

**Technical Specification**  
**for**  
Approved by the technical committee vide memorandum no 03/2023  
**400/220/132/33 kV Oil Immersed**  
**Current Transformers with Porcelain and**  
**Polymer Housing**

**Revision 1**

**March 2023**

Approved by the technical committee vide memorandum no 03/2023

## **IMPORTANT INSTRUCTION**

**(Please read the following instructions carefully before submitting your bid)**

1. All the drawings, i.e. dimension, elevation, side view, front view, plan, cross sectional view, isometric view, important component drawing etc., in PDF along with AutoCAD format and manuals (Technical/Installation/Operation) in PDF format, for offered item shall be submitted. The hard copies as per specification also shall be submitted. All above documents should be legible.
2. The acceptability of type test report submitted by any bidder/EPC agency shall be strictly in adherence to the broad guidelines mentioned in clause no 2 of "GUIDELINES FOR THE VALIDITY PERIOD OF TYPE TEST(S) CONDUCTED ON MAJOR ELECTRICAL EQUIPMENT IN POWER TRANSMISSION" published in May 2020.
3. The Bidder/ EPC agency shall have to submit all the required type test reports for the offered item along with the accessories. In case of submission of soft copy of type test report, high resolution colour scan of the original test report must be submitted. Scanned copy of Xerox of type test reports shall not be entertained. If required, the firm has to show the original type test report for the purpose of verification. In absence of this, the evaluation shall be carried out accordingly as non-submission of type test reports. The type test report of Current Transformer submitted by the manufacturer shall be considered valid if the date of type test does not exceed 10 years as on the last date of submission of bid; provided:
  - 3.1. There is no major changes introduced in the basic design / technology /material /mechanical /construction /functionalities /performance characteristics/ manufacturing process of the equipment.
  - OR
  - 3.2. Until the relevant IS/IEC / statutory guidelines is revised which warrants fresh type tests because of introduction of new type tests even though there is no change in material/basic design of the equipment.
4. The Bidder/ EPC agency must fill up all the point of GTP for offered item/s. Instead of indicating "refer drawing, or as per IS/IEC", the exact value/s must be filled in. All the points other than GTP, which are asked to confirm in technical specifications must be submitted separately with the bid.
5. The Bidder/ EPC agency is required to impart training in view of manufacture, assembly, erection, operation, and maintenance for offered item, at his works, to the person/s identified by OPTCL, in the event of an order, free of cost. The cost of logistics will be borne as per the clauses of respective purchase orders/work orders.
6. The discrepancies between the specification and the catalogues or literature, submitted as part of the offer or with prevalent standards or government guidelines shall not be considered as valid deviations unless otherwise the same deviations related to TS is brought out separately by the Bidder/ EPC agency in the pre-bid queries or in form of clarification.
7. If any modifications felt necessary to improve performance, efficiency and utility of equipment, the same must be submitted along with pre bid queries which reasons duly

supported by documentary evidences and such modifications not mentioned in pre bid queries will not be considered.

8. For purpose of Agreement, the firm shall provide warranty as specified in the purchase order / tender document. Notwithstanding the foregoing, Supplier agrees to waive the expiration of the Warranty Period in the event where in a pattern of defect/trend of failure is observed after the Warranty Period in a significant portion of the supplied quantity, or any critical defect discovered which, in Purchaser's opinion, constitutes a threat of damage to property or to the health and safety of any person.
9. Warranty certificate for purchase of any material, whether directly procured by OPTCL or through EPC agency, shall be issued directly in favour of OPTCL.

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## 1. SCOPE:

- 1.1. The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery F.O.R. (destination) of the outdoor mounted live tank type, single phase, single unit type current Transformers for protection and metering services in 33KV, 132KV, 220 KV & 400KV solidly grounded system.
- 1.2. The current transformers shall be of the outdoor type, single phase, 50 C/S, oil immersed, self-cooled, hermetically sealed and suitable for operating in the tropical conditions with maximum ambient temperature up to 50 °C. The CTs should be suitable for use in the areas subject to heavy lightning storms and highly polluted conditions.
- 1.3. Followings are the list of documents constituting this specification.

Important Instruction to Bidders	
Technical specification (TS)	
Technical Requirements	Clause 11
Specified Parameters	Clause 12
Guaranteed Technical Particulars	Annexure – A
Calibration Status of testing equipment's and meters / Instruments	Annexure-B
Check-List towards Type Test & Special Test Reports	Annexure-C
Check-List For Delivery Schedule	Annexure-D
NOTE : Annexure- A, B, C & D are to be filled up by the Bidder	

- 1.4. The current transformer shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and purchaser shall have the power to reject any work or material which in his judgment is not in full accordance therewith.
- 1.5. Bidders are required to quote for Current transformers of respective voltage class along with following data / information etc., failing which the tender may not be considered for evaluation.
  - a. Guaranteed Technical particulars.
  - b. Technical literatures, brochures and drawings as per this specification.
  - c. Type Test Reports.
  - d. List of orders, executed and User's certificates.

## 2. STANDARDS:

- 2.1. Except to the extent modified in the specification, the CTs shall conform to the latest editions and amendments of the standards listed hereunder.
- 2.2.

IEC 61869-1/ IS 16227-1	<i>Instrument transformers —Part 1: General requirements</i>
IS 2705-1	<i>Current Transformers – Specification Part 1: General Requirements</i>
IEC 61869-2/ IS 16227-2	<i>Instrument transformers —Part 2: Additional Requirements for Current Transformers</i>
IS 335	<i>New insulating oil</i>
IS 613	<i>Copper rods and bars for electrical purposes</i>

IS 2071-1	<i>Methods of high voltage testing</i>
IS/IEC 60060	<i>High-Voltage Test Techniques</i>
IS/IEC 60137	<i>Bushings for alternating voltages above 1 000 Volts</i>
IS/IEC 60947	<i>Low-voltage switchgear and controlgear</i>
IEC 60529	<i>Degrees of protection provided by enclosures (IP) code</i>
IS/IEC 60071	<i>Insulation coordination</i>
IS:3347	<i>Dimensions of Porcelain Transformer Bushing</i>
IS 9676	<i>Reference ambient temperature for electrical equipment</i>
IS/IEC TR 62271-301	<i>High-voltage switchgear and controlgear – Part 301: Dimensional standardisation of high-voltage terminals</i>
IS 4201	<i>Application guide for Current Transformer</i>
IEC 60567	<i>Oil-filled electrical equipment – Sampling of gases and of oil for analysis of free and dissolved gases – Guidance</i>
IEC TS 60815	<i>Selection and dimensioning of high-voltage insulators intended for use in polluted conditions</i>
IEC 62155	<i>Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V</i>
IEC 61462	<i>Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V –Definitions, test methods and acceptance criteria and design recommendations</i>
IEC 62217	<i>Polymeric HV insulators for indoor and outdoor use</i>
IS 2629	<i>Recommended Practice for Hot-Dip Galvanizing of Iron and Steel</i>
IEC 60554-1: 1977	<i>Specification for cellulosic papers for electrical purposes. Part 1: Definitions and general requirements</i>

2.3. Current Transformers with the requirements of other authoritative standards, which ensure equal or better quality than the standards, mentioned above, shall also be acceptable, Where the equipment, offered by the supplier conforms to other standards, salient points of difference between the standards adopted and specified standards shall be brought out in the offer. 4 (four) copies of the reference standards in English language shall be furnished along with the offer.

2.4. **All the above along with amendments thereof shall be read and interpreted together. However, in case of a contradiction between the Technical Specification and any other volume, the provisions of this specification will prevail.**

### 3. TOPOGRAPHICAL AND METROLOGICAL CONDITIONS:

3.1.

