locations of emergence of primary and secondary terminals.
- ii) Interface between porcelain housing and metal tank/s.
- iii) Cover of the secondary terminal box. (IP-55 Class)

4.1.6.2 Nuts and bolts or screws used for fixation of the interfacing porcelain bushings for taking out terminals shall be provided on flanges cemented to the bushings and not on the porcelain.

4.1.6.3 For gasket joints, wherever used, Nitrile Butyl rubber NBR/Viton/RC70C/RC80C shall be used. No Plain CORK gaskets shall be used. All O rings shall be fixed in a machine groove. The gaskets shall be securely fitted for perfect sealing.

4.1.7 Oil Level Indicators:

Current transformers shall be supplied with stainless-steel bellow or appropriate nitrogen cushion to take care of increase/decrease in volume of oil due to temperature variation. A prismatic type oil sight window shall be provided. *Purity of Nitrogen before filling in shall be verified and documented.*

4.1.8 Earthing:

Metal tank of the current transformer shall be provided with two separate earthing terminals for bolted connection to 50 x 8 mm MS flat to be provided for connection to station earth-mat.

4.1.9 Current transformer shall be provided with suitable lifting arrangement, to lift the entire unit. The lifting arrangement shall be clearly shown in the general arrangement drawing. Lifting arrangement (lifting eye) shall be positioned in such a way as to avoid any damage to the porcelain housing or the tanks during lifting for installation/transport. Necessary string guides shall be offered which shall be of removable type.

4.1.10 Name Plate:

The current transformer shall be provided with non-corrosive, legible name plate with the information specified in relevant standards, duly engraved/punched on it. "Property of GETCO" & A/T no.

4.1.11 Terminal Connectors:

All Current Transformer shall be provided with *Rigid and Flexible* type terminal connectors suitable to receive 4" IPS (114.3 OD) aluminum pipes or *compression type suitable for* bundled ACSR conductors *as indicated in Schedule – A of respective tender*. Clamps shall be designed adequately to take care of any bimetallic effect. The temperature at the clamp shall not exceed 80 °C. Corona rings shall be provided at the breaker terminals. The terminal pad shall have protective covers which shall be removed before connections. The ratings of Terminal connectors shall be equal or higher than that of the current transformer.

The terminal connectors shall meet the following requirements:

- 1) Terminal connectors shall be manufactured and tested as per IS:5561.
- 2) All castings shall be free from bow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 3) No part of a clamp shall be less than 12 mm thick.
- 4) All ferrous parts shall be hot dip galvanised conforming to IS:2633.
- 5) For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body.
- 6) Flexible connectors shall be made from tinned copper/aluminium sheets.
- 7) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 8) All Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS:5561.
- 9) *All nut bolts shall be of size M12 or higher as per requirement. Material shall be non-magnetic electric grade stainless steel.*

4.1.12 Enamel, if used for conductor insulation, shall be either polyvinyl acetate type or amide type and shall meet the requirements of IS:4800. Polyester enamel shall not be used. Double cotton cover, if used, shall be suitably covered to ensure that it does not come in contact with oil.

4.1.13 The temperature rise on any part of equipment shall not exceed the maximum temperature rise specified below under the conditions specified in test clauses. The permissible temperature rise indicated is for a maximum ambient temperature of 50°C.

4.1.14 The maximum temperature rise of the current transformer and its oil, winding and external surface of the core and other parts shall be as per standards specified.

SR. NO.	NATURE OF THE PART OR OF THE LIQUID	TEMP. (°C)	TEMP. RISE AT A MAX. AMBIENT AIR TEMP. NOT EXCEEDING 50°C
1	Contacts in air, silver faced copper, copper alloy or aluminium alloy (see note (i) and (ii))	105	55
	Bare Copper or tinned aluminium alloy	75	25
2	Contacts in oil:		
	Silver-faced copper, copper alloy or aluminium alloy (see note ii)	90	40

	Bare Copper or tinned aluminium alloy	80	30
3	Terminal to be connected to external conductors by screw or bolts silver faced (see note iii)	105	55
	Bare	90	40
4	Metal parts acting as springs	(See note iv)	(See note iv)
5	Metal parts in contact with insulation of the following classes:		
	Class Y: For non-impregnated materials	90	40
	Class A: For materials immersed in oil or impregnated	100	50
	Class E: In Air	120	70
	In Oil	100	50
	Class B: In Air	130	80
	In Oil	100	50
	Class F: In Air	155	105
	In Oil	100	50
	Enamel: Oil base	100	50
	Synthetic, in Air	120	70
	Synthetic, in Oil	100	50
6	Any part of metal or of insulating material in contact with oil, except contacts	100	50
7	Oil	50	40

