



ODISHA POWER TRANSMISSION CORPORATION LIMITED

**TECHNICAL SPECIFICATION
FOR
CURRENT TRANSFORMERS**

I: - 33KV CT

- a) **RATIO-400-200A-100/1-1-1A**
- b) **RATIO-800-400-200A/1-1-1A**

II: - 132 KV CT

- a) **RATIO-800-400-200A/1-1-1-1A**
- b) **RATIO-600-300-150A/1-1-1-1A**
- c) **RATIO-400-200A-100/1-1-1-1A**
- d) **RATIO-200-100/1-1-1-1A**

III: - 220 KV CT

RATIO-1200-600-300A/1-1-1-1-1A

IV:- 400 KV CT

RATIO:2000-1000-500/1-1-1-1-1A

TECHNICAL SPECIFICATION FOR 33KV, 132KV, 220 KV & 400 KV CURRENT TRANSFORMERS WITH METERING CORES OF ACCURACY CLASS 0.2S

1.0 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 dead / live tank type, single phase, single unit type current Transformers and CT console(one CT console per 3 CT's) for protection and metering services in 33KV, 132KV, & 220KV and 400 KV solidly grounded system.

Current transformers shall be supplied with common marshalling box in a batch of three CT's along with terminal connectors and other fittings for forming necessary interphase and control room interconnections. The CT console shall be of Aluminum alloy sheets having 3 mm thickness.

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 upto 50⁰C. The C.TS 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.

[i]	Technical specification(TS)	
[ii]	Technical Requirements	Appendix I
[iii]	Quantity and Delivery Schedule (Appendix II)	Appendix II
[iv]	Guaranteed Technical Particulars	Annexure –A
[v]	Calibration Status of testing equipments and meters / Instruments	Annexure – B
[vi]	Check-List towards Type Test Reports	Annexure-C
[vii]	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 0.2S accuracy class of metering cores with the following data / information etc.

- [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, failing submission of the above particulars with the offer, the tender may not be considered for evaluation.

2.0 STANDARDS.

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

Sl. No.	Standard Ref. No.	Title
1	IEC-44	Instrument transformer-measurement of PDS
2.	IEC-60	High Voltage Testing Technique.
3.	IEC-171	Insulation co-ordination
4.	IEC-185	Current Transformers.
5.	IEC-270	Partial Discharge Measurement
6.	IEC-8263	Method for RIV Test on High Voltage Insulators.
7.	IS-335	Insulating oil for Transformers
8.	IS:2071	Method of High Voltage Testing
9.	IS:2099	High Voltage porcelain Bushings
10.	IS:2147	Degree of Protection Provided by Enclosures for Low Voltage Switchgear and Control.
11.	IS:2165	Insulation Co-ordination for equipment of 100KV and above
12.	IS:2705 [Part-I to IV)	Current Transformers
13.	IS:3347	Dimensions of Porcelain Transformer Bushing
14.	IS:5621	Specification for Large Hollow Porcelain for use in Electrical installation.
15.	IS:4201	Application guide for CTS
16.		Indian Electricity Rules, 1956
17.	IS:13072 –of1991	SF6 Gas (for 220kv SF6 gas filled CTs only)
18.	IEC:60376	SF6 Gas(for 220kv SF6 gas filled CTs only)

2.2 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 1 (one) copy of the reference standards in English language shall be furnished along with the offer.

2.3 The supplier is to furnish the latest edition of the standards as mentioned above from SI.1 to SI.15 with their amendments, if any, at their own cost, if required by the Purchaser.

2.4 All the above alongwith 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.

3.0 CLIMATIC & SERVICE CONDITIONS :

3.1 The current Transformers are required to operate satisfactorily under the following conditions.

[a]	Maximum ambient temperature	50 ⁰ C
[b]	Minimum ambient temperature	0 ⁰ C
[c]	Maximum daily average ambient air temperature	45 ⁰ C
[d]	Maximum relative humidity	100%
[e]	Average no. of rainy days in a year.	120 days
[f]	Average annual rainfall	150 cm
[g]	Maximum wind pressure	260 Kg/Sq.m
[h]	Altitude not exceeding	1000 m

3.2 EARTHQUAKE INCIDENCE

The current Transformers are to be designed to withstand earthquakes of an intensity equivalent to seismic acceleration of 0.3g in the horizontal direction and 0.15g in the vertical direction, where 'g' stands for acceleration due to gravity.

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

4.0 PUCHASER'S AUXILIARY POWER SUPPLY :

4.1 Following power supplies shall be made available at site.

- (a) A.C. Three phase, 415V, 50HZ earthed
- (b) A.C. Single Phase, 240V, 50HZ earthed.
- (c) 220 V D.C. ungrounded.

