



**GUJARAT ENERGY TRANSMISSION**  
**CORPORATION LTD.**  
**SARADAR PATEL VIDYUT BHAVAN,**  
**RACE COURSE, BARODA – 390 007.**

**TECHNICAL SPECIFICATIONS**  
**FOR**

**220 kV INSTRUMENT TRANSFORMERS**  
(with Tariff Metering)

**GETCO/E/02TS CT6 PT7/R10/Jun 22**

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# **TECHNICAL SPECIFICATIONS FOR 220 KV CT & PT**

## **SECTION – I**

### **1.1 SCOPE :**

**1.1.1** This section covers the design, manufacture, assembly, testing at the manufacturer's, supply and delivery of outdoor, oil impregnated paper, single phase Instrument Transformer, along with supporting structure as detailed in the enclosed schedule of requirement for relaying and metering services in three phase solidly ground system.

**1.1.2** The tenderer 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/replace free of cost immediately in case of any trouble. Therefore, the tenderer shall ensure that sealing of Instrument Transformer is properly achieved.

### **1.2 STANDARDS:**

#### **1.2.1 CURRENT & VOLTAGE TRANSFORMERS:**

| <b>SR. NO.</b> | <b>STANDARD NO.</b> | <b>TITLE</b>   |
|----------------|---------------------|--|
| 1              | IS:2165             | Insulation co-ordination for equipment of 100 KV and above |
| 2              | IS:16227(I to III)  | Instrument 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    | Instrument Transformers                                    |
| 9              | IEC-61869-1 to 3    | Instrument Transformers (VT)                               |
| 10             | IEC-270             | Partial discharge measurement                              |
| 11             | IEC-44(4)           | Instrument transformer measurement of PDs                  |
| 12             | IEC-171             | Insulation co-ordination                                   |
| 13             | IEC-60              | High voltage testing techniques                            |
| 14             | IEC-8263            | Method for RIV test on high voltage insulators             |
| 15             | --                  | Indian Electricity Rules 1956                              |
| 16             | IS:16227(I to III)  | Voltage Transformer  |

**1.2.2** 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 offer.

The Instrument Transformers covered by this specification shall comply with the requirement of the latest edition of IEC Publication No. IEC-61869-1 to 3 or Indian Standard No. IS:16227(I to III) (as amended upto date) but the Instrument Transformers for the accuracy class 'PX' shall conform to Part – II of IS:16227 except where specified otherwise in the specification.

### 1.3 **DRAWINGS :**

1.3.1 Drawing incorporating the following particulars shall be submitted by each tenderer with the tender for the purpose of preliminary study in hard as well as in AutoCAD format.

- (a) General showing and assembly drawings of equipment.
- (b) Graphs showing the performance of equipment in regard to magnetizing characteristics, ratio and phase angle error curves and composite error curves.
- (c) Arrangement of secondary terminal equipment and including of duplicate terminal connection arrangement.
- (d) Supporting structure drawing.(Structure is also in the scope of supply)

1.3.2 Within thirty days of the receipt of the order, the Bidder shall submit to the Purchaser, the following drawings for the approval of the Purchaser. The schedule shall be prepared so as to ensure delivery commitments made in the contract.

- (a) Outline dimensional drawing plan, elevation, end-view dimension, shipping dimensions etc. of the CTs.
- (b) Dimensional drawing of CT alongwith details of clamp and terminal connectors.
- (c) Complete mounting arrangement and structure drawing of CTs indicating cable entry clearly.
- (d) Cross section view of the Instrument Transformers.
- (e) Winding diagram with polarity marks.
- (f) Magnetisation curves.
- (g) Diagram plate, electrical connections of component parts of the CTs and terminal arrangement of secondary terminal box.
- (h) Name and rating plate as per Indian Standard 16227.

- (i) Drawing is necessary for design and fabrication of supporting structure (structures are included in the scope of supply).

1.3.3 The Bidder may submit any other drawing found necessary in addition to these stated above.

#### **1.4 TYPE AND RATING :**

1.4.1 The Instrument Transformers shall be of outdoor , **oil impregnated paper**, single phase, 50 Hz, oil immersed, self cooled and suitable for the services indicated and for operation in the climatic conditions specified without protection from sun, rain and dust. The Instrument Transformer shall be complete in all respects and shall conform to the modern practice of design and manufacture.

1.4.2 The core shall be high grade non-ageing, electrical, silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over currents. The core material used in case of metering cores shall be stated in the tender.

1.4.3 Instrument Transformers provided with prismatic type oil sight window at suitable location so that the oil level is clearly visible with naked eye to an observer standing at ground level. If metal bellow is used for above purpose, a ground glass window shall be provided to monitor the position of the metal bellow.

