



**ODISHA POWER TRANSMISSION CORPORATION LIMITED**

**TECHNICAL SPECIFICATION**

**FOR**

**33 KV, 132KV, 220KV INDUCTIVE &  
132KV, 220KV, & 400 KV  
CVT & IVT**

# TECHNICAL SPECIFICATION FOR 33 KV,132KV ,220KV INDUCTIVE & 132KV, 220KV,& 400 KV CAPACITIVE VOLTAGE TRANSFORMER

## 1.0 SCOPE :

- 1.1. This specification provides for the design, manufacture, assembly inspection and testing at the manufacturer's works, packing and delivery FOR [Destinations] of outdoor mounted type, single phase, oil filled, self-cooled, single unit type Inductive voltage transformers for 33 KV, 132KV,220 KV systems, & Capacitive Voltage Transformers for,132KV, 220kv & 400 KV system to be used for voltage indication, supply of potential to tariff meters, relays for feeder protection in Grid Sub-stations of OPTCL, ODISHA.. In addition to the above functions the 400 KV 220kv, 132KV CVT shall be suitable for carrier coupling..
- 1.2 The IVTs shall be complete in all respects with insulators, bimetallic connectors, fixing details etc. as described herein.
- 1.3 Bidders are required to quote for 0.2 accuracy class [metering winding] for 33 KV, 132KV, 220 Kv IVTs &132KV, 220kv,400 Kv CVTs in the following manner.
- (a) Guaranteed Technical Particulars.
  - (b) Technical literatures, brochures and drawings as per this specification.
  - (c) Type Test reports.
  - (d) List of orders, executed and Users' certificates with offer, failing submission of the above particulars with the offer, the tender may not be considered for evaluation.

## 2.0 Following is the list of documents constituting this Specification.

- (i) Technical Specification (TS).
- (ii) Technical requirements. - [Appendix-I]
- (iii) Quantity and delivery schedule. - [Appendix-II]
- (iv) Guaranteed Technical Particulars. - [Annexure-A]
- (v) Calibration status of testing equipment and meters/Instruments. - [Annexure-B]
- (vi) Check list towards Type Test Reports.- [Annexure-C]
- (vii) Check list for Delivery Schedule. - [Annexure-D].

N.B.:- Annexure-A,B,C & D are to be filled up by the Bidder.

## 3.0 STANDARDS:-

- 3.1 The IVTs & CVTs shall conform in all respects to high standards of Engineering, design, workmanship and latest revisions of relevant standards at the time of offer and the Purchaser shall have the power to reject any work or material which in his judgement is not in full accordance therewith.

Except to the extent modified in the specifications, the IVTS & CVTs (CVTs shall be in line with IEC 61869-5/1) shall conform to the latest editions and the amendments of the standards listed hereunder:

Sl. No.	Standard Ref. No.	Title.
01	IEC-44(4)	Instrument Transformer – measurement of PDS.
02	IEC-60	High voltage testing techniques.
03	IEC-171	Insulation co-ordination.
04	IEC-186	Voltage Transformers.
05	IEC-186(A)	Voltage Transformers (first supp. to IEC-186)
06	IEC-270	Partial discharge measurement.
07	IS-335	Insulating oil for transformers and switch gears.
08	IEC-8263	Method for RIV Test on high voltage insulators.

09	IS-2071	Method of high voltage testing.
10	IS-2099	High Voltage porcelain bushings.
11	IS-2147	Degree of protection provided by enclosures for low voltage switch-gear and control.
12	IS-2165	Insulation co-ordination for equipments of 100KV and above.
13	IS-3156 (Part-I to IV).	Voltage transformers.
14	IS-3347	Dimensions of porcelain transformer bushings.
15	IS-4146	Application guide for voltage transformers.
16.	IS-5547	Application guide for Capacitor Voltage Transformers.
17.	IS-9348	Coupling Capacitor & Capacitor Devices.
18	IEC 61869-5/1	CVT

- 3.2 All the above along with the 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 Technical Specification will prevail.
- 3.3 The voltage 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 shall be brought out in the offer.

#### **4.0 CLIMATIC AND SERVICE CONDITIONS :**

4.1 The VTS are required to operate satisfactorily under the following conditions.

- (a) Maximum ambient temperature - 50°C.
- (b) Maximum daily average ambient air temperature - 45°C.
- (c) Maximum relative humidity – 100%.
- (d) Average number of rainy days in a year – 120 days.
- (e) Average annual rainfall – 150 cms.
- (f) Altitude not exceeding – 1000 M.
- (g) Maximum wind pressure – 260kg/sq.m.

#### **4.2 EARTHQUAKE INCIDENCE:-**

The VTS are to be designed to withstand earthquake of an intensity, equivalent to 0.3g in the horizontal and 0.15g in the vertical direction

Where, 'g' stands for acceleration due to gravity.

#### **5.0 PURCHASER'S AUXILIARY POWER SUPPLY:-**

5.1 Following power supplies shall be made available at site:

- (a) AC-3 phase, 415V, 50HZ earthed.
- (b) AC single phase, 240V, 50HZ earthed.
- (c) 220V DC, Ungrounded.

5.2 All equipments and devices shall be capable of continuous satisfactory operation on AC and DC supplies of nominal voltage, mentioned above with variations as given below.