4.2 All the equipments and devices shall be capable of continuous satisfactory operation on AC and DC supplies of normal voltage mentioned above with the variation given below.

[a]	AC voltage variation	± 10%
[b]	Frequency variation	± 5%
[c]	Combined voltage and frequency variation	± 10%
[d]	DC Voltage Variation	<u>190V to 240V</u>

4.3 The supplier shall make his own arrangements for the power supplies other than those specified under clause 4.1 above.

5.0 GENERAL TECHNICAL REQUIREMENTS :

5.1 The **220 KV/132KV/33 KV** C.T. shall be of **dead / 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. *The **400 KV** CTs may be of **live tank** design.*

5.2 For compensation of variation in the oil volume due to ambient variation, nitrogen cushion / metal bellows shall be used. Rubber diaphragms shall not be permitted for this purpose.

5.3 The C.T. secondary terminals shall be brought out in a weather proof terminal box. The terminal box shall be provided with removable gland plate 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 stud-type and provided with ferrules indelibly marked or numbered. The terminals shall be rated for not less than 10 Amps. The terminal box shall be dust and vermin proof. Suitable arrangements shall be made for drying of air inside the secondary terminal box. 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.

5.4 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.

5.5 The C.T. shall be provided with non-corrosive, legible name plate with the information, specified in the relevant standards, duly engraved/punched on it.

5.6 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, if provided to facilitate factory processing should be properly sealed before despatching the C.T., The method adopted for hermetic sealing shall be described in the offer

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

5.8 The instrument security factor of metering core shall be low enough and not greater than '5'. This shall be demonstrated on all the ratios of the metering core in accordance with procedure, specified in IEC-185 OR IS:2705. In case the instrument security factor of 5 or less is not possible to be achieved on higher ratios, auxiliary CTS of ratio 1/1 and 0.2S accuracy class shall be deemed to be included in the supplier's

scope of supply. This shall also be specifically brought out by the supplier in his offer. However, all parameters, specified shall have to be met treating auxiliary CT/ reactor as an integral part of the current Transformer. The auxiliary C.TS/reactor shall be inbuilt construction of the C.TS.

5.9 Current transformers' guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

5.10 For 245 KV, 145 and 36 KV Current Transformers, characteristics shall be such as to provide satisfactory performance for burdens ranging from 25% to 100% of rated burden over a range of 5% to 120% of rated current in case of metering CTS and upto accuracy limit factor / knee point voltage in case of relaying C.TS.

5.11 Current Transformers shall be designed so as to achieve the minimum risk of explosion in service. The Bidder shall bring out in his offer, the measures taken to achieve this.

5.12 PRIMARY WINDING

5.12.1 Primary winding may be either ring type or hair pin type or the type, which has been type tested. For 220KV, 132KV, and 33KV class C.Ts, the rated extended primary current shall be 120% on all cores of the C.Ts, specified in tables.

5.12.2 The primary windings of current transformers shall be constructed of high purity, annealed, high conductivity electrolytic copper/Aluminium meeting to the requirements of IEC 28/IS:2705.

5.13 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.

5.14 PRIMARY TERMINALS

The primary terminals shall be heavily tinned electrolytic copper or Aluminium alloy of 99.9% conductivity. The minimum thickness of tinning shall be 1.5 microns.

5.15 SECONDARY TERMINALS

5.15.1 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.

5.15.2 The current transformer shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges. 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 energising the Current Transformer.

5.15.3 The secondary terminals shall be provided with shorting arrangements.

5.16 CORE

Each core of the Current Transformer shall be of torroidal 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.

5.17 TANK

5.17.1 Both expansion chambers and the tanks of the Current Transformers shall be made up of high quality steel, 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 tanks along with all ferrous parts shall be galvanised as per relevant standard.

5.17.2 The metal tanks shall have bare minimum number of welded joints so as to minimise 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.

5.18 SECONDARY TERMINAL BOX :

5.18.1 Secondary Terminal Boxes shall be weather proof with a rating not less than IP 55

5.18.2 All secondary terminals shall be brought out in a compartment on one side of each current transformer for easy access.

5.18.3 The exterior of this terminal box shall be of aluminium alloy sheet of minimum 3 mm thickness.

5.18.4 A terminal board which shall have arrangement for series / parallel connection and arrangement for shorting of secondary terminals shall be provided. For 220KV and

132KV C.Ts, at least one of the ratios should be achieved through secondary tapping(s). i.e primary re-connection is allowed for two ratios where as third ratio is to be achieved by provision of secondary tapping or alternatively all the stipulated ratios may be achieved through secondary tapplings. For 132KV C.T. of ratio-400-200A/1-1-1-1A, the specified ratios may be obtained by Series parallel connection or by secondary tapping.