Location	State of Odisha
Altitude	1000 m
Air Temperature	
Minimum	0 °C
Maximum	50 °C
Maximum Daily Average	35 °C
Maximum Humidity	99 %

Pollution Level	Heavy/Very Heavy
Airborne Contamination	Highly Polluted
Isoceraunic Level	70 day/annum
Average no. of dust storm days per annum	20 day/annum
Seismic withstand level	0.3 g (Horizontal) & 0.15g (Vertical)
Wind velocity	55 m/s (Wind zone VI)
Average Annual Rain Fall	150 cm
Average no. of rainy days in a year	120 days
Special Environmental Conditions	<ol style="list-style-type: none"> <li>1. In coastal areas of the state presence of salinity in air and exposure to moisture</li> <li>2. In industrial belts of the state excessive dust in air</li> </ol>

3.2. **The current Transformers covered under this specification shall be suitable for outdoor installation.**

**4. General Technical Requirements:**

- 4.1. The C.T. shall be of oil immersed **live tank design** and shall be so constructed that it can be easily transported to site within the allowable limitation and in horizontal position if the transport limitations so demand.
- 4.2. For compensation of variation in the oil volume due to ambient temperature variation, stainless steel metal bellows shall be used for 400, 220, & 132 kV. For 33 kV nitrogen cushion with pressure release valve/SS bellow shall be used. **Rubber diaphragms shall not be permitted for this purpose.**
- 4.3. The C.T. secondary terminals shall be brought out in a weather proof terminal box, made of 3 mm thick aluminum alloy/ 2 mm thick stainless steel. The terminal box shall be provided with removable gland plate (3 mm thick aluminum alloy/ 3 mm thick stainless steel) and gland (s) suitable for 1100 volts grade PVC insulated, PVC sheathed, multicore 4 Sq. mm stranded copper conductor cable. The terminal blocks shall be disconnecting stud-type (melamine composition, elmex/connectwell make) and provided with ferrules, indelibly marked or numbered. The terminal blocks shall be rated for not less than 1.1 kV, 10 Amps. The terminal box shall be dust and vermin proof. The dimensions of the terminal box and its openings shall be adequate to enable easy access and working space with the use of normal tools.
- 4.4. In case of aluminum alloy construction of CT secondary terminal box, it shall be duly painted.
- 4.5. Polarity shall be indelibly marked on each primary and secondary terminal. Facility shall be provided for short-circuiting and grounding of the C.T. secondary terminals inside the terminal box.
- 4.6. The C.T. shall be provided with non-corrosive, legible nameplate, made of stainless steel with the information, specified in the relevant standards, duly engraved on it.
- 4.7. The current Transformer shall be vacuum filled with oil after processing and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture from entering the tanks. Oil filling and / or sampling cocks, shall be provided which should be properly sealed before dispatching the CT. The method adopted for hermetic sealing shall be described in the offer.

- 4.8. **The impregnation details along with test checks to ensure successful completion of impregnation cycle shall be furnished for approval.**
- 4.9. Oil level gauge and convenient means of filling, sampling and draining of oil should be provided.
- 4.10. **The tank of 400, 220 & 132 kV CT shall be made up of cast Aluminum Alloy. The tank of 33 kV CT shall be made up of cast MS HDG. Type tested CT should have same construction and material of tank as the proposed design. Other materials not acceptable.**
- 4.11. Other metal components shall be made of MS HDG/Aluminum Alloy.
- 4.12. All galvanization shall be 86 micron thick equivalent to 610 gram per sqm or higher.
- 4.13. Current transformers' guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.
- 4.14. **The CT assembly and other critical process shall be carried out in a dust free controlled environment, under positive pressure.**
- 4.15. **PRIMARY WINDING:**
- 4.15.1. The rated extended primary current (continuous) shall be 120% on all cores of the CTs, specified **in tables, clauses 11 and 12.** The offered Primary winding type, for 400KV, 220KV, 132KV, and 33KV class C.Ts, should have been type tested.
- 4.15.2. The primary windings of current transformers shall be constructed of high purity, annealed, high conductivity electrolytic copper meeting to the requirements of IEC 28/IS: 2705.
- 4.15.3. One CT HV terminal should be connected to the CT main tank for all kV CTs, which shall be checked during FAT by continuity check.
- 4.16. **SECONDARY WINDINGS:** Suitably insulated copper wire of electrolytic grade shall be used for secondary windings. Type of insulation, used shall be described in the offer. The secondary taps shall be adequately reinforced to withstand handling without damage. The rating of the Current Transformer's secondary winding shall be 1 (One) Amp. The secondary terminals shall be brought out in a compartment for easy access. **Different ratios specified shall be achieved by secondary tapings only.**
- 4.17. **PRIMARY TERMINALS:** The primary terminals shall be tinned electrolytic copper of 99.9% conductivity. The minimum thickness of tinning shall be 1.5 microns.
- 4.18. **SECONDARY TERMINALS:**
- 4.18.1. 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 brass, duly nickel-plated.** The minimum outside diameter of the stud shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads. The horizontal spacing between the centers of the adjacent studs shall be at least 1.5 times the outside circum-dia of the nuts.
- 4.18.2. The current transformer shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges (for 132

kV & above CT). **The test tap should be such that it covers both bushing and shell capacitance.**

- 4.18.3. Provision shall be made on a screw cap 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 the necessity of its solid earthing as per prescribed method before energizing the Current Transformer.
- 4.18.4. The secondary terminals shall be provided with shorting arrangements.
- 4.19. **INSULATION: The paper insulation shall be made up of high-quality, high density paper with cellulose content of more than 75% complying with IEC 60554-2 and 60641-3-1. The manufacturer shall submit the test certificate regarding conductivity and other major attributes like density, grammage, tan delta, dielectric strength, air permeability, capillary rise in distilled water etc of paper insulation and the invoice of the above material to OPTCL representative during FAT. Winding enamel coating shall comply with IEC 60317-0-1. The necessary raw material test certificate shall be verified at the time of acceptance test by OPTCL representative.**
- 4.20. **CORE:** Each core of the Current Transformer shall be of toroidal shape. Core laminations shall be of cold rolled grain oriented silicon steel or other equivalent alloys of low hysteresis and eddy current losses, high permeability to ensure high accuracy at both normal and over-current conditions. The cores used for protection shall produce undistorted secondary current under transient conditions at all ratios, with specified Current Transformer parameters. The core material, thickness of lamination, the relevant graphs showing the characteristics of the core material shall be submitted along with the offer.
- 4.21. **TANK:**
- 4.21.1. The expansion chambers/ metal bellow shall be made of stainless steel and the tank of the Current Transformers shall be made up of high-quality cast aluminum alloy for 400/220/132 kV CT and MS HDG for 33 kV CT, which should be able to withstand full vacuums and pressure occurring during transit and thermal and mechanical stresses resulting from maximum short circuit current during operation. The other ferrous parts shall be got dip galvanized as per relevant standard.
- 4.21.2. The cast aluminum alloy tanks shall have no joints to minimize oil leakage.
- 4.21.3. For MS HDG type tank, tank shall have bare minimum number of welded joints so as to minimize possible locations of oil leakage. 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.
- 4.21.4. SS bellow shall made with SS grade 304/316 or better.
- 4.21.5. **Size of the Nickel plated Copper TERMINAL STUD in offered CTs must not be less than type tested design. Terminal stud for CTs shall be made with copper with following standard dimensions as per IEC 62271-301:**



- a. **132 & 33 kV – 30 mm dia 100 mm long (minimum)**
- b. **220 kV – 40 mm dia 100 mm long (minimum)**
- c. **400 kV – 50 mm dia 100 mm long (minimum)**

#### 4.22. SECONDARY TERMINAL BOX:

- 4.22.1. A terminal board which shall have arrangement for series / parallel connection and arrangement for shorting of secondary terminals shall be provided. All secondary terminals shall be brought out in a compartment on the same side of each current transformer for easy access.
- 4.22.2. The terminal box shall be aluminum alloy 3 mm thick/stainless steel 2 mm thick. In case of aluminum alloy construction of CT secondary terminal box, it shall be duly painted.
- 4.22.3. **For 400 kV,220 kV,132 kV and 33 kV CTs, all the ratios should be achieved through secondary tapping(s) only. The primary can be bar/wound type, without tapping.**
- 4.22.4. The terminal box shall be provided with a removable cable gland plate at bottom for mounting cable glands for 1.1KV PVC sheathed 4 Sq. mm stranded copper conductor cables.
- 4.22.5. The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing / locking arrangement. Secondary Terminal Boxes shall be weather proof with a rating not less than IP 55.
- 4.22.6. The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing / locking arrangement and shall be suitable to prevent penetration of moisture and rainwater. Ingress protection rating shall be not less than IP 55.
- 4.22.7. All terminals shall be clearly marked with identification number to facilitate connection to external wiring.