- Notes:** 1) When applying the temperature rise of 55°C, care should be taken to ensure that no damage is caused to the surrounding insulating materials.
- 2) The quality of the silver facing shall be such that a layer of silver remains at the point of contact. Otherwise, the contacts shall be regarded as “bare”.
- 3) The values of temperature and temperature rise are valid whether or not the conductor connected to the terminals is silver-faced.
- 4) The temperature shall not reach a value where the elasticity of the material is impaired. For pure copper, this implies a temperature limit of 75°C.

4.2 CURRENT TRANSFORMER (CT) DESIGN:

4.2.1 The C.T. shall be of dead tank or Live Tank design and shall be so constructed that it can be easily transported to site within the allowable transport limitation and in horizontal position if the transport limitations so demand.

4.2.2 For compensation of variation in the oil volume due to ambient variation, nitrogen cushion or stainless steel bellows or nitrogen cushion shall be used. Rubber diaphragms shall not be permitted for this purpose.

Instrument transformer shall be hermetically sealed to climatic breathing and entering air & moisture in the tank, either by providing stainless steel bellow or by nitrogen cushioning. All parts of bellow shall be stainless steel only. In case of instrument transformer without stainless steel bellow, but sealed by nitrogen

cushion, the pressure relief valve shall be provided so that overpressure caused by internal faults can be instantaneously relieved and bursting of unit is avoided.

The pressure relief valve shall comply as follow:

- a) It shall be either of stainless steel or brass material.*
- b) Spring used shall be of non magnetic stainless steel.*
- c) It shall conform to relevant IS/IEC standards.*
- d) It shall be suitably calibrated for the maximum allowed pressure. Bidder shall ensure that during any of the acceptance tests PRV shall not operate.*
- e) Its satisfactory operation shall be offered during stage inspection.*
- f) It will be treated as major bought out item hence; necessary test report from vendor shall be submitted.*

4.2.2.1 Bellows made of stainless steel shall only be used at the top for hermetic sealing of Live Tank CT.

4.2.3 The C.T. secondary terminals shall be brought out in a weatherproof terminal box. The terminal box shall be provided with removable gland plate and gland/s suitable for 1100 volts grade, PVC insulated, PVC sheathed multi core 6 sq. mm. or 10 sq. mm. stranded copper or aluminium conductor cable. The terminal box shall be dust and vermin proof **and shall comply with** IP55 degree of protection standards & type test report shall be submitted with technical bid. Suitable arrangement shall be made for drying of air inside the secondary terminal box. The dimensions of the terminal box and its openings shall adequate to enable easy access and working space with use of normal tools.

4.2.4 Polarity shall be indelibly marked on each primary and secondary terminal, Facility shall be provided for short-circuiting of the C.T. secondary terminals inside the terminal box.

4.2.5 The C.T. shall be provided with a rating plate with dimensions and markings as per IS:16227. The markings shall be punched and not painted.

4.2.6 The current transformer shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air moisture from entering the tanks. Oil filling and/or oil sampling cocks, if provided to facilitate factory processing, should be permanently sealed before dispatching the C.T. The method adopted for hermetic sealing shall be described in the offer.

4.2.7 The castings of base, cooler etc. shall be die cast and tested before assembly to detect cracks and voids if any.

4.2.8 The instrument security factor of metering core shall be low enough and not greater than

5. This shall be demonstrated on all the ratios of the metering core, in accordance with procedure specified in IEC: 61869 or IS: 16227. In case the instrument security factor of 5 or less is not possible to be achieved on higher ratios, auxiliary CTs ratio 1/1 and 0.5 accuracy class shall be deemed to be included in the Bidder's scope of supply. This shall also be specifically brought out by the Bidder in his offer.

- 4.2.8.1 Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.

4.2.9 Primary Winding:

- 4.2.9.1 Primary winding shall be made out of high conductivity copper or aluminum, Conductors used for the primary winding shall be rigid or housed in rigid metallic shell. Unavoidable joints in the primary winding shall be welded type. The details of such welded joints shall be indicated in the drawings submitted with the offer. For primary winding current density shall not exceed 1.65 A/sq. mm for copper and 1.05 A/Sq.mm for aluminum, if made out of solid conductor. If the primary conductor is made out of tubular conductor (pipe), the joints in the bend portion shall be allowed. The welding type quality and extent shall be as per relevant ISS or other equivalent standard.