5.18.5 The terminal box shall be provided with a removable cable gland plate at bottom for mounting cable glands for 1.1KV PVC sheathed 4 x 4 Sq. mm stranded copper conductor cables.

5.18.6 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 rain water.

5.18.7 All terminals shall be clearly marked with identification number to facilitate connection to external wiring.

5.18.8 The secondary box of the CT's also of high quality steel materials with galvanizing as per standard (IS).

5.18.9 The CT console to be provided (one per 3 CT's) is also of high quality steel with proper galvanization.

5.19 PORCELAIN HOUSING

5.19.1 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.

5.19.2 The bushings of the Current Transformers shall conform to the latest edition of IS:2099. The hollow porcelain insulator shall conform to the latest edition of IS:5621.

5.19.3 The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength.

5.19.4 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.

5.19.5 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 ionisation.

5.19.6 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.

5.19.7 Oil level gauge and convenient means of filling, sampling and draining of oil should be provided.

5.19.8 End shields should be provided for distribution of stresses.

5.19.9 Corona shields for bushings, if required should be provided.

5.20 INSULATING MEDIUM (OIL TYPE)

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. The current Transformers shall be supplied, filled with purified oil completely.

PREVENTION OF OIL LEAKAGE AND ENTRY OF MOISTURE:

5.20.1 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.

5.20.2 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.

5.20.3 For gasketed joints, wherever used, nitrite butyl rubber gaskets shall be used. The gasket shall be fitted in properly machined groove with adequate space for accommodating the gasket under compression.

5.21 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 :

- (a) Oil level gauge.
- (b) Oil filling hole and cap.
- (c) Pressure relieving device.
- (d) Phase terminal connectors.
- (e) Lifting lugs for core and windings, bushings and complete Current Transformers.

(f) Tank earthing pads/terminals with necessary nuts, bolts and washers for connecting to purchaser's earth strip.

(g) Name / Rating plate.

5.21.1 (A) OIL LEVEL GAUGE :

An 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.

5.21.2 PRESSURE RELIEVING DEVICE :

Each Current Transformer shall be provided with a pressure relieving device so as to protect bushing of the Current Transformer even under unfavorable Conditions. In case of non provision of the PRD, the same should be brought out clearly in the offer with detailed explanation and proof.

5.21.3 (A) OIL DRAIN COCK :

An oil drain cock alongwith a stop cock shall be provided in the bottom flange so as to permit taking of oil samples for testing, if required.

5.21.4 EARTHING :

Metal tank of each Current Transformer shall be provided with two separate earthing terminals for bolted connection to 50mm X 6mm and 75X10 mm flat, to be provided by the purchaser for connection to station earth-mat.

5.21.5 LIFTING ARRANGEMENT :

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 housing or the tanks during lifting for installation / transport. Necessary string guides shall be offered which shall be of removable type.

5.21.6 NAME PLATE & MARKING :

5.21.6.1 The Current Transformer shall be provided with non-corrosive, legible name plate with the information specified in relevant standards, duly engraved/punched On it.

5.21.6.2 A schematic drawing indicating the connections shall be provided in the interior of the Terminal box.

5.21.7 TERMINAL CONNECTORS :

All the Current Transformers shall be provided with bimetallic solderless clamp type, rigid type terminal connectors, suitable for

- (i) 33KV C.T. – ACSR ‘MOOSE’ conductor.
- (ii) 132KV C.T. – ACSR ‘MOOSE’ conductor.
- (iii) 220 KV C.T. – ACSR ‘MOOSE’ conductor & also suitable for AC tube of 4 inchs.
- (iv) 400 KV CT – suitable for Al tube of 4 inch or more

Each terminal connector shall be of universal type, suitable for both horizontal and vertical connections to the transmission line conductors / station bus bars.

5.21.7.1 Terminal connectors shall be manufactured and tested as per IS:5561.

5.21.7.2 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

5.21.7.3 No part of a clamp shall be less than 10mm thick.

5.21.7.4 All ferrous parts shall be hot-dip galvanised conforming to relevant standard.

5.21.7.5 For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body.

5.21.7.6 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

5.21.7.7 Connectors shall be designed to be corona free in accordance with the requirements, stipulated in IS:5561.

6.0 TEST :

6.1 TYPE TESTS & SPECIAL TESTS:-

The current transformers, offered should have been subjected to the following type tests and Special Tests in Government approved test laboratory. The bidder shall furnish four sets of type test and Special Tests reports along with the offer for 0.2S accuracy class CTs. These tests should not have been conducted earlier than five years from the date of opening of the bid. For any change in the design/type already type tested and the design/type offered against this specification, the purchaser reserves the right to demand repetition of some or all type & special tests without any extra cost to OPTCL in the presence of OPTCL's representative(s) at the cost of the supplier.