- (a) AC voltage variation.  $\pm 10\%$
- (b) Frequency variation.  $\pm 5\%$ .
- (c) Combined voltage & frequency variation.  $\pm 10\%$
- (d) DC voltage variation. 190V to 240V DC.

- 5.3 The supplier shall make his own arrangements for the power supplies other than those specified under Clause-5.1 above.

## **6.0 INSTALLATION:-**

The VTS covered under this specification shall be suitable for outdoor installation without any protection from rain, dust, mist and direct rays of the sun.

### **A.7.0. GENERAL TECHNICAL REQUIREMENTS FOR IVT :-**

- 7.1 Each IVT shall be supplied, filled with insulating oil and shall be hermetically sealed to prevent atmosphere coming in contact with oil, avoiding filtration and change of oil. Stain less Steel Bellow shall be provided to take care of the expansion in the oil due to various stresses developed in the IVT & CVT.
- 7.2 However, the IVT shall have a provision for draining and filling insulating oil after drying or preferably must have arrangement for drying the oil by continuous process with oil filters.
- 7.3 The IVT shall be suitable for transport in horizontal position if the transport limitations so demand.
- #### **7.4 SECONDARY TERMINAL BOX:-**
- 7.4.1 The secondary terminals shall be brought out in a weather proof terminal box made up of Aluminium cast with a rating not less than IP-55.
- 7.4.2 All secondary terminals shall be brought out in a compartment on one side of each IVT for easy access.
- 7.4.3 Provision of Thermostat control Heater in the secondary box. The Voltage shall be 230 V AC.
- 7.4.4 The terminal box shall be provided with removable gland plate and glands suitable for 1100 volts grade. PVC insulated, PVC sheathed multi core 4 sq.mm to 6 sq.mm stranded copper conductor cable.
- 7.4.5 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 and shall be suitable to prevent penetration of moisture and rain water.
- 7.4.6 The dimensions of the terminal box and its openings shall be adequate to enable easy access and sufficient working space for use of normal tools.
- 7.4.7 The terminal blocks shall be standard type and provided with ferrules indelibly marked or numbered and their identifications shall correspond to the designation on the relevant wiring diagram.
- 7.4.8 Secondary wiring terminal studs shall be provided with at least three nuts, plain and spring washers. The studs, nuts and washers shall be of brass, duly nickel plated. The minimum diameter of the studs shall be 6 mm. The length of at least 15 mm shall be available on the studs for inserting the leads.
- 7.4.9 Primary earthing link should be provided for measurement of capacitance & dielectric dissipation factor.
- 7.4.10 Separate point should be provided
- 7.5 Polarity shall be indelibly marked on each primary and secondary terminal.
- 7.6 The IVT 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 oil sampling cocks, if provided to facilitate factory processing should be properly sealed before dispatching the IVT. The method, adopted for hermetic sealing shall be described in the offer.
- 7.7 The castings of base, collar etc. shall be die cast and tested before assembly to detect cracks and voids, if any.
- 7.8 The characteristics of the IVTS shall be such as to provide satisfactory performance such as voltage error and phase displacement at rated frequency shall not exceed the values as per relevant standards at any voltage between 80% and 120% of rated voltage and with burdens of between 25% and 100% of rated burden at a power factor of 0.8 lagging. The error shall be determined at the terminals of the IVT and shall include the effects of any fuses or resistors as an integral part of the IVT.

- 7.9 Inductive voltage transformers shall be designed so as to achieve the minimum risk of explosion in service. The bidder shall bring out in his offer, measures taken to achieve this.
- 7.10 **PRIMARY WINDING:-**  
Primary winding of the IVT will be connected phase to neutral with the neutral point solidly earthed. The arrangement for this shall be included in the scope of supply. The primary conductor shall be of adequate cross-section so that the maximum permissible current density shall not be exceeded even during short-circuit conditions.
- 7.11 **SECONDARY WINDING.**  
Suitably insulated copper wire of electrolytic grade shall be used for secondary windings. The secondary conductor shall be of adequate cross section so that the maximum permissible current density shall not be exceeded even during short- circuit conditions. Secondary windings details, burden & accuracy class are mentioned in Appendix-I. Secondary windings shall be used for metering, relaying and synchronizing. Each winding shall comply requirements of both Part-II and III of up-to-date editions of IS-3156/IEC-186.
- 7.12 **CORE:-** 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 accuracy i.e. 0.2 accuracy class at both normal and high over voltage. The core material , thickness of lamination, the relevant graphs showing the characteristics of the core materials shall be submitted along with the offer.
- 7.13 **TANK.**
- 7.13.1 Both expansion chambers and tanks of the IVT shall be made of high quality **Aluminum cast** and shall be able to withstand full vacuum and pressure, occurring during transit and thermal and mechanical stresses resulting from maximum short circuit current during operation.
- 7.13.2 The 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 the purchaser for any horizontal welding, used in the bottom tank
- 7.14 **PORCELAIN HOUSING.**
- 7.14.1. 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.
- 7.14.2. The bushings of the IVTS shall conform to latest edition of IS-2099. The hollow porcelain insulators shall conform to the latest edition of IS-5621
- 7.14.3 The insulators shall be cemented with Portland cement to the flanges resulting in high mechanical, tensile and breaking strength
- 7.14.4. 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.
- 7.14.5 Cast metal and caps for the bushings shall be of high strength **Aluminium Cast** . They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionisation.
- 7.14.6 The insulation of bushings shall be co-ordinated with that of the IVT such that the flashover, if any, shall occur only external to the IVT.
- 7.14.7 Oil level gauge and convenient means of filling, sampling and draining of oil shall be provided.
- 7.14.8 End shields should be provided for distribution of stresses.
- 7.14.9 Corona shields for bushings, if required, should be provided.