#### 4.23. HOUSING:

- 4.23.1. **The CT housing shall be made of hollow porcelain material unless specifically called for silicone polymer composite housing in the tender.**
- 4.23.2. **PORCELAIN:**
  - a. The housing shall be made up of homogeneous, vitreous porcelain of high mechanical and dielectric strength; Glazing of porcelain 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 details of location and type of joint, if provided on the porcelain, shall be furnished by the Bidder along with the offer.
  - b. The type and profile of the porcelain insulator sheds shall be in accordance with IEC 60815 & IEC 62155.
  - c. **The specific creepage distance of insulators shall be 31mm/kV.**
  - d. The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.
  - e. The porcelains used shall be free from cavities and other flaws. The bushings shall have ample insulation, mechanical strength and rigidity for the

condition under which they shall be used and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove the internal heat.

- f. Cast metal end caps for the bushings shall be of high strength, hot dip galvanized malleable iron. They shall have smooth surface to prevent discharge-taking place between the metal parts and porcelain as a result of ionization.
- g. The insulation of bushings shall be coordinated with that of the current transformer such that the flashover, if any, will occur only external to the Current Transformer. The puncture strength of the bushings shall be greater than the flashover value.
- h. End shields should be provided for distribution of stresses, where required.
- i. Corona shields, if required should be provided.

**4.23.3. POLYMER COMPOSITE: (only applicable when explicitly mentioned in the PO)**

- a. Polymer housing material shall be made of high quality hydrophobic silicone rubber. Polymer Rubber housing shall be free from lamination cavities, surface tack, roughness or other flaws affecting the maximum level of mechanical and electrical strengths. Properties of the polymeric materials shall be specified in the offer and test reports for the same from a NABL accredited laboratory shall be submitted for approval of the purchaser. The polymer material which is used for arrester housing must be resistant to tracking & erosion, stabilized against UV radiation and shall not exhibit any fatigue to temperature and load.
- b. The CT housing in general shall conform to IEC 61462 and IEC 62217 as applicable. It shall not fail due to housing contamination. Housing shall be so coordinated that external flashover will not occur due to application of any impulse or switching surge voltage up to maximum design value of CT.
- c. The rain sheds / petticoats shall be of silicone polymer material and shall conform relevant standards.
- d. Type test reports of composite housing shall be submitted.
- e. The Polymer weather shed design shall be preferably of self-cleaning type (Aero foil design). The details of the Polymer housing shed profile such as distance, angle of Inclination, gap between the shed, diameter (ID and OD) etc. shall be as per relevant Standard and shall be indicated by the Bidder/EPC in his offer in the form, during detailed Drawing evaluation.
- f. The minimum specific creepage distance of the Composite housing shall be 31 mm/kV.

**4.24. INSULATING MEDIUM (OIL):** The quantity of insulating oil for the filling and the complete specification of the insulating oil shall be stated. The oil shall comply in all respects with the provisions of latest edition of IS 335/IEC 60296. **Mineral oil shall be naphthenic based. RM test certificates shall be checked by OPTCL inspector during FAT.**

**4.25. PREVENTION OF OIL LEAKAGE AND ENTRY OF MOISTURE:**

- 4.25.1. The supplier shall ensure that the sealing of the 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.
- a. Locations of emergence of primary and secondary terminals.
  - b. Interface between porcelain housing and metal tank/s.
  - c. Cover of the secondary terminal box.
- 4.25.2. 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.
- 4.25.3. For 400/220/132/33 kV CT with O ring: All sealing surfaces shall be smooth, straight, and reinforced, if necessary to minimize distortion and to make a tight seal. Sealing shall be done with O—ring seals. The O ring sealing shall have compression set of < 15% in adherence to ASTM D395-16. O rings shall be housed in CNC machined O ring groove.
- 4.25.4. For 400/220/132/33 kV CT gaskets are allowed to be used. For gasketed joints, wherever used, nitrite butyl rubber gaskets or better shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.
- 4.26. **FITTINGS AND ACCESSORIES:** Fittings and accessories, listed below shall be supplied with each Current Transformer. Any fitting, required essential other than those listed below shall also be supplied along with each Current Transformer without any extra cost to the purchaser:
- 4.26.1. **OIL LEVEL GAUGE:** Prismatic oil level gauge shall be provided to indicate the oil level in the Current Transformer. This gauge shall be mounted in such a way that the oil level can be seen from ground level. If metal bellow is used, a ground glass window shall be provided to monitor the position of the metal bellow. The metal below shall be tested in accordance with relevant standards. The details shall be to the approval of the purchaser.
- 4.26.2. **PRESSURE RELIEVING DEVICE:** Each 33 kV Current Transformer with nitrogen cushioning shall be provided with a pressure relieving device so as to protect bushing of the Current Transformer even under unfavorable Conditions. The pressure relief valve shall comply with the following requirements:
- a. It shall conform to relevant IS/IEC standards.
  - b. It shall be suitably calibrated for the maximum allowed pressure. Bidder shall ensure that the PRD shall not operate during any of the acceptance tests.
  - c. *It will be treated as a major bought out item hence, necessary test report from manufacturer (of PRD) shall be submitted during approval of the drawing.*
- 4.26.3. **OIL DRAIN COCK:** All CTs shall be provided with oil filling/draining valves for filling and collection of oil. Cover/Cap shall be provided. **CTs must have adequate provision for taking samples without exposure to atmosphere. Manufacturer shall recommend the frequency at which oil sample should be drawn and norms for various gases in oil after being in operation for**

**different durations. Manufacturer should also indicate the total quantity of oil which can be withdrawn from CT for gas analysis before refilling or further treatment of CT becomes necessary.**

- 4.26.4. **EARTHING:** Each Current Transformer shall be provided with two separate **earthing pads** for bolted connection to 50mm X 6mm flat, to be provided by the purchaser for connection to station earth-mat.
- 4.26.5. **LIFTING ARRANGMENT:** The 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 so as to avoid any damage to the porcelain/polymer housing or the tanks during lifting for installation / transport. Necessary string guides shall be offered which shall be of removable type.
- 4.26.6. **NITROGEN FILLING VALVE:** 33 kV CTs with nitrogen cushioning shall be provided with a nitrogen filling valve.
- 4.26.7. **RATING/NAME PLATE & MARKING:**
- a. The Current Transformer shall be provided with non-corrosive (stainless steel), legible name plate with the information specified in relevant standards, duly engraved on it.
  - b. A schematic drawing indicating the connections shall be provided in the interior of the Secondary Terminal box.
- 4.26.8. **TERMINAL CONNECTORS: Not to be supplied with CT.**
- 4.26.9. **NUT & BOLTS:**
- a. Nuts and bolts for mounting CT on CT structure shall be supplied by the OEM.
  - b. Nut and bolts for connection of earthing flat with CT earthing terminal shall be supplied by OEM.

## **5. TESTS:**

### **5.1. Type Tests:**

- 5.1.1. All the equipment offered shall be fully type tested as per the relevant standards (IS 2701-1, IEC 61869-1/IS 16227-1 & IEC 61869-2/IS 16227-2 with latest amendments) & tests as indicated below. The bids offering equipment not type tested will be rejected. In case, the equipment of the type & design offered has already been type tested, the bidder/ EPC agency shall furnish four sets of the type test reports along with the offer. The test must have been conducted not later than ten years from the date of opening of the bids.
- 5.1.2. The purchaser reserves the right to demand repetition of some or all the type & additional type tests in the presence of its representative. For this purpose, the bidder/ EPC agency may quote unit rates for carrying out such type tests.
- 5.1.3. For any change in the design/type of already type tested CT offered against this specification, the purchaser reserves the right to demand repetition of some or all type and special tests in presence of OPTCL's representative(s) at the cost of the supplier (without any extra cost to the purchaser) or reject the bid without any intimation.