- (a) Lightning Impulse Voltage Test.
- (b) High Voltage power frequency wet withstands voltage Test.
- (c) Short time current test.
- (d) Temperature rise test.

(e) Determination of errors or other characteristics according to the requirements of the appropriate designation and accuracy class as per individual parts of IS:2705.

(f) Instrument Security Factor Test.

(g) IP-55 Test on Secondary Terminal Box.

(In addition to the above tests, following type tests/special tests should have been conducted exclusively for 220KV/400 KV C.T)

(h) Radio Interference voltage test.

(i) Corona Extinction test.

(j) Thermal stability test.

(k) Thermal Co-efficient test.

(l) Fast transient test.

(m) Seismic withstand test.

(n) Mechanical terminal load on bushing.

(o) Magnetisation and internal burden tests..

(p) Effectiveness of sealing tests.

(q) Capacitance and dielectric loss angle test. (For 400 KV, 220KV & 132KV C.Ts.)

N.B :

- Lightning Impulse Test, switching Impulse Voltage test and High Voltage power frequency wet withstand voltage Tests should have been carried out on the same current transformer.

- After the current transformers have been subjected to lightning Impulse Test, and High Voltage power frequency wet withstand voltage tests, these must have been subjected to all the routine tests as per IS:2705 (Part-I to IV).

6.2 ROUTINE TESTS :

The following routine tests shall be conducted on each Current Transformer in the presence of OPTCL's representative(s) for which no charges will be payable by OPTCL. No sampling will be allowed.

(i) Appearance and Dimensional Check.

(ii) Verification of Terminal Marking and polarity.

(iii) Verification of all individual parts / components of the Current Transformer so as to ensure to have complied the above specification.

(iv) Measurement of Insulation Resistance.

(v) Power Frequency Dry withstands Test on Primary and Secondary winding including primary intersections.

(vi) Over – Voltage Inter turn test.

(vii) Partial discharge Test for 400 KV, 220 KV and 132KV C.TS

- (viii) Knee point voltage and Excitation current measurement for 'PS' class cores.
- (ix) Secondary winding resistance measurement.
- (x) Determination of errors.
- (xi) ISF Test.
- (xii) Leakage Test.
- (xiii) Magnetization Characteristics of the Current Transformers.
- (xiv) Turn ratio error on 'PS' class cores.
- (xv) Measurement of capacitance for 400 KV, 220KV and 132KV C.TS.
- (xvi) Measurement of tan delta at 0.3, 0.7, 1.0 and $1.1\text{UM}/\sqrt{3}$ for 400 KV, 220KV & 132KV C.Ts.
- (xvii) Checking of SF6 gas Pressure. (for SF6 gas filled CTs)

- The Method For Conducting Partial Discharge Test.

The test circuit for the measurement of partial discharge (PD) should have been in accordance with sub-clause 4.2 of IEC-270. The applied voltage should be raised to the rated voltage of the Current Transformers and should have been maintained for a period greater than or equal to 10 seconds. The voltage should have been reduced to measuring voltage of

1.1 X145/245/400KV rms/ phase

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to ground and maintained for a period greater than or equal to 1 minute. The PD should not exceed 10 picco-coulombs.

7.0 **INSPECTION :**

7.1 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.

7.2 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.

7.3 No material shall be despatched from its point of manufacture unless the material has been satisfactorily inspected, tested and despatch clearance issued. However, the purchaser reserves the right to alter the despatch schedule, attached to this specification without any extra financial liability to OPTCL.

7.3.1 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 equipments are found to be defective.

8.0 QUALITY ASSURANCE PLAN :

8.1 The Bidder shall invariably furnish following information alongwith his offer.

- (i) Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards, according to which the raw materials are tested, list of tests, normally carried out on raw material in presence of Bidders" 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 test and inspections.
- (vi) Special features provided in the equipment to make it maintenance free.
- (vii) List of testing equipments, meters available with the Bidder for final testing of equipment specified and test plant limitation, if any, vis-à-vis the type, acceptance and routine tests, specified in the relevant standards. These limitations shall be very clearly brought out in the offer.
- (viii) All the testing equipments, meters etc, should have been calibrated in a Government approved laboratory. The Bidder must submit the list of testing equipments and meters test-wise as per Annexure – B of the Technical Specification.

8.2 The supplier shall within 30 days of placement of order submit the following information to the purchaser.

- (i) List of raw materials as well as bought out accessories and the names of the materials as well as bought-out accessories and the names of sub-suppliers, selected from those, furnished alongwith the offer.
- (ii) Type Test Certificates of the raw material and bought out accessories.
- (iii) Quality Assurance plan (QAP) with hold points for the purchaser's inspection. The QAP and hold points shall be discussed between the purchaser and the supplier before the QAP is finalized.

8.3 The supplier shall submit the routine test certificate of bought-out items and raw materials at the time of acceptance testing of the fully assembled equipment.