*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 .* **Purity of nitrogen shall be demonstrated by**

**water ppm before nitrogen filling.** *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.*

*It will be treated as major bought out item hence; necessary test report from vendor shall be submitted.*

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

1.4.4 The Instrument Transformers core to be used for metering and instrumentation shall be accuracy class specified or appropriate class suitable for commercial and industrial metering as per the standard adopted. The saturation factor of this core shall be low enough as not to cause any damage to the measuring instruments in the event of maximum short circuit current.

1.4.5 The Instrument Transformer cores to be used for protective relaying purposes shall be of accuracy class specified or appropriate class suitable for distance protection, back-up over current and earth fault, differential and bus-bar protection. The magnetization curves for cores shall be furnished with the tender.

## **1.5 Windings :**

1.5.1 The rating of the secondary winding shall be as specified in the specification. The secondary terminals shall be brought out in a compartment for easy access. The secondary terminals shall be provided with the shorting arrangements. The secondary taps shall be adequately reinforced to withstand the normal handling without damage. All the secondary winding will be loaded simultaneously.

## **1.5.2 Primary & Secondary winding :**

1.5.1 There are three ratios specified in tender specification. The change in ratio shall be by secondary taps (winding). Selection of ratio on each core shall be independent of the ratio of other core. The guaranteed burden, knee point voltage, winding resistance and magnetising current as specified for each ratio will have to adhere too. The secondary taps shall be adequately reinforced to withstand normal handling without damages.

1.5.2 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.

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.

1.5.3 Primary and secondary windings shall have continuous thermal rating, as specified, for

all ratios. It shall be possible to select the CT ratio of core, different than and independent of the CT ratio of another core of the same CT. Different ratios specified shall be achieved by secondary taps only and primary reconnection shall not be accepted.

#### 1.5.4 **Primary Terminal**

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 winding Primary Terminal shall be Flat pad/Rod type. The Terminal offered shall be same as provided in tested CT for temperature rise test.

1.5.5 220 kV CT having ratio 400 – 200- 100 / 1-1 A (two identical core) shall have type & rating as per clause No: 2.3.1. Separate sealable compartments for each ratio should be provided and the ISF ( $\leq 5$ ) should be certified for each ratio. The instrument security factor at all ratios shall be less than five (5) @ all Ratios 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.

1.5.6 The outer surface of metal tank if made of steel shall be Hot Dip Galvanized, whereas, the inner portion shall be painted with oil resistive, insoluble paint *or hot dip galvanised*. The GETCO reserves right for stage inspection during manufacturing process of tank / CT. The galvanising shall be as per applicable standard IS: 2629 and minimum thickness of zinc coating shall be 610 gm/sqmt. If made of aluminium, external surface of aluminum can have natural finish.

#### 1.6 **Terminal Box:**

All secondary terminals shall be brought out through composite epoxy block with single gasket in a weather proof compartment of one side of each Instrument Transformer for easy access. A terminal board shall have arrangement for series parallel connections, shorting of secondary terminals of CT and grounding of PT secondary terminals. A cable box alongwith necessary glands for receiving control cables suitable for mounting on the bottom plate of the terminal box shall be included in the scope of supply. The size of the cable gland will be intimated to the successful tenderer. A door with locking arrangement shall be provided on the front of the terminal box so as to permit easy access to the secondary terminals. The door shall have suitable arrangement to check ingress of moisture into the terminal box. The secondary terminal box shall comply with degree of protection IP-55 standards and type test report shall be submitted with the technical bid.

1.6.1 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.

## **1.7 Temperature Rise :**

- 1.7.1 The instrument transformers shall be designed to limit the temperature rise of winding and other parts as specified in the Indian Standard, when corrected for the difference between the temperature prevailing and site and temperature specified by the Indian Standard. The temperature rise at 1.1 times and rates primary voltage when applied continuously at rated frequency and at rated burden shall not exceed the limits specified above and the temperature rise at 1.5 times rated primary voltage when applied for 30 seconds starting from previous stable operating condition at rated frequency and rated burden shall not exceed the above temperature limits by more than 10°C.
- 1.7.2 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.

### **Limits of Temperature rise of Windings:**

| <b><u>Class of Insulation</u></b>                  | <b><u>Temperature rise °C</u></b> |
|--|-----------------------------------|
| All classes immersed in Oil                        | 55                                |
| All classes immersed in bituminous Compound.       | 45                                |
| Class not immersed in oil or bituminous compound : |                                   |
| Y  | 40                                |
| A  | 55                                |
| E  | 70                                |
| B  | 80                                |
| F  | 105                               |
| H  | 130                               |

Note : (1) The reference ambient temperature for the purpose of temperature rise shall be 40°C.