- 5.1.4. All type test reports should have been conducted in independent third-party NABL laboratories. The tests for which testing facility is not available in India, should have been conducted in a laboratory of foreign Country accredited by National Accreditation Body of that Country.
- 5.1.5. The type tests conducted in-house by manufacturers shall also be acceptable provided the lab is accredited by National Accreditation Body of the Country and the tests have been witnessed by a representative of NABL accredited laboratory/Government Power Utility.
- 5.1.6. **List of Type Tests as per IS/IEC:**
- a. Temperature-rise test
  - b. Impulse voltage withstand test on primary terminals
    - i. Lightning impulse voltage test on primary terminals
    - ii. Switching impulse voltage test for 420 kV CT
  - c. WET Test :
    - i. Power-frequency wet withstand voltage tests for CT up to and including 245 kV
    - ii. Switching-impulse wet withstand voltage tests for 420 kV CT
  - d. Tests for accuracy
    - i. Test for ratio error and phase displacement error for measuring core
    - ii. Determination of the instrument security factor for measuring core
    - iii. Test of low-leakage reactance type for protection core
  - e. Short-time current tests
  - f. EMC tests: Radio Interference voltage test for 145kV, 245 kV & 420 kV CT
  - g. IP 55 test on secondary terminal box
- 5.1.7. **List of Special Tests as per IS/IEC:**
- a. Chopped impulse voltage withstand test on primary terminals for 145 kV and above CT
  - b. Multiple chopped impulse test on primary terminals for 420 kV CT
  - c. Measurement of capacitance and dielectric dissipation factor for 145kV, 245 kV & 420 kV CT
  - d. Transmitted overvoltage test for 145kV, 245 kV & 420 kV CT
  - e. Mechanical terminal load test
  - f. Internal arc fault test for Porcelain Housed 145kV, 245 kV & 420 kV CT (If manufacturer doesn't have internal arc type test report for the same voltage class CT as the submitted design, applicability report along with type test report conducted on other voltage class CT may be acceptable)
  - g. Corrosion test for 145kV, 245 kV & 420 kV CT
- 5.1.8. **Additional Type Tests:**
- a. Corona extinction voltage test for 245 kV & 420 kV CT
  - b. Seismic withstand voltage test as per IEC/TR 62271-300
  - c. Thermal stability test. (Application of rated voltage and rated extended thermal current simultaneously for 145kV, 245 kV & 420 kV CT)

- d. Thermal Co-efficient test. (Measurement of tan-delta as a function of temperature (at ambient and between 80 °C & 90 °C) and voltage (at 0.3, 0.7, 1.0 and 1.1  $U_m/\sqrt{3}$ ) for 145kV, 245 kV & 420 kV CT)
- 5.1.9. Additionally all the hollow insulators ~~and terminal connectors~~ should be completely type tested as per relevant standards.
- 5.1.10. **All the dielectric type tests shall be carried out on the same instrument transformer. After the current transformers have been subjected to the dielectric type tests they shall be subjected to all the routine tests.**
- 5.1.11. All the type tests shall be carried out on a maximum of two specimens.
- 5.2. **ACCEPTANCE/ROUTINE TESTS:**
- 5.2.1. All acceptance/routine tests as stipulated in IEC-61969-1/2 and IS 2705-1 and its latest amendments & routine tests as indicated below shall be carried out by the supplier in the presence of purchaser's representative.
- 5.2.2. **The manufacturer should have in house NABL accredited lab for conducting below mentioned acceptance tests. If the in house lab is not NABL accredited, than all FAT shall be done in third party NABL labs in presence of OPTCL representative, without any additional financial implication to OPTCL.**
- 5.2.3. **No sampling is allowed for factory acceptance tests. FAT of 100% of the offered quantity shall be witnessed by OPTCL representative.**
- 5.2.4. **List of Acceptance/Routine Tests:**
- a. Appearance and Dimensional Check.
  - b. Power-frequency voltage withstand tests on primary terminals
  - c. Power-frequency voltage withstand tests on secondary terminals
  - d. Tests for accuracy
    - i. Test for ratio error and phase displacement error for measuring core
    - ii. Test for ratio error for protection core
    - iii. Determination of the instrument security factor for measuring core
  - e. Verification of terminal marking and polarity
  - f. Partial discharge measurement  
***(NOTE: Before test, minimum PD sensitivity of laboratory shall be demonstrated as 2.5 pC)***
  - g. Enclosure tightness test at ambient temperature
  - h. Determination of the secondary winding resistance
  - i. Inter-turn overvoltage test
  - j. Measurement of Insulation Resistance.
  - k. Test for rated knee point e.m.f. and exciting current at rated knee point e.m.f.
  - l. Measurement of capacitance and Tan delta at 10 kV and  $U_m/\sqrt{3}$  in all CTs
- 5.2.5. The below tests are required to be carried out **at least in one CT per LOT** in the factory during Acceptance test. These tests will be conducted on one randomly selected unit among the lot offered for inspection and **these test will be conducted after HV test only.**

- a. Lightning impulse withstand test on the primary terminals.
- b. The Thermal stability test. (Application of rated voltage and rated extended thermal current simultaneously for 145kV, 245 kV & 420 kV CT)
- c. Thermal Co-efficient test. (Measurement of tan-delta as a function of temperature (at ambient and between 80 °C & 90 °C) and voltage (at 0.3, 0.7, 1.0 and 1.1 Um/√3) for 145kV, 245 kV & 420 kV CT)
- d. Temperature rise test.
- e. DGA before and after LI impulse withstand test.
- f. Properties of Insulating Oil (Reference standard IEC 60296/IS 335)
  - i. BDV
  - ii. Tan delta
  - iii. Water content
  - iv. Specific resistance

**5.2.6. In addition to the above tests the following checks shall be done by OPTCL inspector during factory visit.**

- a. **Visual verification by the inspector whether the workshop/assembly line of factory are maintained under positive pressure or not where critical components and assemblies are carried out.**
- b. **Raw material and invoice checking of insulating oil, core, coil, paper insulation & stainless steel metal bellow/PRV.**
- c. **Verification of shell metal foil connection with bushing foil in CT assembly process of factory.**
- d. **Verification of one CT HV terminal connection with tank through continuity check for all kV CTs.**

**5.3. ADDITIONAL TESTS:**

The purchaser reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier/laboratory or at any other recognized laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the purchaser to satisfy that the material complies with the intent of this specification.

**6. INSPECTION:**

- 6.1. The purchaser shall have access at all times to the works and all other places of manufacture, where the Current Transformers are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacture of all the accessories and for conducting the necessary tests.
- 6.2. The supplier shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of equipment in its various stages so that arrangement could be made for inspection.
- 6.3. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected, tested and dispatch clearance issued. However, the purchaser reserves the right to alter the dispatch schedule, attached to this specification without any extra financial liability to OPTCL.

- 6.4. The acceptance of any quantity of equipment shall in no way relieve the supplier of his responsibility for meeting all the requirements of this specification and shall not prevent subsequent rejection, if such equipment are found to be defective.
- 6.5. Before offering for inspection, the supplier shall furnish shop routine test certificates and calibration reports of the equipment/instruments to be used during testing. After acceptance of these calibration reports and shop routine test certificate, inspecting officer will be deputed for witnessing such inspections.
- 6.6. The purchaser reserves the right to insist for witnessing the acceptance/routine testing of the bought-out items.

## 7. QUALITY ASSURANCE PLAN:

- 7.1. The Successful Bidder/ EPC agency shall submit Quality Assurance Plan for manufacturing process for approval (or may comply with the Standard Manufacturing Quality Plan of **OPTCL as available with the Technical specification**).
- 7.2. The Successful Bidder/ EPC agency shall submit process flow chart for the manufacturing process along with the drawings/GTP.
- 7.3. The QAP shall contain the followings:
  - 7.3.1. RAW Materials/Bought out items:
    - a. Incoming raw materials/bought out items from sub vendors,
    - b. Name of the sub vendors,
    - c. List of standards to which the raw materials/bought out items adhere/according to which the raw materials are manufactured,
    - d. List of tests carried out by the OEM on the raw materials/bought out items to verify the quality of the incoming raw materials with sampling rate of the tests,
    - e. Acceptance norms,
    - f. The record of these test results shall be kept for verification by OPTCL.
  - 7.3.2. In process inspection by OEM:
    - a. List of tests carried out by OEM to ensure quality at various stages of manufacture.
    - b. Sampling rate of the tests
    - c. Reference standards for tests and acceptance norms,
    - d. The record of these test results shall be kept for verification by OPTCL.
    - e. **OPTCL preserves the right to witness all/some of these tests at the factory premises of OEM.**
  - 7.3.3. Factory acceptance tests:
    - a. All tests as per IEC 61869-1/61869-2/IS 2705-1 as applicable on CT.
    - b. Quantum of check/Sampling rate = 100%.
    - c. Reference standards for tests and acceptance norms,
    - d. Tests shall be carried out by manufacturer and witnessed by OPTCL representative.
  - 7.3.4. Type test reports:
    - a. The QAP shall also contain list of type test conducted on the design,
    - b. Reference standard,
    - c. Acceptance norms.