- 4.2.9.2 The design density for short circuit current as well as conductivity of the metal used for primary winding shall meet the requirement of IS:16227. The Bidder shall in his offer furnish detailed calculations for selection of winding cross-sections.

4.2.10 Secondary Windings:

- 4.2.10.1 Suitably insulated copper of electrolytic grade shall be used for secondary windings. Type of insulation used shall be described in the offer. For multi ratio design, suitable tapplings shall be provided on the secondary winding.

- 4.2.11 The exciting current of the CT shall be as low as possible. The Bidder shall furnish along with his offer the magnetisation curve/s for all the core/s.

A duplicate set of secondary terminals connected through a suitable link shall be provided in the terminal box. One set shall be connected to the terminal secondary leads while the other one shall be connected to external cable leads. This type of arrangement is essential to prevent undue pressure to internal leads and failure of studs while connecting the external cable leads to the secondary terminals, as both the terminals will be independent for their connections.

4.2.12 Primary Terminals:

Primary terminals shall be of heavily tinned electrolytic copper (tinned plated with minimum thickness 15micron) or aluminium alloy of 99.9% conductivity. For Copper made Primary Winding, Primary Terminal shall be made of copper rod/s & for Aluminium made Primary winding Primary Terminal shall be Flat pad/Rod type. The Terminal offered shall be same as provided in tested CT for temperature rise test.

4.2.13 Secondary Terminals:

Secondary terminal studs shall be provided with at least three nuts and adequate plain and spring washers for fixing the leads. The studs, nuts and washers shall be of tinned copper of 99.9% purity and conductivity. The minimum out side diameter of the studs shall be 6mm. The length of at least 20 mm shall be available on the studs for inserting the leads. The horizontal spacing between

centers of the adjacent studs shall be at least 1.5 times the outside circum dia of the nuts. Secondary terminals shall be brought out through composite epoxy block with single gasket. Terminal blocks shall be provided for dummy terminals. *20% spare terminal blocks shall be provided.*

- 4.2.14 The current transformer shall be provided with suitable test tap for measurement of capacitance/tan delta, in factory as well as at site. Provision shall be made of a screw on cap/nut-bolt type for solid and secured earthing of the test tap connection, when not in use. A suitable caution plate shall be provided duly fixed on the cover of the secondary terminal box indicating the purpose of the test tap and necessity terminal box indicating the purpose of the test tap and necessity of its solid earthing as per prescribed method before energizing the C.T. *Tan delta tap shall measure value of whole mass of insulation in the CT.*

4.3 Bushing / Insulator:

- 4.3.1 The porcelain hollow insulator used for the instrument transformer shall be homogenous, free from lamination cavities and other flaws or imperfection that might affect the mechanical or dielectric qualities. The hollow insulator shall conform to the latest edition of IS/IEC:62155. The puncture strengths of the hollow insulator shall be entirely free from external and internal corona. The total creepage distance of the hollow insulator shall be suitable for heavily polluted atmosphere i.e. the total creepage distance shall be 6125 mm (minimum). The hollow insulator shall have ample insulation, mechanical strength and rigidity for the conditions under which they will be used and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove internal heat. There shall be no undue stressing of any part of the bushings due to temperature changes and adequate means shall be provided to accommodate conductor expansion.
- 4.3.2 The hollow insulator shall be so designed that when operating at highest system voltage specified, there will be no electric discharge between the conductors, and hollow insulator. No corrosion or injury shall be caused to conductor insulation or supports by the formation of substances produced by chemical action. The insulation of hollow insulator shall be co-ordinated with that of the instrument transformer such that the flashover, if any, will occur only externally to the Instrument Transformer. The hollow insulator shall not cause radio interference when operated at rated voltage. The specification of the bushing shall be stated in the tender.
- 4.3.3 The outer surface of metal tank shall be Hot Dip Galvanized, whereas, the inner portion shall be painted with oil resistive, insoluble paint. The GETCO reserves right for stage inspection during manufacturing process of tank / CT. The galvanizing shall be as per applicable standard IS:2629 and the minimum thickness of zinc coating shall be 610 gr/sqmt. If made of aluminium, external surface of aluminum can have natural finish.