(2) If the ambient temperature is in excess of the value given in (Note – 1) the permissible temperature rise shall be reduced by an amount equal to the excess ambient temperature.

## **1.8 Bushing Insulator:**

- 1.8.1 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: 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.

- 1.8.2 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.

## 1.9 **Insulation Oil:**

- 1.9.1 The quantity of insulating for the 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 for 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 & 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°C Max.                    | 0-89g / cm <sup>3</sup>  | IS:1448 (P-16) 1967 or equivalent Authoritative standard.   |
| 3       | Kinematics viscosity at 27°C Max.       | 27 CST   | IS : 1448 (P-25), 1960 or equivalent Authoritative standard.  |
| 4       | Interfacial tension at 27°C Min.        | 0.04 N / m   | IS : 6104 – 1971 or equivalent Authoritative standard.  |
| 5       | Flash point pensky marten (closed) Min. | 140 °C   | IS : 1448 (P-21) 1970 or equivalent Authoritative standard.   |
| 6       | Four point max.                         | - 10 °C  | IS : 1448 (P-10) 1970 or equivalent Authoritative standard.   |

|    |   |   |  |
|----|---|---|--|
| 7  | Neutralisation value (Total acidity) max.   | 0.03Mg/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,AppendixB. or equivalent Authoritative standard.   |
| 9  | Electric strength (break-down voltage) Min.<br>a) New untreated oil.<br>b) After treatment                  | 30KV (rms). If the above value is not attained, the oil shall be treated.<br>50 KV (rms.) | IS : 6792 – 1972 or equivalent Authoritative standard.         |
| 10 | Dielectric dissipation factor (tan $\delta$ ) at 90°C Max.  | 0.002   | IS : 6262 – 1971 or equivalent Authoritative standard.         |
| 11 | Specific resistance (resistivity)<br>a) At 90 °C Min.<br>b) At 27 °C Min.                                   | 35 x 12 <sup>12</sup> ohm / cm<br>1500 x 10 <sup>012</sup> Ohm                            | IS : 6103 – 1971 or equivalent Authoritative standard.         |
| 12 | Oxidation stability<br>a) Neutralisation value after oxidation max.<br>b) Total sludge after oxidation Max. | 0.40 mg / KOH / g<br><br>0.10 percent by weight.  | IS:335–1972, Appendix-C. or equivalent Authoritative standard. |

| Sr. No. | Characteristics   | Requirements  | Method of Test                           |
|---------|---|---|--|
| 13      | Ageing characteristic after accelerated aging<br>a) Specific resistance (Resistivity).<br>i) At 27°C Min.<br>ii) At 90°C Min.<br>b) Dielectric dissipation factor (tan $\delta$ ) at 90°C | 2.5 x 10 <sup>12</sup> ohm/cm.<br>0.2 x 10 <sup>12</sup> ohm/cm.<br>0.2 | IS : 6103 – 1971<br><br>IS : 6262 – 1971 |

|    |   |                             |   |
|----|---|-----------------------------|---|
|    | Max.<br>c) Total slug acidity %<br>by weight.<br>d) Total slug value%<br>by weight. | 0.05 max. mg. KOH/G<br>0.05 | IS:1448 – 1967  |
| 14 | Water content max.  | 50 ppm.                     | IS : 2362 – 1963 or equivalent<br>Authoritative standard. |

### **1.10 Cleaning and Galvanising :**

- 1.10.1 All ferrous parts of ITs including lifting hook and shall be hot dip galvanized. Before filling with oil all ungalvanised 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 Instrument Transformer tank if made of steel shall be cleaned of all scale and rust by sandblasting or other approved method. These surfaces shall be hot dip galvanised or painted with oil resisting varnish or paint. Zinc coating shall be 610 gm/sqmt.
- 1.10.2 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.
- 1.10.3 The hot dip galvanising shall be done as per relevant IS specifications.
- 1.10.4 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.