- 7.3.5. Level of automation achieved and list of areas where manual processing exists.
- 7.3.6. List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such test and inspections.
- 7.3.7. Special features provided in the equipment to make it maintenance free.
- 7.3.8. List of testing equipment available with the OEM for final testing of CT vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. Any limitations in this regard shall be very clearly brought out in the offer.

**7.3.9. All the testing equipment, meters etc, should have been calibrated in a NABL accredited laboratory. The Bidder must submit the list of testing equipment and meters test-wise as per Annexure – B of the Technical Specification.**

7.3.10. Packing and Dispatch:

- a. List of checks to ensure the completeness of equipment and accessories as per PO,
- b. List of checks to ensure proper packing of CB and spares,
- c. Supply of O&M Manual and test reports.

7.4. Subsequent to/(During) approval of drawings/GTP & before offering inspection, the supplier shall, submit following information to the purchaser:

7.4.1. List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

7.4.2. Type test certificates of the raw material and bought out accessories. **(Core, Winding, Oil, Paper Insulation, Terminal Clamps & Hollow Insulators)**

7.4.3. Quality assurance plan (QAP) with hold points for purchaser's inspection (if purchaser so desires). The QAP and hold points shall be discussed between the purchaser and the supplier before the QAP is finalized.

7.5. The supplier shall submit the raw material/ bought out item test certificates and routine test reports, before/at the time of offering inspection call.

## **8. DOCUMENTATION:**

8.1. All dimensions in submitted drawings shall be in SI units.

8.2. All submitted drawings, GTP, MQP, and other documentations shall confirm to IS/IEC and this TS.

8.3. List of drawings & documents:

The Bidder/ EPC agency shall furnish four sets of the following drawings/documents along with the offer.

- a. General outline drawings showing dimensions and shipping weights, quantity of oil etc.,
- b. Sectional views showing
  - i. General constructional features,
  - ii. Materials / gaskets/o ring / sealing used,
  - iii. The insulation of the winding arrangement, method of connection of the primary / secondary winding to the primary / secondary terminals etc.
- c. Guaranteed technical Particulars,
- d. Schematic drawing,
- e. Rating and Diagram plate,

- f. Secondary Terminal Box,
  - g. The detailed dimensional drawing of Porcelain Housing/Polymer Housing such as ID, OD, thickness and Insulator details such as height, profile of petticoats, angle of inclination and gap between successive petticoats, total creep age distance etc.,
  - h. Assembly Sectional view of Primary Terminal,
  - i. Assembly drawing for secondary terminal,
  - j. Sectional view of Pressure Release device,
  - k. Drawing showing details of Oil level Indicator,
  - l. Sectional view of Pressure Release device,
  - m. Drawing showing details of Oil level Indicator,
  - n. All type and special test reports relating to tests, as mentioned at **Cl. No. 5.1 of this Technical Specification,**
  - o. Ratio and phase angle error curves for CTs,
  - p. Magnetization characteristic curves such as B-H curves and sp.loss vs. flux density curves,
  - q. Design calculation for thermal ( $I_d^2t$ ) and dynamic (A-T) short circuit withstand w.r.t type tested design.
  - r. ~~Terminal clamp with isometric view.~~
- 8.4. After placement of order the supplier shall submit four sets of final version of all the above drawings/GTP for purchaser's approval. The purchaser shall communicate his comments/approval on the drawings to the supplier within reasonable period. The supplier shall, if necessary, modify the drawings and resubmit four copies of the modified drawings for purchaser's approval. After receipt of purchaser's approval, the supplier shall, submit 15 prints of the approved drawings for purchaser's use.
- 8.5. The supplier shall also furnish fifteen (15) copies of manuals covering erection, commissioning, operation and maintenance instructions and all relevant information and approved drawings pertaining to the CTs. Marked erection drawings shall identify the component parts of the equipment as shipped to enable purchaser to carry out erection with his own personnel. Each manual shall also contain one set of all the approved drawings, type test reports as well as acceptance reports of the corresponding consignment dispatched. The instruction manuals shall contain storage, handling, erection, commissioning, troubleshooting, servicing and overhauling instructions.
- 8.6. 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.
- 8.7. Approval of drawings/work by purchaser shall not relieve the supplier of his responsibility and liability for ensuring correctness and correct interpretation of the drawings for meeting the requirement of the latest revision of applicable standards, rules and codes of practices. The equipment shall conform in all respects to high standards of engineering design workmanship & latest revisions of relevant

standards at the time of ordering & purchaser shall have the power to reject any work or materials which in his judgment is not in full accordance therewith.

**8.8. TEST REPORTS:**

- 8.8.1. Four copies of type test and special test reports shall be furnished to the purchaser with the tender offer.
- 8.8.2. Four copies of acceptance test reports shall be furnished to the purchaser as per the inspection of testing. One copy will be returned, duly certified by the purchaser and only there afterwards shall the material be dispatched.
- 8.8.3. All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.
- 8.8.4. All test reports of tests conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when requested for by the purchaser.

**9. PACKING AND FORWARDING:**

- 9.1. The equipment shall be packed in suitable crates so as to withstand handling during transit and outdoor storage. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing and handling. The easily damageable materials 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 the supplier without any extra cost.
- 9.2. 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. Sign showing upper / lower side of the crate.
  - f. Handling and unpacking instructions.
  - g. Bill of material indicating contents of each package and spare material.
  - h. Manuals containing approved drawings & test reports
- 9.3. The supplier shall ensure that the packing list and bill of material are to be supplied in advance to the purchaser & to the consignees before dispatch.

**10. DEFECT LIABILITY:**

The actions required to be taken by contractor in case of defects observed in CT during the warranty period (defect liability period) shall be as specified below.

Nature of Problem	Corrective measures to be taken by supplier/EPC
<b>Violation of Tan delta</b> Tan Delta: <ul style="list-style-type: none"><li>• &gt;0.5%(during pre-commissioning)</li><li>• &gt;0.7%(in operation)</li><li>• or change w.r.t. to previous year value &gt; 0.1%</li></ul>	Replacement of CT

- Oil leakage
- Low Oil level

Replacement or repair as per repair procedure approved by QA

E&Q OPTCL

### 11. TECHNICAL REQUIREMENT FOR 400, 220, 132 & 33 KV CT:

The Current Transformers under this specification shall conform to the parameters given below:

SN	Description	36 kV	145 kV	245 kV	420 kV
1.	Type of CT/Installation	Single phase, Live tank, oil filled, hermetically sealed, outdoor, self-cooled			
2.	Type of mounting	HDG Steel (Lattice/Pipe) Support Structure			
3.	Suitable for system frequency	50 Hz			
4.	Rated Voltage of CT (kV <sub>rms</sub> )	33	132	220	400
5.	Nominal System Voltage (kV <sub>rms</sub> )	33	132	220	400
6.	Highest System Voltage (kV <sub>rms</sub> )	36	145	245	420
7.	Current Ratio (A/A)	Refer clause 12			
8.	Method of earthing the system where the current transformer will be installed.	Effectively Earthed / Solidly Grounded			
9.	Rated continuous thermal current I <sub>cth</sub> (A)	120 % of rated primary current			
10.	Acceptable limit of temperature rise above 50 °C ambient temperature for continuous operation at rated continuous thermal current.				
a.	Winding	45 °C			
b.	Oil	40 °C			
c.	External surface of the core, metallic parts in contact with or adjacent to, insulation.	45 °C			
11.	Acceptable partial discharge level	PD Test voltage		PD Level	
		$U_m$		$\leq 10 pC$	
		$1.2 \times U_m / \sqrt{3}$		$\leq 5 pC$	
12.	RIV at $1.1 \times U_m / \sqrt{3}$	$\leq 1000 \mu V$			
13.	Rated Insulation Levels				
a.	Primary Terminal				
i.	1.2/50 $\mu s$ Lightning Impulse Withstand Voltage (kV <sub>p</sub> )	170	650	1050	1425
ii.	1 minute Power frequency withstand voltage (kV <sub>rms</sub> )	70	275	460	630
iii.	Switching Impulse Withstand Voltage (kV <sub>p</sub> )	-	-	-	1050
b.	Secondary Terminal				
i.	1 minute Power frequency withstand voltage (kV <sub>rms</sub> )	3	3	5	5