#### 7.15 **INSULATING OIL.**

The quantity of insulating oil for the filling and the complete specification of the insulating oil shall comply in all respects with the provisions of the latest edition of IS-335. The IVTS shall be supplied completely filled with purified oil.

#### 7.16. **PREVENTION OF OIL LEAKAGE AND ENTRY OF MOISTURE:-**

The supplier shall ensure that the sealing of the IVT 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 & secondary terminals.

(b) Interface between porcelain housing and metal tank(s).

(d) Cover of the secondary terminal box.

7.16.1 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.

7.16.2 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.

7.17 **FITTINGS AND ACCESSORIES:-** Fittings and accessories, listed below shall be supplied with each IVT. Any fitting, required essential other than those listed below shall also be supplied along with each IVT.

(a) Oil level gauge.

(b) Oil filling hole and cap.

(c) Pressure relieving device.

(d) Lifting lugs for core and windings, bushings & complete transformers.

(e) Phase terminal connectors.

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

(g) Name/Rating plate.

(h) MCB's

7.18.1 **OIL LEVEL GAUGE:-** An oil level gauge shall be provided to indicate the oil level in the IVT. This gauge shall be mounted in such a way that the oil level can be seen from the ground level.

7.18.2 **PRESSURE RELIEVING DEVICE:-** Each IVT shall be provided with a pressure relieving device so as to protect bushing of the IVT even under unfavorable conditions.

7.18.3 **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.

7.18.4 **EARTHING:-** Metal tank of each IVT shall be provided with two separate earthing terminals for bolted connection to 50mm x 6mm flat to be provided by the Purchaser for connection to station earth-mat.

7.18.5 **LIFTING ARRANGEMENT:-** The IVT 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.

7.18.6 **NAME PLATE:-** The IVT shall be provided with non-corrosive legible name plate with the information specified in relevant standards, duly engraved/punched on it.

7.18.7 **GASKET JOINT:-** The manufacturer shall furnish the type of gasket used or setting methods.

#### **TERMINAL CONNECTORS:-**

All the IVTS shall be provided with bimetallic solderless clamp type, rigid type terminal connectors, suitable for ACSR Moose Conductor for 400, 220, 132 & 33 KV IVT. ACSR Moose Conductor for 400 KV CVT & ACSR Zebra for 220 KV CVT and ACSR Panther for 132 KV CVT. Each terminal



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

7.18.8.1 **TERMINAL CONNECTORS** shall be manufactured and tested as per IS: 5561.

7.18.8.2 All castings shall be free from blow holes, surface blisters, cracks and cavities.

All sharp edges and corners shall be blurred and rounded off.

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

7.18.8.4 All ferrous parts shall be hot dip galvanized conforming to IS-2633. For bimetallic connectors, copper alloy liner of minimum thickness of 2 mm shall be cast integral with aluminium body.

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

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

7.18.9 **SECONDARY WIRING:-**

The Secondary wiring shall be enclosed in conduits and shall be brought to a terminal block ready for external connections. The wiring shall be of adequate cross-section and not less than 4.00 sq.mm copper wire.

7.18.10 The supplier shall supply necessary hardware, required for connection of phase side conductor to the line terminal and the grounding strip to the grounding terminal.

7.18.11 Necessary nuts and bolts for fixing the IVTS on the supporting structures shall be in tenderer's scope of supply.

B.7.0 **GENERAL TECHNICAL REQUIREMENTS FOR 400 KV, 220KV & 132KV CAPACITIVE VOLTAGE TRANSFORMER:-**

B.7.1 The design of capacitor voltage transformers shall be such that its accuracy shall not be affected by the presence of pollution on the external surface of its insulators.

**Note: The rated frequency at which the CVT shall meet its accuracy requirement for both metering and protection windings: Sub-Clause 5.4 of IEC 61869-5 is applicable with the following additions for meeting the accuracy requirement:**

**(a) For Measuring Accuracy Class the rated frequency range is from 99% to 101% of rated frequency.**

**(b) For Protective Accuracy Class the rated frequency range is from 96% to 102% of rated frequency.**

B.7.2 The CVT shall operate satisfactorily in system with high X/R ratio. ( $T_p=100$  ms).

B.7.3 The EMU tank of the offered CVTs shall be of Aluminium Alloy. Synthetic Oil should be used in the EMU Tank. The other part of the CVT shall also be of Aluminium Alloy except the insulator.

7.4 Impregnation details along with tests and checks to ensure successful completion of impregnation cycle shall be furnished for purchaser's approval.

7.5 Bellows (stainless steel), to cater for expansion of insulating oil, shall be tested in accordance with relevant standards. The details shall be subject to the approval of the purchaser.