5.0 TESTS:

5.1 TYPE TESTS:

The following tests from NABL accredited laboratory shall be carried out in accordance with latest / amended / up to date IS/IEC. The bidder has to submit the all type test reports as stated hereunder for the offered item along with the technical bid. **The type test reports from NABL approved laboratory shall not be older than TEN years.** Type Test shall be

valid as on the last date of submission of bid.

Following type tests reports shall be submitted for CT.

1. Lightning Impulse voltage test on primary terminal
2. Switching impulse voltage test (Wet)
3. Multiple Chopped impulse test on primary Terminal
4. Temperature rise test
5. Short Time Current test
6. Test of Accuracy
7. Measurement of dielectric dissipation factor **(0.3% max) & capacitance at 10 kV and at $U_m/\sqrt{3}$.**
8. Degree of protection IP55 for secondary terminal box
9. STC test on primary terminal connector
10. Seismic withstand test
11. **Mechanical tests**
12. **Radio interference voltage test**
13. **Thermal stability test (IEEMA-22-2005)**
14. **Temperature coefficient test (IEEMA-22-2005)**

However the purchaser reserves the right to demand repetition of some or all the type tests in the presence of purchaser's representative. **For this purpose the Bidder may quote unit rates for carrying out each type test. This will not be considered for Evaluation.**

IMPORTANT NOTE: *In case of non-submission/partial submission or type test reports of which validity is over, bidder shall submit pending type test report/s from NABL accredited laboratory, in the event of an order, before commencement of supply without affecting delivery schedule, free of cost to GETCO. Confirmation for above shall be invariably submitted along with technical bid.*

5.2 ACCEPTANCE AND ROUTINE TESTS:

5.2.1 All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the bidder in presence of purchaser's representative.

5.2.2 Immediately after finalisation of the programme of type/acceptance/routine testing, the supplier shall give sufficient advance intimation to the Purchaser to enable him to depute his representative for witnessing the tests.

5.2.3 Following tests shall be performed on CT.

- 1 Verification of terminal marking and polarity(on 10% of offered lot)
- 2 High voltage power frequency dry withstand test on primary winding(on 10% of offered lot)
- 3 High voltage power frequency dry withstand test on secondary winding(on 10% of offered lot)
- 4 Over Voltage inter turn test(on 10% of offered lot)
- 5 Measurement of Partial Discharge test(on 10% of offered lot)
- 6 Test of Accuracy(on 10% of offered lot)
- 7 Measurement of dielectric dissipation factor **of whole mass of insulation (0.3% max) & Capacitance at 10 kV and at $U_m/\sqrt{3}$.** (on 100% of offered lot)
- 8 Thermal stability test (On any one unit from offered lot) (IEEMA-22-2005)

- 9 Temperature coefficient test (On any one unit from offered lot) (IEEMA-22-2005)
- 10 Measurement of IR value by 5 kV motorized megger (on 10% of offered lot)
- 11 Determination of the secondary winding resistance (on 10% of offered lot)
- 12 Test for rated knee point e.m.f & exciting current at rated knee point e.m.f (on 10% of offered lot)
- 13 Power-frequency voltage withstand tests between sections. (on 10% of offered lot)
- 14 Tests on Oil for CT:

a) BDV test	]	On randomly selected unit of very first lot offered for inspection and to be conducted after HV test only.
b) Tan Delta test	]	
c) Water ppm test	]	
d) Specific at 7 ° & 90°	]	
e) Resistance 5	]	
f) Viscosity	]	
Total Acidity		
g) DGA test	]	Copy of test report, received from the power oil manufacturer, to be submitted.

(NOTE: If the supplier of oil is changed during execution of order, same test shall be repeated for the oil of new supplier.

Test no. 1 to 6 shall only be performed on 100% tariff metering CTs in an NABL accredited/Govt lab.

All the tests reports and oscillograms shall be submitted and got approved from the purchaser before dispatching the equipment.

5.2.4 General points:

5.2.5 The manufacturer shall use 5 KV motorized megger for measuring IR values of CTs.

5.2.6 The manufacturer shall carry out Partial Discharge test and tan delta test as per relevant ISS, and shall keep record of the same.

5.2.7 If so required, the purchaser shall select one CT of each ratio from the first lot or any subsequent lot of CTs, which shall be type tested in presence of purchaser's representative at third party Govt. recognized laboratory. The balance CT from the first offered lot or any subsequent lot shall be inspected and tested for routine tests.