14.	Specific Creepage Distance <b>refer clause 4.23</b>	31 mm/kV			
15.	Minimum creepage distance of porcelain Housing (mm)	13020	7595	4495	1116
16.	Rated short time withstand current for <b>1 second</b> at all ratios ( $KA_{rms}$ )	31.5 kA	40 kA	50 kA	63 kA
17.	Minimum corona extinction voltage ( $kV_{rms}$ )	--	92	156	320
18.	Instrument security factor at all ratios for metering core.	$\leq 5$			
19.	Maximum rated short time thermal current density of the primary winding at all ratios $I_d$ ( $A/mm^2$ )	For copper windings, $I_d \leq 160 A/mm^2$ for $t_r = 1 sec$ where, $t_r$ = rated duration of short time withstand current			
20.	Application, current ratio, output burden, accuracy class, minimum knee point voltage, secondary winding resistance, maximum excitation current at minimum knee point voltage etc.	<b>Refer clause 12</b>			
21.	Type of core	Torroidal type			
22.	Seismic acceleration Withstand	0.15g (Vertical) & 0.3g (Horizontal) (IS/IEC TR 62271-301)			
23.	Dielectric dissipation factor for 132 KV & higher voltage class CT at ambient temperature at $U_m/\sqrt{3}$	$\leq 0.004$ (w/o applying correction factor)			
24.	Accuracy class of standard C.T. to be used during testing towards determination of ratio errors and phase angle errors for metering cores.	0.05 or better			

## 12. SPECIFIED PARAMETERS FOR 400/220/132/33 KV CLASS CT:

( $V_k$  = Knee point voltage,  $R_{ct}$  = Secondary winding resistance &  $I_e$  = Excitation current)

### 12.1. 36 KV CURRENT TRANSFORMERS:

No of cores	Core No	Application	Current Ratio	Output burden (VA)	Accuracy Class	Minimum $V_k$ (Volt)	Maximum $R_{ct}$ at 75°C ( $\Omega$ )	Maximum $I_e$ at $V_k$ (mA)	ISF
<b>For Transformer Bay: 1200-600-300/1-1-1-1</b>									
4	1	Protection	1200/1	--	PX	1200	12	30	--
		–	600/1		PX	600	6	60	
		Differential	300/1		PX	300	3	120	
	2	Metering	1200/1	20	0.2s	--	--	--	$\leq 5$
			600/1	20					$\leq 5$
			300/1	20					$\leq 5$
	3	Protection	1200/1	--	PX	1200	12	30	--

		– REF	600/1		PX	600	6	60	
			300/1		PX	300	3	120	
	4	Protection – OC & EF	1200/1	--	PX	1200	12	30	--
			600/1		PX	600	6	60	
			300/1		PX	300	3	120	
<b>For Bus Coupler Bay: 1200-600-300/1-1-1</b>									
	1	Protection – OC & EF	1200/1	--	PX	1200	12	30	--
			600/1		PX	600	6	60	
			300/1		PX	300	3	120	
	2	Metering	1200/1	20	0.2s				≤ 5
			600/1	20	0.2s	--	--	--	≤ 5
			300/1	20	0.2s				≤ 5
	3	Protection – Spare	1200/1	--	PX	1200	12	30	--
			600/1		PX	600	6	60	
			300/1		PX	300	3	120	
<b>For Transformer Bay: 800-400-200/1-1-1-1</b>									
	1	Protection – Differential	800/1	--	PX	800	8	40	--
			400/1		PX	400	4	80	
			200/1		PX	200	2	160	
	2	Metering	800/1	20	0.2s				≤ 5
			400/1	20	0.2s	--	--	--	≤ 5
			200/1	20	0.2s				≤ 5
	3	Protection – REF	800/1	--	PX	800	8	40	--
			400/1		PX	400	4	80	
			200/1		PX	200	2	160	
	4	Protection – OC & EF	800/1	--	PX	800	8	40	--
			400/1		PX	400	4	80	
			200/1		PX	200	2	160	
<b>For Feeder &amp; Bus Coupler Bay: 800-400-200/1-1-1</b>									
	1	Protection – OC & EF	800/1	--	PX	800	8	40	--
			400/1		PX	400	4	80	
			200/1		PX	200	2	160	
	2	Metering	800/1	20	0.2s				≤ 5
			400/1	20	0.2s	--	--	--	≤ 5
			200/1	20	0.2s				≤ 5
	3	Protection – Spare	800/1	--	PX	800	8	40	--
			400/1		PX	400	4	80	
			200/1		PX	200	2	160	
<b>600-300-150/1-1-1</b>									
	1	Protection	600/1	--	PX	600	6	40	--
			300/1		PX	300	3	80	
			150/1		PX	150	1	160	
	2	Metering	600/1	20	0.2s				≤ 5
			300/1	20	0.2s	--	--	--	≤ 5
			150/1	20	0.2s				≤ 5
	3	Protection	600/1	--	PX	600	6	40	--
			300/1		PX	300	3	80	
			150/1		PX	150	1	160	

### 12.2. 36 KV NEUTRAL CURRENT TRANSFORMERS:

No of cores	Core No	Application	Current Ratio	Output burden (VA)	Accuracy Class	Minimum V <sub>k</sub> (Volt)	Maximum R <sub>ct</sub> at 75°C (Ω)	Maximum I <sub>e</sub> at V <sub>k</sub> (mA)	ISF
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1200-600-300/1-1									
2	1	Protection - REF	1200/1	--	PX	1200	12	30	--
			600/1		PX	600	6	60	
			300/1		PX	300	3	120	
	2	Protection - Spare	1200/1	--	PX	1200	12	30	--
			600/1		PX	600	6	60	
			300/1		PX	300	3	120	
800-400-200/1-1									
2	1	Protection - REF	800/1	--	PX	800	8	40	--
			400/1		PX	400	4	80	
			200/1		PX	200	2	160	
	2	Protection - Spare	800/1	--	PX	800	8	40	--
			400/1		PX	400	4	80	
			200/1		PX	200	2	160	
200/1									
1	1	Protection	200/1	--	PX	400	2	80	--

### 12.3. 145 KV CURRENT TRANSFORMERS:

No of cores	Core No	Application	Current Ratio	Output burden (VA)	Accuracy Class	Minimum V <sub>k</sub> (Volt)	Maximum R <sub>ct</sub> at 75°C (Ω)	Maximum I <sub>e</sub> at V <sub>k</sub> (mA)	ISF
For Feeder, Bus Coupler & Transformer Bay: 800-400-200/1-1-1-1									
4	1	Protection - Differential	800/1	--	PX	1000	8	25	--
			400/1		PX	500	4	50	
			200/1		PX	250	2	100	
	2	Metering	800/1	20	0.2s	--	--	--	≤ 5
			400/1	20	0.2s				≤ 5
			200/1	20	0.2s				≤ 5
	3	Protection - REF	800/1	--	PX	1000	8	25	--
			400/1		PX	500	4	50	
			200/1		PX	250	2	100	
	4	Protection - OC & EF	800/1	--	PX	1000	8	25	--
			400/1		PX	500	4	50	
			200/1		PX	250	2	100	
600-300-150/1-1-1-1									
4	1	Protection	600/1	--	PX	800	6	25	--
			300/1		PX	400	3	50	
			150/1		PX	200	1.5	100	
	2	Metering	600/1	20	0.2s	--	--	--	≤ 5
			300/1	20	0.2s				≤ 5
			150/1	20	0.2s				≤ 5
	3	Protection	600/1	--	PX	800	6	25	--
			300/1		PX	400	3	50	
			150/1		PX	200	1.5	100	
	4	Protection	600/1	--	PX	800	6	25	--
			300/1		PX	400	3	50	
			150/1		PX	200	1.5	100	
400-200-100/1-1-1									
3	1	Protection	400/1	--	PX	500	4	25	--
			200/1		PX	250	2	50	
			100/1		PX	125	1	100	