7.6 The CVT shall be capacitor voltage type with electromagnetic units and shall be suitable for carrier coupling.

7.7 All windings of voltage transformer secondary shall be protected by **MCB's of required rating**. In addition, fuses shall be provided for the protection and metering windings for fuse monitoring scheme. The secondary terminals of the CVTs shall be terminated to stud type non-disconnecting terminal blocks in the individual phase secondary boxes via.

7.8 CVTs shall be suitable for high frequency (HF) coupling, required for power line carrier communication. The carrier signal must be prevented from flowing into potential transformer

(EMU) circuit by means of a RF choke/reactor, suitable for effectively blocking the carrier signal over the entire carrier frequency range i.e. 40 to 500 KHZ. Details of the arrangement shall be furnished along with the bid. HF terminal of the CVT shall be brought out through a suitable bushing and shall be easily accessible for connection to the coupling devices of the carrier communication equipment, when utilized. The bushing shall be fully protected against rain and vermin so as to avoid the possibility of short circuits to earth. An earthing link with fastener shall be provided for HF terminal.

- 7.9 The electromagnetic unit, comprising compensating reactor, intermediate transformer and protective and damping devices should have a separate terminal box with all secondary terminals, brought out.
- 7.10 Voltage transformers should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.
- 7.11 The accuracy of the windings (3P 2T/3P 2T/0.2) shall be maintained throughout the entire burden range preferably in the frequency range of 48 HZ to 51.5 HZ on all the three windings without any adjustment during operation. Preference will be given to such bidders who can offer for maintaining the above accuracy class in the frequency range i.e. 48 HZ to 51.5 HZ up to the above specified burden values.

#### 7.12 **CONSTRUCTIONAL FEATURES:-**

- 7.12.1 The 400 KV, 220KV & 132KV CVT shall be suitable for mounting on support structure of tubular GI pipe of nominal bore of 300/200 mm. or lattice type structures.

The CVT's shall consist of two primary assemblies; the high voltage capacitor sections and the base box, housing the electro-magnetic components. Series connected capacitor elements, housed in porcelain insulators, each hermetically sealed, are referred to as capacitor sections. The dielectric of the capacitor elements shall be made up of high quality polypropylene film/paper and impregnated with highly processed synthetic fluid. Each capacitor section is equipped with a stainless steel bellow which will allow the synthetic fluid to expand and contract with changes in ambient operating temperature while maintaining the hermetic sealing. A tap voltage (approximately 5-12 kV depending on type) is taken from the lowest capacitor section and fed to an electromagnetic circuit in the cast aluminum base box. The base box contains the intermediate transformer which will provide the final output voltages via multiple tapped secondary windings, series compensating reactor and Ferro resonance control circuitry. The base box shall be filled with dried mineral oil, protecting the components from environmental deterioration. The Ferro resonance suppression circuit should not adversely affect transient response.
- 7.12.2 Access to secondary terminals shall be possible without any danger of access to high voltage circuit.
- 7.12.3 CVTs shall be hermetically sealed units.
- 7.12.4 A protective surge Arrester/spark gap shall be provided to prevent break down of insulation by incoming surges and to limit abnormal rise of terminal voltage of shunt capacitor/primary winding, tuning reactor/RF choke etc. due to short circuit in transformer secondaries. In case of an alternative arrangement, the Bidder shall bring out the details in the Bid.
- 7.12.5 The CVT secondary terminals shall be brought out in to a weather proof terminal box made up of Aluminium Alloy for ease of access. The terminal box shall have an IP rating of not less than IP 55. The terminal box shall be provided with a removable gland plate at the bottom and shall be suitable for accepting the required number of PVC insulated PVC sheathed, 10 core 2.5 mm<sup>2</sup> standard copper conductor cable.
- 7.12.6 All terminals shall be clearly marked to facilitate connection of secondary wiring.
- 7.12.7 MCBs shall be provided in the secondary side of required rating in each core of each CVT, These MCB's shall be located in such manner that they are accessible while the primary is live and shall be provided with labels indicating their function and their phase colours CVT secondary circuits shall be complete in themselves and shall be earthed at one point only. A separate earth link



shall be provided for each secondary winding and shall be situated at the CVT. Primary earthing links should be provided.

- 7.12.8 Where CVTs are supplied which are, or may be connected to different sections of the bus bar, it shall not be possible for the CVT secondary circuits, to be connected in parallel.
- 7.12.9 Suitable earthing pad of size 75X10 mm two nos shall be provided.
- 7.12.10 To prevent ferro resonance, suitable damping devices shall provided for connection to the transformer secondaries.
- 7.12.11 CVTs shall meet the requirements, given in this section of the specification.
- 7.12.12 The creepage and flashover distances of the high voltage insulator shall be suitable for the outdoor service conditions, specified in the schedules.
- 7.12.13 The bidder in the offer is to state the suitable precautions/methods, adopted during design stage of the CVT to avoid the undesirable effects due to ferro resonance phenomena. The precautions/methods include lower level of working flux density in EMU, greater utilization of the linear portion of the magnetization curve, providing an air gap in the magnetic circuit, connecting a suitable damping resistance permanently across the secondary etc.
- 7.12.14 It should be stated in the bid offer regarding the steps taken in the design stage for elimination/minimization of the influence of the transient response on the behaviour of high speed relays.
- 7.12.15 It shall be ensured by the bidder in the offer that the connection of carrier, frequency coupling device across the CVT will not affect the designated accuracy class of the CVT windings.
- 7.12.16 The capacitor divider unit shall comply to IS: 9348/1979.
- 7.12.17 It shall also be complied in the offer through a calculation sheet, proving that the designated accuracy class of the CVT (both metering and protection) are not affected by extreme temperatures, to be encountered in service conditions (Max. ambient temperature 50° C and minimum -0° C).
- 7.12.18 The terminal connectors should be suitable for **ACSR Moose Conductor for 400 KV CVT & ACSR Zebra for 220 KV CVT and ACSR Panther for 132 KV CVT**, complying to CI.No.A.7.18.8 of this specification.
- 7.12.19 Separate point should be provided for measurement of capacitance & dielectric dissipation factor.