### **1.11 TERMINAL CONNECTORS AND EARTHING TERMINALS :**

- 1.11.1 Terminal connectors suitable for *TWIN* ACSR Moose / *AL 59* conductor with conductor spacing 350 mm. shall be supplied. The terminal connector shall be suitable for both vertical and horizontal connections of the transmission line conductor or station bus bar.
- 1.11.2 Terminal connectors shall be manufactured as per relevant IS/IEC. The Terminal Connector shall be compression type bimetallic connector type. S.S. bolts shall be supplied with one number of S.S. washer and two numbers of S.S. bolts.
- 1.11.3 The drawings of the clamp connectors shall be submitted with the Technical Bid.
- 1.11.4 ***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.***

## 1.12 **TEST:**

### 1.12.1 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 tests reports shall be submitted for CT.**

1. Lightning Impulse voltage test on primary terminals
2. High voltage power frequency wet withstand test on CT
3. Multiple Chopped impulse test on primary terminal
4. Temperature rise test
5. Short Time Current tests
6. Test for Accuracy
7. Measurement of dielectric dissipation factor
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)

#### **Following tests reports shall be submitted for PT.**

1. Lightning Impulse voltage withstand test on primary terminal.
2. High voltage power frequency wet withstand test on primary winding.
3. Chopped Impulse voltage test on primary terminal
4. Temperature rise test
5. Short circuit withstand capability test
6. Test for accuracy
7. Degree of protection IP55 for secondary terminal box
8. STC test on primary terminal connector
9. Seismic withstand test
10. **Mechanical tests**
11. **Radio interference voltage test**

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.*

***If bidder has submitted all valid type / special / additional test reports as per requirement of technical specifications then the same are not required to be repeated. However,***

***those tests which are covered under acceptance/ additional/ routine tests will be required to be carried out during the inspection, which is not a repetition.***

#### **1.12.2 ACCEPTANCE AND ROUTINE TESTS:**

- 1.12.2.1 Each Instrument Transformer shall be tested to comply with the requirement of routine tests as per the relevant standard in the presence of purchaser's representative.
- 1.12.2.2 Three sets (3) of certified copies of acceptance/routine test reports and oscillograms shall be submitted to the Purchaser for approval before dispatch.
- 1.12.2.3 The Purchaser and/or authorised consulting engineer reserves the right to witness any/or all tests. The purchaser will have the right to get any other test(s) of reasonable nature, carried out at his own expense at manufacturer's work or at site or at any other place in addition to the routine tests, to confirm that the material/items complies with the requirements of Specification.
- 1.12.2.4 All tests on galvanised components shall be conducted according to the latest addition of IS: 2633 (as amended up to date) or any other equivalent authentic standard.

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 for 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. Determination of the secondary winding resistance(on 10% of offered lot).
11. Test for rated knee point e.m.f & exciting current at rated knee point e.m.f(on 10% of offered lot).
12. Power-frequency voltage withstand tests between sections (on 10% of offered lot)

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

Following tests shall be performed on PT.

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. Measurement of Partial Discharge test (on 10% of offered lot)
5. Test for accuracy (on 10% of offered lot)
6. Measurement of dielectric dissipation factor **of whole mass of insulation (0.3% max)** and capacitance **at 10 kV and at  $U_m/\sqrt{3}$**  (on 100% of offered lot)
7. Temperature Rise test (On any one unit from offered lot)
8. Power-frequency voltage withstand tests between sections (on 10% of offered lot)

(Test no. 1 to 5 shall be performed on 100% tariff metering PTs in an NABL accredited/Govt lab.)

1.12.2.5 Tests on Oil for CT & PT:

|                                      |   |  |
|--------------------------------------|---|--|
| 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 Resistance at 75 ° & 90° | ] |  |
| e) Viscosity                         | ] |  |
| f) 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.)

### 1.13 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's representative all facilities for unrestricted inspection of the works, raw materials, manufacture of all the accessories and for conducting necessary tests.
- 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) *"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.*
- iv) *Applicability of PROTO unit will be to each class and not to each ratio, if the design is not changed.*
- v) *Manufacturing of PROTO unit will start from drawing approval. However, if the type tests are pending then bidder shall ensure to complete type tests within commencement period.*
- vi) *Applicability of Sealing test for every lot of 20 units even after Proto confirms sealing test & manufacturing clearance is issued by GETCO.*

*If bidder wants to offer PROTO from first lot of 20 units and if Proto successfully passes all tests then sealing test on other unit from that lot is not required. But if PROTO do not pass any of the tests whole lot will be rejected.*

- vii) *Sealing test is applicable to each lot of each class and each ratio even if the design is same.*
- viii) *No material shall be dispatched without Inspection.*
- ix) *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 found defective later.*



## 1.14 QUALITY ASSURANCE PLAN:

1.14.1 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 Doble)
  - 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.

1.14.2 The successful Bidder shall within commencement period days of placement of order, 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 finalized. **The bidder shall submit the field QAP also.**

- iv) 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.

#### **1.15 Design Calculations :**

- 1.15.1 For rated short circuit and dynamic current the type test report may please be furnished alongwith the offer. The design calculation should also be furnished stating that the peak value of dynamic amp. Turns are not exceeding the tested value. The value of current density for primary as well as secondary winding for each type of C.T./PT shall also be specified.