5.2.8 The manufacturer shall offer CTs for routine tests / inspection in line with the requirement as per delivery schedule specified in the A/T

5.2.9 Record of each manufacturing process shall be maintained by the manufacturers, and shall be shown to the inspector, on demand at the time of inspection.

6.0 INSPECTION:

- i) The purchaser shall have access at all times to the works and all other places of manufacture, where the instrument transformers are being manufactured and the supplier shall provide purchaser representative all facilities for unrestricted inspection of the works, raw materials, manufacture of all the accessories and for conducting necessary testes as detailed herein.
- ii) **The successful bidder shall submit the stage wise inspection program. Stages of inspection and owners participation would be defined and tied up at the time of award of contract.**
- iii) No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

- iv) The acceptance of any quantity of the equipments shall in no way relieve the successful Bidder of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection if such equipments are later found to be defective.
- v) *"The successful bidder shall first offer PROTO unit for stage inspection. During stage inspection all the raw material and manufacturing process shall be verified. On clearance of stage inspection bidder shall process for manufacturing of PROTO unit and offer the same for inspection. During inspection all the acceptance tests as indicated at respective clause under head of 'Acceptance tests' along with additional Sealing test as detailed here under, shall be carried out before temperature coefficient test.*

In the event of failure of PROTO unit, bidder shall analyze the defects & submit report to GETCO along with remedial measures taken and again offer PROTO for inspection.

On successful completion of all acceptance tests along with Sealing test on PROTO unit, release for manufacturing will be given by GETCO.

The successful PROTO unit shall be kept aside and made available to inspector for verification. This unit shall be dispatched after the inspection of last lot is over.

Sealing test shall be carried out on one randomly selected unit out of every 20 or less offered quantity. In the event of failure of unit during sealing test next unit will be randomly selected from the offered lot. Failed unit shall not be accepted. If second unit also fail to clear Sealing test WHOLE lot shall be rejected."

SEALING TEST PROCEDURE:

- (i) *Test shall be performed on completely assembled unit.*
- (ii) *Test shall be performed on PROTO as well as during acceptance test on one randomly selected unit.*
- (iii) *Temperature of CT/PT under test will be elevated and maintained at 50 (°C) and simultaneously it shall be subjected to internal pressure of 103 kPa (@1.1 kg/sqcm) for 12 hrs.*
- (iv) *Arrangement shall be made by manufacturer to maintain required pressure and temperature for 12 hrs.*
- (v) *During and after the test, there shall not be any oil leakage from any part or joint of CT/PT.*
- (vi) *Readings of temperature, internal pressure applied and duration test along with observation of leakage, if any, shall be noted in inspection report.*

7.0 QUALITY ASSURANCE PLAN:

7.1 The Bidder shall invariably furnish following information along with his offer. Information shall be separately given for individual type of equipment offered.

- i) Statement giving list of important raw materials, names of sub-suppliers for the raw material, list of standards according to which the raw material in presence of Bidder's representative, copies of test certificates.

- ii) Information and copies of test certificates as in (i) above in respect of bought out items.
- iii) List of manufacturing facilities available.
- iv) Level of automation achieved and list of areas where manual processing exists.
- v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- vi) Special features provided in the equipment to make it maintenance free.
- vii) List of testing equipment available with the Bidder for final testing of equipment specified and test plant limitation, if any, vis-a-vis type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test equipments.
- viii) The following testing equipments shall be available for testing at bidders works.
 - 1) Partial Discharge test set up (preferably Robinsons)
 - 2) Tan delta and capacitance test set up (Tettex or Dobbie)
 - 3) Minimum Sensitivity of high voltage laboratory-2.5pC for PD measurement. This is to be demonstrated before test.All test set up shall be calibrated at NABL accredited laboratory and report shall be submitted with inspection report.
- ix) Bidder shall have ISO certification.

7.2 The successful Bidder shall within commencement period, submit following information to the Purchaser.

- i) List of raw material as well as bought out accessories and the names of sub- suppliers selected from the lists furnished along with offer.
- ii) Type test certificates of the raw material and bought out accessories.
- iii) Quality Assurance Plan (QAP) with hold points for purchaser's inspection. The quality assurance plan and hold points shall be discussed between the Purchaser and Supplier before the QAP is finalised. The bidder shall submit the field Quality Plan also.

7.3 The successful Bidder shall submit the routine test certificates of bought out items and form raw material at the time of routine testing of the fully assembled equipment.