9.0 DOCUMENTATION :

9.1 All drawings shall conform to relevant Indian Standard as per relevant IS. All drawings shall be in ink and suitable for microfilming. All dimensions and data shall be in S.I. units.

9.2 The supplier shall furnish four sets of following drawings/documents along with his offer for 0.2S accuracy class metering core CTs.

- (a) General outline and assembly drawings of the Current Transformers.
- (b) Sectional views showing.
 - (i) General constructional features.
 - (ii) Materials / gaskets / sealing used.
 - (iii) The insulation of the winding arrangement, method of connection of the primary / secondary winding to the primary / secondary terminals etc.
- (c) Schematic drawing
- (d) Rating and Diagram plate.
- (e) Secondary Terminal Box.
- (f) Assembly Sectional view of Primary Terminal
- (g) Assembly drawing for secondary terminal.
- (h) The detailed dimensional drawing of Porcelain Housing such as ID, OD, thickness and Insulator details such as height, profile of petticoats, angle of inclination and gap between successive petticoats, total creepage distance etc.
 - (i) Sectional view of Pressure Release device.
 - (j) Drawing showing details of Oil level Indicator.
- (k) All type and special test reports relating to tests, as mentioned at Cl. No. 6.1 of this Technical Specification.
- (l) Ratio and phase angle error curves for CTS.
- (m) Magnetization characteristic curves such as B-H curves and sp.loss vs. flux density curves.
- (n) Drawings for Terminal Connector.

10.0 TEST REPORTS :

- (i) One set of type test and special test reports shall be furnished to the purchaser with the tender offer for 0.2S accuracy class metering core CTs.
- (ii) Copies of acceptance test reports and routine test reports shall be furnished to the purchaser. One copy will be returned, duly certified by the purchaser and only thereafter shall the materials be despatched.
- (iii) All records of routine test reports shall be maintained by the supplier at his works for periodic inspection by the purchaser.
- (iv) All test reports of tests, conducted during manufacture shall be maintained by the supplier. These shall be produced for verification as and when required for by the purchaser.

11.0 SPARE PARTS

A list of spare parts recommended for five years operations for each Current Transformer shall be furnished with the tender. The purchaser will decide the actual quantities of spare parts to be ordered on the basis of the list and the item wise price of spare parts.

12.0 The necessary galvanized flanges, bolts etc. for the base of the Current Transformers shall be supplied without any extra cost to the purchaser.

13.0 PACKING AND FORWARDING :

13.1 The equipment shall be packed in suitable crates so as to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. A material found short inside the packing cases shall be supplied by supplier without any extra cost.

13.2 Each consignment shall be accompanied by a detailed packing list containing the following informations :-

- (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 materials indicating contents of each package.

13.3 The supplier shall ensure that the bills of materials are approved by the purchaser before despatch.

13.4 Any tender without complete information, as asked for in the above specification, is likely to be rejected.

APPENDIX-I**TECHNICAL REQUIREMENT FOR 33 KV, 132 KV & 220 KV CURRENT TRANSFORMERS**

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

Sl. No.	Item.	Specification		
		36 KV	145 KV	245KV
1	Type of CT/Installation.	Single phase, dead tank, oil filled, hermetically sealed, outdoor, self-cooled.(For 220KV SF6 gasfilled CTs-Single phase, live tank, hermetically sealed, out door,self-cooled)		
2	Type of mounting.	Pedestal type		
3	Suitable for system frequency.	50 HZ \pm 5 %		
4	Rated voltage (KV rms)	33	132	220
5	Nominal system voltage (KV rms)	33	132	220
6	Highest system voltage (KV rms)	36	145	245
7	Current ratio (A/A)	a) 400-200A-100/ 1-1-1A b)800-400-200A/1-1-1A	a) 800-400-200A/1-1-1-1A b) 600-300-150A/1-1-1-1A c) 400-200A-100/1-1-1-1A d) 200-100/1-1-1-1A	1200-600-300A/1-1-1-1-1A
8.	Method of earthing the system where the current transformer will be installed.	Solidly effectively earthed.		
9	Rated continuous thermal current (A)	120 % of rated primary current		
10	Acceptable limit of temperature rise above 50°C ambient temperature for continous 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	Less than 10 picco coulombs		
12.	Maximum radio interference voltage at 1.1 times the maximum rated voltage.	Less than 500 micro volts		
13.	1.2/50 micro second lightning impulse withstand voltage (KVP) (dry)	170	650	1050
14.	1 minute dry power frequency withstand voltage primary (KV rms)	70	275	460
15.	Switching Impulse with stand and voltage (KVP)	--	-	-
16.	1 Minute dry power frequency withstand voltage secondary (KV rms)	3	3	3
17.	Minimum creepage distance of porcelain Housing (mm)	900	3625	6125
18.	Rated short time withstand current for 1 second at all ratios (KA rms)	25KA	31.5 KA	