8.. **TESTS:-**

- 8.1 **Type Tests:-** The offered 33 KV,132KV , 220 KV & 400 KV Inductive voltage transformer and 400 KV, 220kv, 132KV capacitive voltage transformer should have been subjected to the following type tests in a Government approved Test Laboratory. The bidder shall furnish four sets of type test reports along with the offer. These tests must not have been conducted earlier than **Ten years** from the date of opening of the bid. For any change in the design/type already type tested and to the design/type offered against this specification, the purchaser reserves the right to demand repetition of some or all type tests/special tests without any extra cost to OPTCL in the presence of purchaser's representative at the cost of the supplier.

**For 220 KV, 132 KV IVT:**

- (a) Temperature rise test.
- (b) Lightning Impulse Test.
- (c) High Voltage power frequency wet withstand voltage tests.
- (d) Determination of errors.
- (e) IP-55 Test on secondary Terminal Box.

N.B.:- [I] The dielectric type tests should have been carried out on the Same **IVT**.

- (i) After the IVT was subjected to the dielectric tests, it should have been subjected to all routine tests as per relevant standards.

- (ii) For Temperature Rise Test, the test must have been made with the appropriate rated burden, connected to each secondary winding.

**For 400 KV, 220KV & 132KV CVT : ( As per IEC 61869-1 & 5)**

**TYPE TESTS/SPECIAL TESTS FOR 400 KV, 220KV, 132KV CVT:-**

- a) Lightning Impulse voltage test on complete CVT unit.
- b) Partial discharge test.
- c) Radio interference voltage test.
- d) Corona extinction voltage test.
- e) Temperature rise test on complete CVT unit.
- f) Ferro resonance test on the complete C.V.T. unit.
- g) Transient response tests.
- h) Determination of Temperature Co-efficient test.
- i) High frequency capacitance and equivalent resistance measurement test (as per IEC-358)
- j) Stray capacitance and stray conductance test (as per IEC-358).
- k) Accuracy tests.
- l) Seismic withstand test.
- m) IP-55 test on secondary Terminal Box.
- n) Effectiveness of sealing tests.
- o) Mechanical Terminal load test: load will be applied to CVT H V terminal.**
- p) Dielectric loss angle test (Tan Delta Test).
- q) 3P T2 transient class: Type Test report provided to prove the IEC compliance of 3P T2.**

N.B:- 1.The dielectric type tests should have been carried out on the same CVT.

2.After the CVT was subjected to the dielectric tests, it should have been subjected to all routine tests as per relevant standards.

3.The ratio errors, phase displacements before, during and after the temperature rise test on complete CVT unit should have been determined with stipulated burdens and the same should comply with the designated accuracy class for each winding of the CVT.

- 8.2 **ROUTINE TESTS:-** The following routine tests shall be conducted on each VT in the presence of Purchaser's representative for which no charges will be payable by OPTCL. No sampling is allowed.

- (a) Verification of terminal markings.
- (b) Power frequency withstand tests on primary windings/capacitor voltage divider for IVT/CVT
- (c) Partial discharge measurement for **132KV & above class IVT and 132KV & above class CVT.**
- (d) Power frequency withstand tests on secondary windings/Low voltage terminal of the capacitor divider for **132KV & above class CVT.**
- (e) Power frequency withstand tests between sections.
- (f) Determination of errors on complete IVT/CVT.
- (g) Measurement of Insulation resistance.
- (h) Oil leakage test.
- (i) Measurement of capacitance and dielectric dissipation factor before and after dielectric tests (as per IEC-358)
- (j) Power frequency tests on electromagnetic unit for 400 KV, 220KV & 132KV CVT.
- (k) Any other test as per relevant national & international standards.

N.B:- Determination of errors shall be performed after the other tests. The standard reference VT to be used during testing for determination of ratio error and phase angle error should of 0.05 accuracy class or better as per standard practice, presently adopted by OPTCL.

9. **INSPECTION:**

- 9.1 The Purchaser shall have access at all times to the works and all other places of manufacture, where the IVTs/CVTs are being manufactured and the supplier shall provide all facilities for unrestricted inspection of the supplier's works, raw materials, manufacturer of all the accessories and for conducting the necessary tests.