8.0 DOCUMENTATION:

8.2 All drawings shall conform to international standards Specification (ISO) 'A' series of drawing sheet/Indian Standards Specification IS11065. All drawings shall be in

ink and suitable for microfilming. All dimensions and data shall be in S.I. Units. Drawing incorporating the following particulars shall be submitted by the bidder with the bid, **in hard as well as in AutoCAD format.**

8.3 List of Drawings and Documents:

The Bidder shall furnish four sets of following drawings along with his offer.

- a) General outline and assembly drawings of the equipment.
- b) Graphs showing the performance of equipments in regard to magnetisation characteristics.
- c) Sectional views showing :
 - i) General Constructional Features.
 - ii) Materials/Gaskets/Sealing used.
 - iii) The insulation of the winding arrangements, method of connection of the primary/secondary winding to the primary/secondary terminals etc.
 - iv) Porcelain used and its dimensions along with the mechanical and electrical characteristics.
- d) Arrangement of terminals and details of connection studs provided.
- e) Name and rating plate.
- f) Schematic drawing.
- g) Cross sectional view of current transformer
- h) Any other drawing required by purchaser during detailed engineering.
- i) *SS bellow drawing and its calculations if used.*
- j) Type test reports in case the equipment has already been type tested.
- k) Test reports, literature, pamphlets of the bought out items and raw material.
- l) *Quality Assurance plan*
- m) *Field Quality Plan*

8.4 The successful Bidder shall submit three sets of final versions of all the above drawings for Purchaser's approval. The Purchaser shall communicate his comments/approval on the drawings to the supplier within reasonable time. After receipt of purchaser's approval, the supplier shall submit *AutoCad format* of the approved drawings.

8.5 The manufacturing of the equipment shall be strictly in accordance with the approved drawings and no deviation shall be permitted without the written approval of the Purchaser. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Supplier's risk.

8.6 One copy of nicely printed and bound volumes of operation, maintenance and erection manuals in English language, for each type and rating of equipment supplied shall be submitted by the Supplier for distribution, prior to the dispatch of the equipment. The manual shall contain all the drawings and information required for erection, operation and maintenance of the instrument transformer. The manual shall also contain a set of all the approved drawings, type test reports etc.

8.7 Approval of drawings/work by Purchaser shall not relieve the supplier of his

responsibility and liability for ensuring correctness and correct interpretation of the latest revision of applicable standards, rules and codes of practices. The equipment shall confirm in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of ordering and purchaser shall have the power to reject any work or material which in his judgment is not in full accordance therewith.

9.0 PACKING AND FORWARDING:

- 9.2 The equipment shall be packed in MS painted crates suitable vertical/horizontal transport, as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing and handling. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.
- 9.3 Each consignment shall be accompanied by a detailed packing list containing the following information:
- a) Name of the consignee.
 - b) Details of consignment.
 - c) Destination.
 - d) Total weight of consignment.
 - e) Handling and unpacking instructions.
 - f) Bill of material indicating contents of each package.
- 9.4 The Supplier shall ensure that the packing list and bill of material are approved by the purchaser before dispatch.

10.0 COMPLETENESS OF EQUIPMENTS:

Any fittings, accessories or apparatus which may not have been specifically mentioned in these specifications, but which are usual or necessary for the equipment of similar plant shall be deemed to be included in the order and shall be supplied by the supplier without extra charges. All plant and equipment shall be complete in all details whether such details are mentioned in the specification or not.

11.0 Protection against Earthquake and Wind Design loads :

Each Instrument Transformer including its supporting structure shall be designed to withstand repeated earthquake acceleration of $0.08 \times 2 \text{ g}$ and wind loads of 150 Kg/M^2 on the projected area (non-simultaneous), without damage and without impairment of operation.

- 12.0 If the equipment is to be supplied with structure it shall be lattice type only.

ANNEXURE – I

(CURRENT TRANSFORMERS)

SYSTEM PARTICULARS

[A]	Electrical System Data:	
	a) System Voltage (KV rms)	400
	b) Max. Voltage (KV rms)	420
	c) Lighting impulse withstand voltage (dry & wet) (Kvp)	1425
	d) Power Frequency withstand voltage (wet) (KV rms)	630
	e) Switching surge withstand voltage (wet) (Kvp)	1050
	f) Min. Corona extinction voltage at 50 Hz A.C. system dry Condition (KV rms)	320
	g) Radio interference voltage at one MHz for phase to earth voltage	1000
	h) Short Circuit level (KA) for 3 seconds	40