		40KA
19.	Instrument security factor at all ratios for metering core.	Not more than 5.0
20.	Minimum rated short time thermal current density of the primary winding at all ratios (A/mm ²)	As per clause No9.6.3- Note of IS: 2705 (Part-I)/1992 Enclosed in separate sheets for each rating of the Current Transformers. Torroidal type 0.15g (Vertical) 0.3g (Horizontal) 0.005 or less
21.	Application, current ratio, output burden, accuracy class, minimum knee point voltage, secondary winding resistance, maximum	
22.	Type of core	
23.	Seismic acceleration	
24.	Dielectric dissipation factor at 245/1.732KV (for 220KV C.T) & 145/1.732KV (for 132 KV C.T.) at ambient temperature	
25.	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.

400 KV Current transformer Selection philosophy

The following shall be adopted for selecting the type of current transformers:

- Insulation : Oil impregnated paper/ porcelain.
- Type : Dead / live Tank type
- Voltage Class : 400kV
- Application : Outdoors

IMPORTANT: ALSO REFER THE SPECIFICATION OF CT,S MENTIONED IN ABOVE SECTIONS.

General

Current transformers shall comply with IEC 60044-1/ IS 2705.

Current transformers shall be supplied with common marshalling box in a batch of three CT's along with terminal connectors and other fittings for forming necessary interphase and control room interconnections.

Current transformers shall operate satisfactorily in system with high **X / R** ratio.(Tp=100ms)

Current transformer tanks along with top metallic parts shall be hot dip galvanised. Spray galvanisation as per IS-5905 with 250 micron thickness of Zinc followed by finishing coats of a suitable primer with sealer.

The impregnation details along with tests and checks to ensure successful completion of impregnation cycle shall be furnished for Project Manager's approval.

Bellows if used for expansions of insulating oil shall be tested in accordance with relevant standards. The details shall be to the approval of the Project Manager.

The instrument transformers shall be designed for use in geographic and meteorological condition as stipulated (GTR)

Constructional features

The secondary windings of current transformers shall be as stated in the schedules and shown in the attached single line diagrams; the secondary windings shall meet the requirements stated in the tables attached under this section of this Specification.

Each current transformer secondary winding circuit shall be earthed at one point only i.e. in the control room.

Terminal boxes shall be weather proof with a rating not less than IP 55. The terminal box shall be provided with a gland plate suitable for PVC insulated PVC sheathed 10 core, 2.5 mm² stranded copper conductor cables.

Where adequate earth screens are fitted between the primary and secondary windings earthing of the secondary winding shall be via a link mounted in the related protection or instrument cubicle. Where such earth screens are not fitted a separate earth system may be necessary.

Wherever possible the connection to earth shall be on the side of the S2 terminals.

Necessary markings for connections shall be provided on each CT at load termination end points and at the associated terminal blocks. Provision shall be provided for short circuiting and grounding of the CT secondary at the terminal blocks.

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

Core laminations shall be of cold rolled grain oriented silicon steel or other equivalent alloys. The cores used for protection shall produce undistorted secondary current under transient conditions at all ratios, with specified CT parameters.

The expansion chamber at the top of the porcelain insulators should be suitable for expansion of oil.

Facilities shall be provided at terminal blocks in the marshalling box for star delta formation, short circuiting and grounding of CT secondary terminals.

A wiring diagram plate for the interconnections of the three single phase CT's shall be provided inside the marshalling box.

The physical disposition of the secondary cores shall preferably be in the same order as that given in the tables in this section of the specification.

Current transformers shall be suitable for mounting on lattice support structure as stipulated elsewhere in this Specification.

Technical specification of current transformers

Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

For 400 kV class CT's the rated extended primary current of the CT's shall be 200 % of rated primary on all except 2000/1 tap ratio. On 2000/1 ratio the rated extended primary current shall be 120%. However, at 2000/1 ratio the CT shall be thermally rated for 200 % for 15 minutes and 120 % continuous.

For 420kV current transformers, characteristics shall be such as to provide satisfactory performance for burdens ranging from 25 % to 100 % of rated burden over a range of 10 % to 100 % of rated current in case of metering CT's, and up to the accuracy limit factor / knee point voltage in case of relaying CT's.

Current transformers shall be suitable for horizontal transportation. It shall be ensured that the CT is able to withstand all the stresses imposed on it while transporting and there shall be no damage in transit.

For 420 kV CT's the instrument security factor at all ratios shall be less than five (5) for metering cores. If any auxiliary CT's or reactors are used in the current transformers then all parameters specified shall have to be met treating auxiliary CT's or reactors as an integral part of the current transformer. The auxiliary CT's or reactors shall preferably be inbuilt construction of the CT's. In case these are to be mounted separately they shall be mounted in the central marshalling box suitably wired up to the terminal blocks.