- 9.2 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 at the discretion of the Purchaser.
- 9.3 No material shall be despatched from its 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.
- 9.4 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 equipments are found to be defective.
- 9.5 Clear 15 (Fifteen) days' notice shall be given to this office for deputing officer(s) for inspection. The Voltage Transformers shall be despatched only after the inspection is conducted by a representative of OPTCL and release order, issued from this office after approval of Routine Test Certificates. The shop routine test certificates in triplicate for all the Voltage Transformers along with the calibration certificates of all the meters and equipments to be used during testing (as per Annexure-B of the Specification) should be furnished along with the Inspection Offer. The Inspecting Officer will be authorised for inspection of the Voltage Transformers subject to the condition that the routine test certificates and calibration certificates of the testing equipments/meters will be found to be in order.
10. **QUALITY ASSURANCE PLAN:-**
- 10.1 The Bidder shall invariably furnish following informations along with 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 materials in presence of Bidder's representative, copies of test certificates.
  - [ii] Information and copies of test certificates as in [i] above in respect of bought out items.
  - [iii] List of manufacturing facilities available.
  - [iv] Level of automation achieved and list of areas where manual processing exists.
  - [v] List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such tests and inspection.
  - [vi] Special features provided in the equipment to make it maintenance free.
  - [vii] List of testing equipments, meters 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.
- 10.2 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 name of Sub-suppliers selected from those, furnished along with the offer.
  - [ii] Type test certificates of the raw materials and bought out accessories.
  - [iii] Quality Assurance Plan (QAP) with hold points for the Purchaser's possible inspection. The QAP and hold points shall be discussed between the Purchaser and the Supplier before the QAP is finalised.
- 10.3 The Supplier shall submit the routine test certificates of bought out items and raw materials at the time of acceptance testing of the fully assembled equipment.
- 11 **DOCUMENT:** The supplier shall furnish four sets of following drawings/documents along with his offer.
- [a] General outline and assembly drawings of the Inductive Voltage Transformers/ Capacitive Voltage Transformers.
  - [b] Sectional views showing:-

- [i] General constructional features.
- (ii) Materials/gaskets/sealing used.
- iii] The insulation of the winding arrangements, method of connection of primary/secondary winding to the primary/secondary terminals etc.
- [c] Schematic drawing.
- [d] Rating & diagram plate as per relevant IEC/ISS
- [e] Secondary Terminal Box.
- [f] Assembly Sectional view of Primary terminal./ capacitor voltage divider
- [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.
- [k] All type test reports relating to the tests as specified in Clause-8.1 of the above.
- [l] Ratio and phase angle error curves for IVTS/ CVTS
- [m] Magnetization characteristic curves such as B-H curves and Sp. Loss vs. Flux density curves for core material, used for IVT & EMU unit of CVT.
- [n] Sectional view of EMU unit of 132KV & above class CVT.

## 12. **TEST REPORTS:-**

- [i] Four copies of type test/special test reports shall be furnished to the Purchaser with the tender offer.
- [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.

13. The necessary galvanized flanges, bolts etc. for the base of the Inductive/Capcitive Voltage Transformers shall be supplied without any extra cost to the purchaser.

## 14. **PACKING AND FORWARDING:-**

- 14.1 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. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.
- 14.2 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.

[h] Set of approved drawings.

- 14.3 The supplier shall ensure that the bill of materials is approved by the Purchaser before despatch.
15. Any bid without complete information as asked for in the above Specification is likely to be rejected.

#### APPENDIX – I.

**TECHNICAL REQUIREMENTS FOR 33 KV, 132KV & 220 KV INDUCTIVE VOLTAGE TRANSFORMERS &, 132KV, 220KV, 400 KV CAPACITIVE VOLTAGE TRANSFORMER.**