#### **1.16 Guaranteed Technical Particulars :**

- 1.16.1 Guaranteed Technical Particular as called for in Schedule – A, Section – III of this specification shall be furnished alongwith tender. Particulars which are subject to guarantee shall be clearly marked. Tender lacking to this regard may not be considered.

#### **1.17 Instruction Manuals :**

- 1.17.1 Three (3) copies of operation, maintenance and erection manuals in English language shall be supplied one month prior to the dispatch of the Instrument Transformer to the Chief Engineer (Project), Gujarat Energy Transmission Corporation Ltd. Vidyut Bhavan, Race Course, Baroda : 390 007. The manuals shall be bound volumes and contain all the drawings and information required for erection, operation and maintenance of the Instrument Transformer. **All the manuals in PDF format also to be submitted.** The manual shall include amongst others the following particulars.
  - a) Marked erection prints identifying the component parts of the Instrument Transformer and dispatched with the assembly drawings.
  - b) Detailed dimensions, assembly and description of all the components.
  - c) The firm have to supply 3 sets of final approved drawing operation manuals, etc. to each consignee for, their records and reference.

**1.18 Inspection of Equipments :**

- 1.18.1 Bidder shall have to arrange for inspections and routine tests on Instrument Transformers and terminal connectors at their works in presence of GETCO Engineer.
- 1.18.2 GETCO Engineer will not inspect incomplete materials. If GETCO Engineer returned without inspections of offered equipments, due to non-readiness of materials at their works, the financial loss to the GETCO, for deputing Engineer representative will be recovered from the concerned supplier.

**SECTION – II****SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES:****2.1 SCOPE :**

- 2.1.1.1 This section covers the specific technical particulars, climatic and isocoraunic conditions, system particulars, etc. suiting which the Instrument Transformers shall be offered as per the general technical requirements given in Section-I of this specification and the schedule of requirements specified herein for relaying and metering services.

**2.2 Climatic and Isoceraunic Conditions :**

- 2.2.1 The climatic and isoceraunic conditions at site are given below :

|   |  |                     |
|---|--|---------------------|
| a | Maximum ambient temperature in shade. ( $^{\circ}\text{C}$ ) | 50                  |
| b | Minimum ambient temperature in shade. ( $^{\circ}\text{C}$ ) | 04                  |
| c | Maximum average ambient temperature. ( $^{\circ}\text{C}$ )  | 40                  |
| d | Maximum yearly average ambient temp. ( $^{\circ}\text{C}$ )  | 30                  |
| e | Maximum relative humidity. ( $^{\circ}\text{C}$ )            | 95                  |
| f | Average rainfall per annum. (Cms)                            | 150                 |
| g | Average number of thunder storm days per annum               | 15                  |
| h | Height above Sea level. (Meters)                             | Not exceeding 1000. |
| i | Maximum wind pressure. ( $\text{Kg} / \text{M}^2$ )          | 150                 |
| j | Earthquake acceleration. (g)                                 | 0.08 x 2 g          |

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

- 2.2.3 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.

### 2.3 Type and Rating of Instrument Transformer:

2.3.1 The Current Transformers shall have the rating as given below:

| 220 kV Hermitically sealed Dead / live tank type<br>with SS bellow or Nitrogen cushioned CT |  |  |  |  |  |
|---|--|--|--|--|--|
| 1   | CT Ratio<br>Amp.<br>/<br>1-1-1-1-1 A                                     | CT<br><br>1200-600-<br>300/1A or 1500-<br>1200-600/1A or<br>1500-100-<br>500/1A<br>(5Core) | 400-<br>200/1A or<br>400-200-<br>100/<br>1 A(1 or 2 Core as<br>indicated in<br>Schedule - A) | 1500-<br>1000-<br>500/1A<br>(5 core)               | Tariff-<br>Metering<br>Ratio (as-<br>indicated in<br>Schedule – A) |
| 2   | Rated Burden (VA)<br>Core - 1<br>2<br>3<br>4<br>5<br>--                  | 30<br>--<br>--<br>--<br>--   | 5 VA<br>5 VA<br>---<br>---<br>---  | --<br>--<br>10<br>20<br>--                         | <b>05 VA</b><br>--<br>--<br>--<br>--                               |
| 3   | Class of<br>accuracy<br>Core - 1<br>2<br>3<br>4<br>5                     | 0.5<br><b>PX</b><br><b>PX</b><br><b>PX</b><br><b>PX</b>                                    | 0.2S or<br>0.2<br>0.2<br>---<br>---<br>---   | <b>PX</b><br><b>PX</b><br>0.2s<br>0.2<br><b>PX</b> | <b>0.2S</b><br>--<br>--<br>--<br>--                                |
| 4   | Rated accuracy<br>limit./ISF @all ratios<br>Core - 1<br>2<br>3<br>4<br>5 | 05<br>--<br>---<br>---<br>---  | 05<br>05<br>---<br>---<br>---  | ---<br>--<br>≤5<br>≤5<br>---                       | <b>05</b><br>--<br>--<br>--<br>--                                  |
| 5   | Purpose<br>Core - 1<br>2<br>3<br>4                                       | Metering<br>Main-I Prot<br>Main-II Prot<br>Bus diff.<br>Bus diff.                          | Tariff<br>Metering<br>Metering<br>---<br>---   | Diff Prot<br>Main-I<br>Prot<br>Metering<br>(ABT)   | <b>Tariff<br/>metering</b><br>--                                   |