	2	Metering	400/1	20	0.2s	--	--	--	≤ 5
			200/1	20	0.2s				≤ 5
			100/1	20	0.2s				≤ 5
	3	Protection	400/1	--	PX	500	4	25	--
			200/1		PX	250	2	50	
			100/1		PX	125	1	100	

### 1.2. 245 KV CURRENT TRANSFORMERS:

No of cores	Core No	Application	Current Ratio	Output burden (VA)	Accuracy Class	Minimum V <sub>k</sub> (Volt)	Maximum R <sub>ct</sub> at 75°C (Ω)	Maximum I <sub>e</sub> at V <sub>k</sub> (mA)	ISF
<b>For Feeder, Bus Coupler and Transformer Bay: 1200-600-300/1-1-1-1</b>									
5	1	Protection – Main 1 //Diff. 1 - OC & EF	1200/1	--	PX	1200	6	20	--
			600/1		PX	600	3	40	
			300/1		PX	300	1.5	80	
	2	Protection – Main 2//Diff. 2	1200/1	--	PX	1200	6	20	--
			600/1		PX	600	3	40	
			300/1		PX	300	1.5	80	
	3	Metering	1200/1	20	0.2s	--	--	--	≤ 5
			600/1	20	0.2s				≤ 5
			300/1	20	0.2s				≤ 5
	4	Protection – Bus-bar	1200/1	--	PX	1200	6	20	--
			600/1		PX	600	3	40	
			300/1		PX	300	1.5	80	
	5	Protection – - OC & EF //REF	1200/1	--	PX	1200	6	20	--
			600/1		PX	600	3	40	
			300/1		PX	300	1.5	80	

### 12.4. 420 KV CURRENT TRANSFORMERS:

No of cores	Core No	Application	Current Ratio	Output burden (VA)	Accuracy Class	Minimum V <sub>k</sub> (Volt)	Maximum R <sub>ct</sub> at 75°C (Ω)	Maximum I <sub>e</sub> at V <sub>k</sub> (mA)	ISF
<b>For : 2000-1000-500/1-1-1-1</b>									
5	1	Protection – Main 1//TRF Differential 1	2000/1	--	PX	2000	10	30	--
			1000/1		PX	1000	5	60	
			500/1		PX	500	2.5	120	
	2	Protection – Main 2 - OC & EF//TRF Differential 2	2000/1	--	PX	2000	10	30	--
			1000/1		PX	1000	5	60	
			500/1		PX	500	2.5	120	
	3	Metering	2000/1	20	0.2s	--	--	--	≤ 5
			1000/1	20	0.2s				≤ 5
			500/1	20	0.2s				≤ 5
	4	Protection – Bus-bar Main//OC & EF	2000/1	--	PX	2000	10	30	--
			1000/1		PX	1000	5	60	
			500/1		PX	500	2.5	120	
	5	Protection – – Bus-bar Check//LBB	2000/1	--	PX	2000	10	30	--
			1000/1		PX	1000	5	60	
			500/1		PX	500	2.5	120	

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**ANNEXURE – A****GUARANTEED TECHNICAL PARTICULARS FOR CURRENT TRANSFORMER**

SL. NO.	DESCRIPTION	33 KV	132KV	220 kV CT	400KV
1.	Bidder's name and address				
2.	Name and address of the Manufacturer				
3.	Manufacture's type designation				
4.	Standards applicable				
5.	Rated frequency (HZ)				
6.	Rated Voltage (KV)				
7.0	Rated current (A)				
7.1	Rated continuous current (A)				
7.2	Rated extended primary current (A)				
8.	Short time thermal current withstand for stipulated time duration (KA)				
9.	Dynamic current withstand (KAP)				
10.	1.2/50 $\mu$ s impulse withstand voltage (KVP)				
11.	One minute dry and wet power frequency withstand voltage (KV-rms)				
12.	No. of cores per CT				
13.	Transformation Ratio				
14.	No. of secondary turns				
15.	Rated output at all ratios for metering core (VA)				
16.	Accuracy class				
17.	Minimum Knee point voltage at different taps for all 'PS' class cores (V)				
18.	Secondary winding resistance at different taps for all cores ( $\Omega$ ) (750C)				
19.0	Maximum exciting current at all ratios (for all PS class cores)				
19.1	100% KPV (Knee point voltage) (mA)				
19.2	25% KPV (Knee point voltage) (mA)				

19.3	20% KPV (Knee point voltage) (mA)				
19.4	10% KPV (Knee point voltage) (mA)				
20.	Instrument security factor at different ratios.				
21.	Radio interference voltage at 1.1 Vr / 31/2 at 1.0 MHZ (Micro volts)				
22.	Whether auxiliary CT provided for metering winding				
23.	Corona extinction voltage (KV rms)				
24.	Partial discharge level (PC)				
25.	Total creepage distance (mm)				
26.	Primary				
26.1	No. of primary turns				
26.2	Material and cross-section of primary (mm <sup>2</sup> )				
26.3	Type of primary				
27.	Whether CT is suitable for transportation horizontally.				
28.	Percentage current (ratio) error and phase displacement in minutes at rated burden and at				
28.1	5% rated current				
28.2	10% rated current				
28.3.	20% rated current				
28.4.	120% rated current				
29.	Percentage current (ratio) error and phase displacement in minutes at 25% rated burden and				
29.1	At 5% rated current				
29.2	At 10% rated current				
29.3.	At 20% rated current				
29.4.	At 120% rated current				
30.	Quantity of oil per CT (Litres)				
31.	Standard to which oil conforms generally.				
32.	Characteristics of oil (prior to filling)				
32.1	Breakdown voltage (KVrms)				
32.2	Dielectric dissipation constant (tan delta)				
32.3	Water content (ppm)				
32.4	Gas content				
32.5	Interfacial tension at 270C (N/m)				
32.6	Specific resistance				

32.6.1	At 900C ( $\Omega\text{cm}$ )				
32.6.2	At 270 C ( $\Omega\text{cm}$ )				
33.	Whether current transformers are hermetically sealed. If so, how ?				
34.	Total weight (Kg)				
35.	Transport weight (Kg)				
36.1	Temperature rise over an ambient temperature of 500C for continuous operation at rated continuous thermal current.				
36.1	Winding				
36.2	Oil				
36.3	External surface of the core, metallic parts in contact with or adjacent to insulation.				
37.	Whether CT characteristic curves enclosed.				
37.1	Ratio and phase angle curve				
37.2	Magnetization curves				
37.3	Ratio correction factor curves.				
38.	DATA ON PRIMARY WINDING				
38.1	Rated primary current (A)				
38.2	No. of conductors in one turn				
38.3	No. of turns of primary				
38.4	Material of the primary conductors				
38.5	Size of the primary conductor (Bare/ Insulated (mm x mm)				
38.6	Cross-sectional area of each conductor (mm <sup>2</sup> )				
38.7	Total cross-sectional area of primary winding (mm <sup>2</sup> ) conductors				
38.8	Current density(A/mm <sup>2</sup> )				
	(i) At highest ratio				
	(ii) At intermediate ratio				
	(iii) At lowest ratio				
38.9	Short circuit current density (A/mm <sup>2</sup> )				
	(i) At highest ratio				
	(ii) At intermediate ratio				
	(iii) At lowest ratio				
38.10	Ampere-turn of Primary (AT)				
	(i) At highest ratio				
	(ii)At intermediate ratio				