[A] COREWISE DETAILS OF CURRENT TRANSFORMERS **(5 cores)**

No. of Core s	Co r es No.	Application	Curre nt Ratio	Outpu t Burde n (VA)	Accurac y class as per IEC 61869	Min. knee pint voltag e (Volts)	Max. CT Sec. Windin g Resistan c e (Ohms)	Max. exciting Current at Knee point Voltage (mA)	Instru ment Secur i ty Facto r
1	5	Bus Diff. Check	2000-1000-500/1	N.A.	PX	2000-1000-500	10/5/2.5	30 on 2000/1 tap, 60 on 1000/1 tap, 120 on 500/1 tap	---
2	4	Bus Diff. Main	-- Do --	N.A.	PX	-- Do - -	-- Do --	-- Do --	---
3	3	Metering	-- Do --	40	0.5	N.A.	-- Do --	N.A.	5 or less @ all ratios

4	2	Transformer back up/line protection main-I	-- Do --	N.A.	PX	4000/2000/1000	-- Do --	30 on 2000/1 tap, 60 on 1000/1 tap, 120 on 500/1 tap	---
5	1	Trans. Diff/ line protection main-II	-- Do --	N.A.	PX	-- Do -	-- Do --	-- Do --	---

[B] COREWISE DETAILS OF CURRENT TRANSFORMERS
(for New Project with Quad Moose conductor) (5 cores)

No. of Cores	Cores No.	Application	Current Ratio	Output Burden (VA)	Accuracy class as per IEC 61869	Min. knee point voltage (Volts)	Max. CT Sec. Winding Resistance (Ohms)	Max. exciting Current at Knee point Voltage (mA)	Instrument Security Factor
1	5	Bus Diff.	3000-2000-1000-500/1	N.A.	PX	3000-2000-1000-500/1	15/10/5/2.5	20 on 3000/1 tap 30 on 2000/1 tap, 60 on 1000/1 tap, 120 on 500/1 tap	---
2	4	Bus Diff.	3000-2000-1000-500/1	N.A.	PX	3000-2000-1000-500/1	15/10/5/2.5	20 on 3000/1 tap 30 on 2000/1 tap, 60 on 1000/1 tap, 120 on 500/1 tap	---
3	3	Metering	-- Do --	40	0.5	N.A.	-- Do --	N.A.	5 or less

									@ all rati os
4	2	Transform er back up/line prot main-I	-- Do - -	N.A .	PX	4000/ 4000/ 2000/ 1000	-- Do --	20 on 3000/1 tap 30 on 2000/1 tap, 60 on 1000/1 tap, 120 on 500/1 tap	---
5	1	Trans. Diff/ line protn. main-II	-- Do - -	N.A .	PX	-- Do -	-- Do --	-- Do --	---

[C] COREWISE DETAILS OF CURRENT TRANSFORMERS
(for Tariff metering Purpose) (1 core)

No. of Core s	Co res No .	Appli cation	Curre nt Ratio	Outp ut Burde n (VA)	Accur ac y class as per IEC 185	Min. knee point voltage (Volts)	Max. CT Sec. Windin g Resist an ce (Ohms)	Max. exciting Current at Knee point Voltage (mA)	Instr u ment Secu ri ty Fact or
1	1	Tariff- Meteri ng	As given in the Schedule- A or R&C Estimate letter or Project requirement	5	0.2S	N.A.	N.A.	N.A.	5 or les s @ all rati os

GUARANTEED TECHNICAL PARTICULARS **FOR CURRENT TRANSFORMER**

(To be filled in by the Bidder Separately for each type and voltage rating)

[I]	<u>CURRENT TRANSFORMER:</u>	<u>420 KV</u>
1	Type/Live or Dead	
2	Manufacturer's Name and Country of Manufacture	
3	Conforming to standard	
4	Rated voltage	
5	Rated primary current	
6	Rated secondary current	
7	Details of Core	Core No. for 420 KV: I II III IV V
7.1	Class of accuracy	
7.2	Accuracy limit factor	
7.3	Knee point voltage (Kvp)	
7.4	Secondary resistance corrected to 75°C	
7.5	Exciting current at 20% knee point voltage 50% of knee point voltage 100% of knee point voltage	
8	Rated short time withstand current for 3 sec. Duration (KA rams)	
9	Rated dynamic withstand current (Kap)	
10	Rated continuous thermal current (PU) Where PC = Rated Current	
11	One minute power frequency withstand voltage (KV rms) Dry. Wet.	
12	1.2/50 Micro-second impulse withstand voltage (Kvp)	
13	One minute power frequency withstand voltage of secondary winding (KV rms)	
14	Minimum creepage distance (mm)	
15	Normal creepage distance (mm)	
16	Weight of oil (Kgs.)	
17	Total weight (Kgs.)	
18	Mounting details	
19	Overall dimension	
20	Characteristics (Whether graphs enclosed): a. Ratio and Phase angle curves b. Magnetisation curves c. Ratio correction factor curves.	
21	Variation in ratio and phase angle error. a) Voltage by 1%. b) Frequency by 1 Hz.	