Current transformers shall be designed so as to achieve the minimum risks of explosion in service. The Bidder shall bring out in his offer, the measures taken to achieve this.

420 kV and 245 kV current transformers shall be suitable for high speed auto reclosing.

Oil impregnated current transformers

Post type current transformers using oil impregnated paper as the insulant may be of the bar, single or multi-turn primary and shall be hermetically sealed and conform to the requirement of IEC 185.

In case bar primary inverted type current transformers are offered the manufacturer will meet following additional requirements :

- The secondary shall be totally encased in metallic shielding providing a uniform equipotential surface for even electric field distribution.
- The lowest part of the insulation assembly shall be properly secured to avoid any risk of damage due to transportation stresses.
- The upper part of insulation assembly resting on primary bar shall be properly secured to avoid any damage during transportation.
- Nitrogen if used for hermetic sealing should not come in direct contact with oil.

The primary windings of current transformers shall be constructed of high purity, annealed, high conductivity copper or electrolytic grade aluminium meeting to the requirements of IEC 28. secondary windings shall be constructed out of copper only.

Each current transformer shall be impregnated and filled with oil of the grade specified in IEC 296.

The following facilities shall be provided:

- Visual means of determining the level of oil within the transformers from ground level.
- Oil drain cock and sampling device where applicable.
- Earth terminal of adequate dimensions so arranged that the earth connection cannot be inadvertently removed.

The creepage and flashover distances of the support insulator shall be dimensioned to suit the outdoor service conditions specified in the schedules.

Technical parameters

In addition to meeting the system technical parameters the parameters given in the following tables shall apply.

**SPECIFIED PARAMETERS FOR KPV,
SEC. WDG. RESISTANCE, EXCITATION
CURRENT FOR PS CLASS CORES**

AND

BURDEN, ISF FOR METERING CORES

OF

ACC.CLASS 0.2S

FOR

33KV,132KV,220KV & 400KV C.TS

REQUIREMENT FOR 245 KV CURRENT TRANSFORMERS OF RATIO

1200-600-300/1-1-1-1-1A

No. of Cores	Core No.	Application	Current ratio	Output burden in VA	Accuracy class as per IS: 2705	Minimum knee point voltage (V _k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V _k in mA at all ratios.	Instrument security factor
1	2	3	4	5	6	7	8	9	10
5	1	Bus different oil check	1200/1 600/1 300/1	- - -	PS PS PS	600	5.0	40	
	2	Bus differential main	1200/1 600/1 300/1	- - -	PS PS PS	600	5.0	40	
	3.	Metering	1200/1 600/1 300/1	30 30 30	0.2S 0.2S 0.2S	- - -	-	- - -	1200/1:-5or less 600/1:-5 or less 300/1:-5 or less
	4.	Transformer back up / line protection	1200/1 600/1 300/1	- - -	PS PS PS	1200	5.0	40	
	5.	Transformer back up/line protection	1200/1 600/1 300/1	- - -	PS PS PS	1200	5.0	40	

REQUIREMENT FOR 145 KV CURRENT TRANSFORMERS OF RATIO

a) 800-400A-200A/1-1-1-1A

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy class as per IS: 2705	Minimum knee point voltage (V_k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V_k in mA at all ratios.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10
4	1.	Protection	800/1 400/1 200/1	- - -	PS PS PS	400	4	30	-
	2.	Metering	800/1 400/1 200/1	30 30 30	0.2S 0.2S 0.2S	- - -	- - -	- - -	5 or less 5 or less 5 or less
	3.	Back up	800/1 400/1 200/1	- - -	PS PS PS	400	4	30	-
	4.	For owner's future use.	800/1 400/1 200/1	- - -	PS PS PS	400	4	30	-

REQUIREMENT FOR 145 KV CURRENT TRANSFORMERS OF RATIO

b) 600-300A-150A/1-1-1-1

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy class as per IS: 2705	Minimum knee point voltage (V_k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V_k in mA at all ratios.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10
4	1.	Protection	600/1 300/1 150/1	- - -	PS PS PS	500	5	60	-
	2.	Metering	600/1 300/1 150/1	30 30 30	0.2S 0.2S 0.2S	-	-	-	5 or less 5 or less 5 or less
	3.	Back up	600/1 300/1 150/1	- - -	PS PS PS	500	5	60	-
	4.	For owner's future use.	600/1 300/1 150/1	- - -	PS PS PS	500	5	60	-