|   |   |  |          |   |                |
|---|---|--|----------|---|----------------|
|   | 5   | (Check)  | ---      | Metering Bus Bar  | --<br>--<br>-- |
| 6 | Min Knee point voltage at highest rated current     | Core – 1<br>2<br>3<br>4<br>5<br>Not applicable<br>1400 (on maximum) Tap with RCT 12 ohms) for PX cores | N A      | 1500-1000-500<br>1500-1000-500<br>--<br>--<br>1500-1000-500 | N A            |
| 7 | Exciting current at knee point voltage              | 25 m A   | 25 mA    | 25 mA   | N A            |
| 8 | Resistance of the secondary winding                 | Less than 12 ohms.   | <12 ohms | <12 ohms  | N A            |
| 9 | Creepage distance (mm) Heavily polluted atmosphere. | 6125 mm  | 6125 mm  | 7595 mm   | N A            |

|    |   |  |
|----|---|--|
| 10 | Type of connection  | Single Primary (Primary re-connection not permitted) Ratio selection by secondary taps only. |
| 11 | Basic insulation level (KV)   | 1050 KV  |
| 13 | Short time withstand current for CT and terminal connectors (corresponding to fault level in MVA) for <b>3 sec.</b> in (kA) with rated dynamic current. | 40 kA rms with 100 kAp   |
| 14 | Nominal system voltage (KV)   | 220KV  |
| 15 | Highest system voltage (KV)   | 245KV  |
| 16 | System Frequency (Hz)   | 50 Hz  |
| 17 | Earthing (solidly grounded or particularly grounded)  | Effective  |
| 18 | Radio interference voltage 155 KV rms.  | 1000 Micro Volts   |
| 19 | Partial discharge level   | < 10 pC<br>< 05 pC at $1.1U_m/\sqrt{3}$  |
| 20 | Type of insulation  | Class – A  |

|    |   |                                   |
|----|---|-----------------------------------|
| 21 | Power frequency over voltage withstand requirement of secondary winding | <b>5 kV</b>                       |
| 22 | Maximum temperature rise over an ambient temperature of °C.             | IS : 16227                        |
| 23 | Rated continuous thermal current in Amp                                 | 120% of the rated primary current |
| 24 | Mounting dimensions   | 600 x 600 mm                      |

The voltage transformers shall have the following technical requirement.

|   |                             |                        |
|---|-----------------------------|------------------------|
|   | <b>Voltage Class</b>        | <b>220KV</b>           |
| 1 | Nominal system voltage (KV) | 220                    |
| 2 | Highest system voltage (KV) | 245                    |
| 3 | System frequency (Hz)       | 50                     |
| 4 | Earthing                    | Effective              |
| 5 | Ratio primary (KV)          | $\frac{220}{\sqrt{3}}$ |

|    |   |                                    |                        |
|----|---|------------------------------------|------------------------|
|    |   | <b>Protection PT<br/>(3 cores)</b> | <b>Tariff metering</b> |
| 6  | Secondary I (V)   | $\frac{110}{\sqrt{3}}$             |                        |
|    | Core – 1  | <b>Metering</b>                    | <b>Tariff metering</b> |
|    | Core - 2  | <b>Main – I Prot</b>               | --                     |
|    | Core - 3  | <b>Main – II Prot</b>              | --                     |
| 7  | Rated burden (VA) Core -1   |                                    | <b>10</b>              |
|    | Core -2   | <b>250</b>                         | --                     |
|    | Core - 3  | <b>250</b>                         | --                     |
|    |   | <b>250</b>                         |                        |
| 8  | Class of accuracy   | <b>0.5</b>                         | <b>0.2</b>             |
|    |   | <b>3P</b>                          | --                     |
|    |   | <b>3P</b>                          | --                     |
| 9  | Basic insulation level(KV peak)                                   | 1050                               |                        |
| 10 | Class of insulation   | A                                  |                        |
| 11 | 1 Minute power frequency with stand voltage (KV rms)              |                                    |                        |
|    | i) Dry  | 460                                |                        |
|    | ii) Wet   | 460                                |                        |
| 12 | 1 Minute power frequency withstand test voltage on secondary (KV) | <b>5</b>                           |                        |
| 13 | Creepage distance:<br>Heavily polluted atmosphere.                | 6125<br>mm                         |                        |
| 14 | Mounting dimensions   | 600 x 600 mm                       |                        |