	(iii) At lowest ratio				
38.11	Length of primary conductor (m)				
38.12	Weight of primary winding (kg.)				
39.	CORE				
39.1	Material and grade of the core				
39.2	Thickness of core (mm)				
39.3	Net Iron cross-sectional area of core (mm <sup>2</sup> )				
39.3.1	Core-1				
39.3.2	Core – 2				
39.3.3	Core – 3				
39.3.4	Core – 4				
39.3.5	Core – 5				
39.4	Mean magnetic path length (cm)				
39.4.1	Core – 1				
39.4.2	Core – 2				
39.4.3	Core – 3				
39.4.4	Core – 4				
39.4.5	Core – 5				
39.5	Whether B-H curve for the core material, used, furnished ? (B-wb/m <sup>2</sup> , H-AT/cm)				
39.6	Whether specific loss vs. flux density graph for the core material used furnished ?				
39.7	Axial length of core (mm)				
39.7.1	Core – 1				
39.7.2	Core – 2				
39.7.3	Core – 3				
39.7.4	Core – 4				
39.7.5	Core – 5				
39.8	Inside diameter / outside diameter of the cores (mm)				
39.8.1	Core – 1				
39.8.2	Core – 2				
39.8.3	Core – 3				
39.8.4	Core – 4				
39.8.5	Core – 5				
39.9	Weight of the core (kg)				
39.9.1	Core – 1				
39.9.2	Core – 2				
39.9.3	Core – 3				
39.9.4	Core – 4				
39.9.5	Core – 5				
40.	SECONDARY WINDINGS				
40.1	Rated secondary current (A)				

40.2	Material of the secondary windings	Insulated Electrolytic grade copper (supper enamel)			
40.3.	Size of the secondary conductor [Bare / Insulated] [mm]				
40.3.1	Core – 1				
40.3.2	Core – 2				
40.3.3	Core – 3				
40.3.4	Core – 4				
40.3.5	Core – 5				
40.4	Cross sectional area of the secondary conductor (mm <sup>2</sup> )				
40.4.1	Core – 1				
40.4.2	Core – 2				
40.4.3	Core – 3				
40.4.4	Core – 4				
40.4.5	Core – 5				
40.5	Current density of secondary windings (A/mm <sup>2</sup> )				
40.5.1	Core – 1				
40.5.2	Core – 2				
40.5.3	Core – 3				
40.5.4	Core – 4				
40.5.5	Core – 5				
40.6	No. of secondary turns				
40.6.1	Core – 1				
40.6.2	Core – 2				
40.6.3	Core – 3				
40.6.4	Core – 4				
40.6.5	Core – 5				
40.7	No. of layers				
40.7.1	Core – 1				
40.7.2	Core – 2				
40.7.3	Core – 3				
40.7.4	Core – 4				
40.7.5	Core – 5				
40.8	No. of turns / layer				
40.8.1	Core – 1				
40.8.2	Core – 2				
40.8.3	Core – 3				
40.8.4	Core – 4				
40.8.5	Core – 5				

40.9	Average length / turn of secondary windings (mm)				
40.9.1	Core – 1				
40.9.2	Core – 2				
40.9.3	Core – 3				
40.9.4	Core – 4				
40.9.5	Core – 5				
40.10	Resistance of the conductor used for secondary winding per meter length at 750C ( $\Omega$ /M)				
40.11	Weight of secondary windings (kg)				
40.11.1	Core – 1				
40.11.2	Core – 2				
40.11.3	Core – 3				
40.11.4	Core – 4				
40.11.5	Core – 5				
41	INSULATION				
41.1	Name and class of insulating material between core and secondary winding.				
41.2	Name/s of Insulating materials between secondary winding and primary windings.				
41.3	Insulating materials used to achieve grading of capacitance.				
42.	DIAMETER OF WINDINGS				
42.1	Inside / outside diameter of secondary windings (mm)				
42.1.1	Inside / outside diameter of secondary windings (mm)				
42.1.1	Core – 1				
42.1.2	Core – 2				
42.1.3	Core – 3				
42.1.4	Core – 4				
42.1.5	Core – 5				
42.2	Inside / outside diameters of primary winding (mm)				
42.3	Minimum clearance from tank (mm)				
42.4	Minimum clearance from secondary to tank (mm)				
43.	TANK AND SECONDARY TERMINAL BOX				
43.1	Material of the CT tank				
43.2	Material of the CT secondary terminal box				



43.3	Thickness of CT tank material (mm)				
43.4	Thickness of CT secondary terminal box material (mm)				
43.5	Zinc coating of the CT tank (gm/m <sup>2</sup> ) as per relevant upto date ISS				
43.6	Zinc coating of the CT secondary terminal box (gm/m <sup>2</sup> ) as per the relevant upto date ISS.				
43.7	Ingress protection rating of the secondary terminal box.				
43.8	Weight of the tank, fittings and other accessories (kg)				
44.	<b>TERMINAL CONNECTOR</b>				
44.1	Manufacturer's name				
44.2	Applicable standard				
44.3	Type				
44.4	Material of connector				
44.4.1	Clamp body				
44.4.2	Bolts and Nuts				
44.4.3	Spring washers				
44.5	Rated current (Amp)				
44.6	Rated terminal load (Kg)				
44.7	Factor of safety				
44.8	Minimum thickness of any part (mm)				
44.9	Weight of clamp complete with hardwares (kg)				
44.10	Type test reports as per IS enclosed				
44.11	OGA drawing enclosed				
45.	<b>INSULATOR</b>				
45.1	Manufacturer's name				
45.2	Type				
45.3	Applicable standards				
45.4	Height (mm)				
45.5	Diameter (top) (mm)				
45.7	Total creepage distance (mm)				
45.8.	Rated voltage (KV)				
45.9	Power frequency withstand voltage for 1 min. dry and wet. (KV – rms)				
45.10	1.2/50 micro-sec impulse withstand voltage (KVP)				
45.11	Corona extinction voltage (KV)				

45.12	Weight (Kg)				
45.13	Maximum allowable span (mm)				
45.14	Cantilever strength (Kg)				
45.15	The drawing enclosed.				
46.	Dielectric dissipation factor at 245/1.732KV (for 220KV C.T) and 145/1.732 KV (for 132 kv C.T.) at ambient temperature.				
47.	Accuracy class of standard C.T. to be used towards determination of ratio errors and phase angle errors for metering cores.				
48.	Whether In house lab of OEM is NABL accredited?				

**ANNEXURE – B**

**CALLIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS / METERS**

Name of the Test	Meters & Equipment required for the corresponding test with range accuracy, make & Sl.No.	Date of Calibration	Due Date of Calibration	Name of the Calibrating Agency	Whether Calibrating Agency is Govt. approved	Whether documents relating to Govt. approval of the calibrating Agency furnished	Whether the meters / equipment fulfil the accuracy class as per calibration report	Whether the calibrating agency has put any limitation towards the use of the particular meter / equipment. If yes state the limitations.	Whether green sticker or Blue Sticker or Yellow Sticker has been affixed on the body of the particular equipment / meter. State the colour of the affixed sticker	In spite of imposed limitations , whether the particular meter / equipment can still be used ? Justify its use for corresponding test (s)	Re-remarks
1	2	3	4	5	6	7	8	9	10	11	12
<b>Signature of the tenderer with Seal &amp; date</b>											

**ANNEXURE – C**

**CHECK-LIST TOWARDS TYPE TEST & SPECIAL TEST REPORTS**

Name of the Type Test & special test	Date of Test.	Name of the Laboratory where the Test has been conducted	Whether the Laboratory is Government approved	Whether the Test report is valid as per Cl.No. 6.1 of TS	Whether the copy of test report in complete shape along with drawings etc. furnished or not ?	Whether the tested Current Transformers fulfil the technical requirements as per TS	If the tested Current Transformer does not fulfil the technical requirements as per this specification, whether the bidder agrees to conduct the particular type test again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative(s) within the specified delivery period.	Remarks
1	2	3	4	5	6	7	8	9

**Signature of the Tenderer with seal and date**

**ANNEXURE – D****CHECK-LIST FOR DELIVERY SCHEDULE**

Sl No.	Description of materials	Quantity	Scheduled Delivery from the date of issue of Purchase order	Destination
1	2		4	5
1	LOT-I: 33 kV Current transformer.			Any site/ store/destination sub- station under the jurisdiction of OPTCL.
	Ratio Accuracy class: 0.2s,			
	Ratio Accuracy class: 0.2s,			
2	LOT-II: 132 kV Current transformer.			
	Ratio Accuracy class: 0.2s.			
	Ratio Accuracy class: 0.2s.			
3	LOT-III: 220 kV Current transformer.			
	Ratio: Accuracy class: 0.2s			
4	LOT-IV: 400 kV Current transformer.			
	Ratio: . Accuracy class: 0.2s			

**Signature of the Tenderer with seal and date**