REQUIREMENT FOR 145 KV CURRENT TRANSFORMERS OF RATIO

c) 400-200A-100/1-1-1-1A

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy class as per IS: 2705	Minimum knee point voltage (V_k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V_k in mA at all ratios.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10
4	1.	Protection	400/1 200/1 100/1	- - -	PS PS PS	800	4	30	-
	2.	Metering	400/1 200/1 100/1	30 30 30	0.2S 0.2S 0.2S	-	-	-	5 or less 5 or less
	3.	Back up	400/1 200/1 100/1	- - -	PS PS PS	800	4	30	-
	4.	For owner's future use.	400/1 200/1 100/1	- - -	PS PS PS	800	4	30	-

REQUIREMENT FOR 145 KV CURRENT TRANSFORMERS OF RATIO

d) 200A-100/1-1-1-1A

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy class as per IS: 2705	Minimum knee point voltage (V_k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V_k in mA at all ratios.	Instrument security factor at all ratios
1	2	3	4	5	6	7	8	9	10
4	1.	Protection	200/1 100/1	- -	PS PS	800	4	30	-
	2.	Metering	200/1 100/1	30 30	0.2S 0.2S	-	-	-	5 or less 5 or less
	3.	Back up	200/1 100/1	- -	PS PS	800	4	30	-
	4.	For owner's future use.	200/1 100/1	- -	PS PS	800	4	30	-

REQUIREMENT FOR 36KV CURRENT TRANSFORMERS OF RATIO

(a) 400-200A-100/1-1-1A

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy class as per IS: 2705	Minimum knee point voltage (V_k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V_k in mA at all ratios.	Instrument security factor
1	2	3	4	5	6	7	8	9	10
3.	1	Protection	400/1 200/1 100/1	- - -	PS PS PS	400	5.0	25	
	2.	Metering	400/1 200/1 100/1	30 30 30	0.2S 0.2S 0.2S	-	-	-	5 or less 5 or less 5 or less
	3.	Protection	400/1 200/1 100/1	- - -	PS PS PS	400	5.0	25	-

REQUIREMENT FOR 36KV CURRENT TRANSFORMERS OF RATIO **(b) 800-400-200A/1-1-1A**

No. of Cores	Core No.	Application	Current Ratio	Output burden in VA	Accuracy class as per IS: 2705	Minimum knee point voltage (V_k) at all ratios in volts.	Maximum CT resistance RCT in ohms at 75 °C at all ratios	Maximum excitation current at V_k in mA at all ratios.	Instrument security factor
1	2	3	4	5	6	7	8	9	10
3.	1	Protection	800/ 1 400/1 200/1	- - -	PS PS PS	450	10	40	
	2.	Metering	800/1 400/1 200/1	30 30 30	0.2S 0.2S 0.2S	-	-	-	5 or less 5 or less 5 or less
	3.	Protection	800/1 400/1 200/1	- -	PS PS PS	450	10	40	-

Requirements for 420 kV current transformers

No. of cores	Core No.	Application	Current ratio	Output burden in VA	Accuracy class as per IEC 185	Minimum knee point voltage V_k corresponding to tap position in Volts	Maximum CT resistance R_{CT} in Ω corresponding to tap position	Maximum excitation Current at V_k in mA corresponding to tap position	Remarks
5	1	Bus differential Check	2000/1 1000/1	PS PS	2000 1000	10 5	30 on 2000/1 tap 60 on 1000/1 tap	
	2	Bus differential Main	2000/1 1000/1	PS PS	2000 1000	10 5	30 on 2000/1 tap 60 on 1000/1 tap	
	3	Metering	2000/1 1000/1 500/1	60 60 60	0.2S 0.2S 0.2S	10 5 2.5	
	4	Transformer / line Protection	2000/1 1000/1 500/1	PS PS PS	4000 2000 1000	10 5 2.5	30 on 2000/1 tap 60 on 1000/1 tap 120 on 500/1 tap	
	5	Transformer back up / line Protection	2000/1 1000/1 500/1	PS PS PS	4000 2000 1000	10 5 2.5	30 on 2000/1 tap 60 on 1000/1 tap 120 on 500/1 tap	

REMARKS: THE BIDDERS ARE ALSO TO FILL-UP THE GTP FOR 400 KV CT'S AS PER THE STANDARD FORMAT OF OPTCL MENTIONED ABOVE FOR OTHER CLASS CT,S. SAME GTP TO BE FILLED-UP.

ANNEXTURE – B.
CALLIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS / METERS

Name of the Test	Meters & Equipments 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 / equipments fulfill 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	Inspite of imposed limitations, whether the particular meter / equipment can still be used ? Justify its use for corresponding test (s)	Re-marks
1	2	3	4	5	6	7	8	9	10	11	12

Signature of the tenderer with seal & date

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 alongwith drawings etc. furnished or not ?	Whether the tested Current Transformers fulfill the technical requirements as per TS	If the tested Current Transformer does not fulfill 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