- 2.3.2 The rating specified shall be guaranteed at all primary connections. Any changes in the particulars of the CTs that may be required for protection relays (Protective relays being procured separately), actually ordered shall have to be met by the supplier of CTs without any extra cost.
- 2.3.3. All Instrument Transformers shall meet the requirement of this specification for  $\pm 3\%$  variation in rated system frequency of 50 Hz.
- 2.3.4 The rated extended primary current shall be 120% of the rated primary current.
- 2.3.5 If any aux. CTs are used in the Instrument Transformer than all parameters specified shall have to meet treating aux. CTs as an integral part of the Instrument Transformer.
- 2.3.6 The ratio selection of **PX** cores shall be independent irrespective of ratio on the other cores.

## **2.3 Protection against Earthquake and Wind Design loads :**

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

**SECTION – III**  
**BIDDING SCHEDULES**  
**(To be filled in and signed by the Bidder)**  
**Schedule - A**  
**Schedule of Guaranteed Technical Particulars**  
**for Current Transformers.**

|    |  |   |  |                            |           |
|----|--|---|--|----------------------------|-----------|
| 1  | Manufacturer's name and type designation                       |   |  |                            |           |
| 2  | Type   |   |  |                            |           |
| 3  | Rated Voltage  |   |  |                            |           |
| 4  | Rated primary current  |   |  |                            |           |
| 5  | Rated secondary current  |   |  |                            |           |
| 6  | Ratio selection by -   |   |  |                            |           |
|    | i) Primary reconnection and secondary tap                      |   |  |                            | Yes / No  |
|    | ii) Secondary taps only  |   |  |                            | Yes / No. |
| 7  | No. of Cores   |   |  |                            |           |
|    |  | Rated Output  | Class of accuracy  | Accuracy factory           | Limit     |
|    | Core – I   |   |  |                            |           |
|    | Core – II  |   |  |                            |           |
|    | Core – III   |   |  |                            |           |
|    | Core – IV  |   |  |                            |           |
|    | Core - V   |   |  |                            |           |
| 8  | Secondary Voltage  |   |  |                            |           |
|    |  | Knee point voltage & corresponding exciting current | Resistance of the secondary winding at 75 <sup>0</sup> C | Secondary limiting voltage |           |
|    | Core – I   |   |  |                            |           |
|    | Core – II  |   |  |                            |           |
|    | Core – III   |   |  |                            |           |
|    | Core – IV  |   |  |                            |           |
|    | Core - V   |   |  |                            |           |
| 9  | Short time thermal rating of primary (Amps.)                   |   |  |                            |           |
|    | a) Three Seconds   |   |  |                            |           |
|    | b) Short time current test report No. and date if carried out. |   |  |                            |           |
| 10 | Rated dynamic current of primary (peak value)                  |   |  |                            |           |



|    |   |  |
|----|---|--|
| 11 | Rated 1.2 time continuous thermal current (Amp.)  |  |
| 12 | Temperature rise at rated continuous thermal current over ambient temperature at site for.<br><br>a) Winding.<br><br>b) Oil at the top.<br><br>c) Exposed current carrying parts.                                   |  |
| 13 | One minute power frequency dry withstand test voltage (KV rms)  |  |
| 14 | One minute power frequency wet withstand voltage (KV rms)   |  |
| 15 | HV test report No. and Date, if carried out.  |  |
| 16 | 1.2/50 microsecond impulse withstand rest voltage (KV peak)   |  |
| 17 | One minute power frequency withstand test voltage secondary (KV rms)  |  |
| 18 | a) Minimum creepage distance mm.<br><br>b) Normal creepage distance mm.<br><br>c) Busing manufacturer Name & its Deg. No. & confirming to IS No.  |  |
| 19 | Whether corona shield is provided or not.   |  |
| 20 | Magnetization curve of CT core.   |  |
| 21 | Characteristics :<br>a) Ratio and phase angle curves<br>b) Magnetisation curves.<br>c) Ratio correction factor curves<br>d) Limits of composite error at rated primary saturation current (for protective CT core). |  |

|    |  |  |
|----|--|--|
| 22 | Variation in ratio and phase angle error.<br><br>a) Voltage by 1%.<br><br>b) Frequency by 1 Hz.  |  |
| 23 | Current density in primary & Secondary winding.  |  |
| 24 | a. Cross sectional area of primary conductor<br>b. Cross sectional area of secondary conductor<br>c. Material of primary winding<br>d. Material of secondary winding |  |
| 25 | Bushing of CTs type test carried out – Yes / No if yes, report furnished or not.   |  |
| 26 | Weight of oil  |  |
| 27 | Total weight   |  |
| 28 | Mounting details.  |  |
| 29 | Overall dimensions   |  |
| 30 | Bi-metallic terminal connectors drawing No. and applicable IS No.  |  |
| 31 | <b>Class of insulation</b>   |  |