SL. NO	PARTICULARS	33 KV IVT	132KV IVT	220 KV IVT	400 KV IVT	132KV CVT	220KV CVT	400 KVCVT
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1	Type	Single phase, 50Hz, oil filled, self cooled, Hermetically sealed, outdoor Porcelain type.	Single phase, 50Hz, oil filled, self cooled, Hermetically sealed, outdoor Porcelain type.	Single phase, 50Hz, oil filled, self cooled, Hermetically sealed, outdoor Porcelain type.	Single phase, 50Hz, oil filled, self cooled, Hermetically sealed, outdoor Porcelain type.	Single phase, 50Hz, oil Filled, self-cooled, Hermetically sealed, Outdoor porcelain type.	Single phase, 50Hz, oil Filled, self-cooled, Hermetically sealed, Outdoor porcelain type.	Single phase, 50Hz, oil Filled, self-cooled, Hermetically sealed, Outdoor porcelain type.
2	Nominal system voltage.	33 KV	132KV.	220 KV.	220 KV.	132KV	220KV	400 KV
3	Highest system voltage.	36 KV	145KV.	245KV.	245KV.	145KV	245KV	420 KV
4	Frequency.	50Hz± 5%	50Hz± 5%	50Hz± 5%	50Hz± 5%	50Hz ± 5%	50Hz± 5%	50Hz± 5%
5	System earthing.	Effectively solidly earthed	Effectively solidly earthed	Effectively solidly earthed	Effectively solidly earthed	Effectively solidly earthed.	Effectively solidly earthed.	Effectively solidly earthed.
6	Number of phases.	3 [single phase]	3 [single phase]	3 [single phase]	3 [single phase]	3 [single phase]	3 [single phase]	3 [single phase]
7	(i)Number of secondary windings. (ii)Purpose of windings.	2 [two]  Protection & metering.	2 [two]  Protection & metering.	3 [three]  Protection & metering.	3 [three]  Protection & metering.	3 [three]  Protection & metering.	3 [three]  Protection & metering.	3 [three]  Protection & metering.
8	Rated primary voltage.	33/1.732 KV	132/1.732KV	220/1.732KV	220/1.732KV	132/1.732 KV	220/1.732 KV	400/1.732 KV
9	Rated secondary voltage.	Winding-I-110/1.732 V (Protection)  Winding-II-110/1.732V(Metering)	Winding-I-110/1.732V (Protection)  Winding-II-110/1.732V(Metering)	Winding-I & II-110/1.732V (Protection)  Winding-III-110/1.732V(Metering)	Winding-I & II-110/1.732V (Protection)  Winding-III-110/1.732V(Metering)	Winding-I-110/1.732V Winding-II-110/1.732V Winding-III-110/1.732V	Winding-I-110/1.732 V Winding-II-110/1.732 V Winding-III-110/1.732 V	Winding-I-110/1.732V Winding-II-110/1.732V Winding-III-110/1.732V
10	Ratio	33 KV/1.732: 110V/1.732	132KV/1.732: 110V/1.732	220KV/1.732: 110V/1.732	220KV/1.732: 110V/1.732	132KV/1.732: 110V/1.732	KV,220KV/1.732: 110V/1.732	400/1.732KV/110/1.732 KV



11	Rated burden.	Winding-I(P)-75 VA Winding-II(M)- 75 VA Simultaneous Burden-150 VA with accu. cl-0.2	Winding-I(P)-200 VA Winding-II(M)-200 VA Simultaneous Burden-400 VA with accu. cl-0.2	Winding-I(P)-100 VA Winding-I(P)-100 VA Winding-II(M)- 100 VA Simultaneous Burden-300 VA with accu. cl-0.2	Winding-I(P)-100 VA Winding-I(P)-100 VA Winding-II(M)- 100 VA Simultaneous Burden-300 VA with accu. cl-0.2	Winding-I(P)-75 VA Winding-II(P)-75 VA Winding-III(M)-75 VA/0.2 class simultaneous burden-75 VA with accu. cl-0.2	Winding-I(P)-75 VA Winding-II(P)-75 VA Winding-III(M)-75 VA/0.2 class simultaneous burden-75 VA with accu. cl-0.2	Winding-I(P)-75 VA Winding-II(P)-75 VA Winding-III(M)-75 VA/0.2 class simultaneous burden-75 VA with accu. cl-0.2
12	Accuracy class .	3P/ 0.2	3P/ 0.2	3P/3P/ 0.2	3P/3P/ 0.2	3P-2T/3P-2T/0.2	3P-2T/3P-2T/0.2	3P-2T/3P-2T/0.2
13	Rated voltage factor at rated frequency.	1.2 continuous 1.5 for 30 seconds.	1.2 continuous. 1.5 for 30 seconds.	1.2 continuous. 1.5 for 30 seconds.	1.2 continuous. 1.5 for 30 seconds.	1.2 continuous. 1.5 for 30 second.	1.2 continuous 1.5 for 30 second.	1.2 continuous. 1.5 for 30 second.
14	Temperature rise at 1.2 times the rated primary voltage, rated frequency & rated burdens.	As per IEC-186.	As per IEC-186.	As per IEC-186.	As per IEC-186.	As per IEC-186	As per IEC-186	As per IEC-186
15	Temperature rise at 1.5 times the rated primary voltage for 30 seconds, rated frequency & rated burden.	As per IEC-186.	As per IEC-186.	As per IEC-186.	As per IEC-186.	As per IEC-186.	As per IEC-186.	As per IEC-186.
16	One-minute power frequency dry withstands test voltage for primary winding.	70 KV [rms]	275KV [rms]	460 KV [rms]	460 KV [rms]	275KV [rms]	460 KV rms	630 KV [rms]
17	1-minute power frequency wet withstands test voltage for primary winding.	70 KV [rms]	275KV [rms]	460KV [rms]	460KV [rms]	275KV [rms]	460 KV rms	630 KV [rms]
18	1.2/50 micro second impulse withstand test voltage for primary winding	170 KV [peak]	650KV [peak]	1050KV [peak]	1050KV [peak]	650KV [peak]	1050KV [peak]	1425 KV peak