22	Current density in primary & Secondary winding.	
23	a. Cross sectional area of primary conductor b. Cross sectional area of secondary conductor	
23A	<i>Material of Primary winding</i>	
24	Nos of primary turns	
24A	<i>Material of secondary winding</i>	
24B	<i>Nos. of Secondary turns</i>	
24C	<i>Material and grade of core</i>	
25	Weight of oil (kg / Ltrs)	
26	Total weight (kg)	
27	Confirmation of Mounting dimension to match GETCO's structures.	
28	Bi-metallic terminal connectors drawing No. and relevant IS No.	
29	COSTRUCTIONAL DETAILS:	
29.1	TANK:	
	i) Thickness of	
	a) Flange	
	b) Top plate	
	ii) Thickness of Press Board provided inside tank	
29.2	GASKET:	
	i) Material	
	ii) Thickness	
29.3	DOME FITTING & LEVEL INDICATORS:	
	i) Material of fitting bolt	
	ii) Size of fitting bolt	
	iv) Location of oil level indicator	
29.4	SECONDARY TERMINALS:	
	i) Material of composite secondary mould (FRP / EPOXY)	
	ii) Dummy leads provided? (YES / NO)	
	iii) Terminal connector block	
	a) Make	
	b) Size	
	c) Rating	

29.5 INSULATOR:	
i) Make	
ii) Sealant used	
iii) Packing at neck	
a) Material	
b) Thickness	
29.6 INSULATING OIL:	
i) Make	
ii) Quantity in ltrs	
29.7 NAME OF RAW MATERIAL SUPPLIERS:	
a) Primary Conductor	
b) Insulator Bushing	
c) Core	
d) Oil	
e) Secondary wires	
f) Sealing Material	
29.8 Is provision of test tap made?	
29.9 Class of insulation	

30.0 Location of Test tap for tan delta measurement

31. Provision of hermetic sealing

a) By Nitrogen cushioning

- i) Gas quantity required in ltr.
- ii) Gas pressure in kg/sqcm.

b) By Bellow

- i) Make
- ii) Material
- iii) Size (I/D and O/D) Mean dia
- iv) Free length
- v) Nos of convolutions
- vi) Maximum expanded height
- vii) Maximum compressed height
- viii) Maximum compensating volume in ltrs. of bellow

- ix) Design temperature
- x) Flange material & thickness
- xi) Working pressure
- xii) Oil quantity of CT in ltrs.
- xiii) Change of oil of CT due to temperature variation from 04 to 95 deg. cel.

32. Details of PRV:

- i) Material
- ii) Make
- iii) Applicable standards
- iv) Rated pressure
- v) Operating pressure
- vi) Material of spring

Note : a) The details against each point of GTP are required to be submitted along with the bid, otherwise, bid is liable for rejection.

b) Actual details should be furnished instead of writing “as per drawing”

Signature :

Name :

Status :

Annexure - C

List of documents attached with technical bid:

Bidder shall invariably attach the following documents and clearly marked and duly flagged in technical bid. In absence of these documents offer will be evaluated as a non submission.

Sr. No.	Particulars of document	Whether attached the with technical bid
1	Drawings in AutoCAD format	
2	Drawings hard copies as indicated in specification	
3	Manual in PDF format	
4	QAP for manufacturing process in SOFT format	
5	QAP for manufacturing process in Hard format	
6	FQP in SOFT format	
7	FQP in Hard copy	
8	Type test Reports in hard copies	
a	for CT	
b	for PT	
9	Confirmation regarding type tests as per clause on page no. 15 – “IMPORTANT NOTE”	
10	Guaranteed Technical Particulars, completely filled in	
11	SS bellow calculation, if bellow is used	
12	Any other essential documents	

SIGNATURE OF BIDDER**COMPANY'S ROUND SEAL****DATE:****PLACE:**