**32 CONSTRUCTIONAL DETAILS:****32.1 TANK:**

- i) Thickness of
  - a) Flange
  - b) Top plate
- ii) Thickness of Press Board provided inside tank

**32.2 GASKET:**

- i) Material
- ii) Thickness

**32.3 DOME FITTING & LEVEL INDICATORS:**

- i) Material of fitting bolt
- ii) Size of fitting bolt
- iii) Location of oil level indicator

**32.4 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

32.5 INSULATOR:

- i) Make
- ii) Sealant used
- iii) Packing at neck
  - 1. Material
  - 2. Thickness

32.6 INSULATING OIL:

- i) Make
- ii) Quantity in ltrs

32.7 NAME OF RAW MATERIAL SUPPLIERS:

- i. Primary Conductor
- ii. Insulator Bushing
- iii. Core
- iv. Oil
- v. Secondary wires
- vi. Sealing Material

33.0 Location of Test tap for tan delta measurement

34. 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.

35. Details of PRV:

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

Signature :

Name :

Status :

Date : Whether authorised attorney of  
Place : Bidder

## TECHNICAL AND GUARANTEED PARTICULARS FOR 220KV VOLTAGE TRANSFORMERS

1. Type of PT
2. Manufacturer's Name & Type designation:
3. Nominal rated primary voltage (kV)
4. Maximum (continuous) service rated primary voltage (kV)
5. No. of secondary winding
6. Rated secondary voltages :
  - a) Winding – I (volts)
  - b) Winding – II (volts)
  - c) **Winding – III**
7. Rated burden :
  - a) Winding – I (VA)
  - b) Winding – II (VA)
  - c) **Winding – III**
8. Accuracy class
  - a) Winding – I
  - b) Winding – II
  - c) **Winding – III**
9. Temperature rise at 1.2 times rated voltage with rated burden (°C)
10. Temperature rise at 1.5 times rated primary voltage for 30 sec. (cl. 1.7) (°C)
11. Rated voltage factor and time
12. One minute power frequency withstand test voltage (dry)  
for primary (kV rms)
13. One minute power frequency withstand test voltage (wet)  
for primary (kV rms)
14. 1.2/50 microsecond lightning impulse withstand test voltage (kV peak)
15. One minute power frequency withstand voltage  
for secondaries (kV rms)

16. Minimum total creep age distance of bushings (mm)
17. Weight of oil (kg)
18. Total weight (kg)
19. Overall dimension (mm)
20. Mounting details (mm)
21. Other details

## **22. Class of insulation**

### **23 CONSTRUCTIONAL DETAILS:**

#### **23.1 TANK:**

- i) Thickness of
  - a) Flange
  - b) Top plate
- ii) Thickness of Press Board provided inside tank

#### **23.2 GASKET:**

- i) Material
- ii) Thickness

#### **23.3 DOME FITTING & LEVEL INDICATORS:**

- i) Material of fitting bolt
- ii) Size of fitting bolt
- iii) Location of oil level indicator

#### **23.4 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

#### **23.5 INSULATOR:**

- i) Make
- ii) Sealant used
- iii) Packing at neck
- 3. Material
- 4. Thickness

#### **23.6 INSULATING OIL:**

- i) Make
- ii) Quantity in ltrs

23.7 NAME OF RAW MATERIAL SUPPLIERS:

- vii. Primary Conductor
- viii. Insulator Bushing
- ix. Core
- x. Oil
- xi. Secondary wires
- xii. Sealing Material

24. 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.

25. Details of PRV:

- i) Material
- ii) Make
- iii) Applicable standards
- iv) Rated pressure

v) Operating pressure

vi) Material of spring

26 Location of Test tap for tan delta measurement:

27.1 Material of primary winding

27.2 Cross sectional area of primary winding

27.3 Material of secondary winding

27.4 Cross sectional area of secondary winding

Signature :

Name :

Status :

Date :

Whether authorized attorney of Bidder

Place :



**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. 13 (for CT & PT) – “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:**