19	One-minute power frequency withstands test voltage for  Secondary winding  Between LV(HF) terminal & earth terminal	3KV [rms]  -	3KV [rms]  -	3KV [rms]  -	3KV [rms]  -	3KV [rms]  10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.	3KV [rms]  10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.	3KV [rms]  10KV [rms] for exposed terminals & 4KV [rms] for terminals, enclosed in a weatherproof box.
20	Class of insulation.	'A'	'A'	'A'	'A'	'A' or better for EMU.	'A' or better for EMU.	'A' or better for EMU.
21	Material of the conductor of primary and secondary windings.	Copper.	Copper.	Copper.	Copper.	Copper for EMU	Copper for EMU	Copper for EMU
22	Short Circuit Fault level of the bus to which the equipment will be connected.	31.5KA [rms].for 1second.	40 KA [rms].for 1second.	50 KA [rms].for 1second.	63 KA [rms].for 1second.	40 KA [rms] 1 second.	50KA [rms] for 1 second	63 KA (rms) for 1 sec
23	Minimum creepage distance.	900mm	3625mm	6125mm	6125mm	3625 mm	10500/6125mm	10500/6125 mm
24	Quality of oil.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS-335.	EHV Grade As per IS-335.
25	Radio interference voltage at 1.1 times maximum rated voltage at 1.0 MHZ.		<1000 micro volts.	<1000 micro volts.	<1000 micro volts.	<1000 micro volts.	<1000 micro volts.	<1000 micro volts.
26	Partial discharge level.		Less than 10 piccoulombs.	Less than 10 piccoulombs.	Less than 10 piccoulombs.	Less than 10 Piccoulombs.	Less than 10 piccoulombs.	Less than 10 piccoulombs.
27	Seismic acceleration- Horizontal – Vertical.	0.3g. 0.15g.	0.3g. 0.15g.	0.3g. 0.15g.	0.3g. 0.15g.	0.3g. 0.15g.	0.3g. 0.15g.	0.3g. 0.15g.
28	Accuracy class of standard V.T. to be used during testing towards determination of ratio errors and phase angle errors for metering windings.	0.05 or better.	0.05 or better.	0.05 or better.	0.05 or better.	0.05 or better.	0.05 or better.	0.05 or better.
29.	Capacitance (Pf)		-	-	-	8800 (+10% & - 5%)	8800 (+10% & - 5%)	8800 (+10% & - 5%)

**ANNEXURE – A**  
**GUARANTEED TECHNICAL PARTICULARS.**

Sl. No	Description.	33 KV IVT	400 KV CVT	220 KV IVT	132KV IVT	132KV CVT	220KV CVT
		3P/0.2 Accuracy Class	3P-2T/3P- 2T/0.2 Accuracy Class.	3P/0.2 Accuracy Class	3P/0.2 Accuracy Class	3P-2T/3P- 2T/0.2 Accuracy Class.	3P-2T/3P- 2T/0.2 Accuracy Class.
1	Bidder's name and address.						
2	Name and address of the Manufacturer.						
3	Manufacturer's type and designation.						
4	Standards applicable.						
5	Type of IVT/CVT						
6	Rated primary voltage (kv).						
7	Rated secondary voltage (volts).						
7.1	Winding-I.						
7.2	Winding-II.						
7.3	Winding-III.						

8	Rated frequency [HZ].						
9	Rated burden:- Protection Winding Protection Winding Metering Winding						
10	Number of secondary windings.						
11	Accuracy class.						
[I]	[protection] Winding						
[II]	[metering] Winding						
12	Rated voltage factor for continuous operation at rated frequency.						
13	Rated voltage factor for 30 seconds at rated frequency.						
14	One minute dry and wet power frequency withstand voltage for primary side [kv] rms.						
15	One minute power frequency withstand voltage for secondary winding [kv] rms.						
16	1.2/50 micro-second impulse withstand test voltage for primary side						
17	Temperature rise over an ambient						

	temperature of 50°C						
[a]	With 1.2 times rated primary voltage at rated frequency and at rated burdens. [I] Winding [°C] [II] Oil [°C] [III] Other parts [°C]						
[b]	With 1.5 times rated primary voltage for 30 seconds at rated frequency and at rated burdens. [I] Winding [°C] [II] Oil [°C] [III] Other parts [°C]						
18	Class of insulation.						
19	Total creepage distance in (mm)						
20	Maximum radio interference voltage at 1.1 times maximum line to ground voltage (micro volts)						
21	Corona inception and extinction voltage (kv) rms						
22	Partial discharge level (piccoulombs )						

23	<p>Primary.[For 220KV, 132KV &amp; 33KV IVT]</p> <p>(a) No. of primary turns</p> <p>(b) Material of primary</p> <p>(c) Size of the primary conductor bare/insulated.</p> <p>(d) Cross sectional area of primary conductor (sq.mm)</p> <p>(e) Current density adopted for primary winding(A/sq.mm)</p> <p>(f) Type of primary winding.</p> <p>(g) Name of the insulating materials used for primary conductor.</p> <p>(h) Weight of primary winding.</p>						
24	<p>Secondary. [For 220KV, 132KV &amp; 33KV IVT]</p> <p>(a)No. of secondary turns</p> <p>(b) Material of secondary</p> <p>© Size of the secondary conductor bare /insulated.</p> <p>(d)Cross sectional area of secondary conductor (mm<sup>2</sup>)</p> <p>(e)Current density adopted for secondary</p>						



	winding(A/mm <sup>2</sup> ) (f)Type of secondary winding (g)Name of the insulating materials used for secondary conductor. (h)Weight of secondary winding.						
25.	Core. [For 220KV, 132KV & 33KV IVT] (a)Shape of the core (b)Material and grade of the core laminations (c)Thickness of the core lamination (mm) (d)Maximum flux density adopted (Tesla) (e)Net iron area of the core (f)Watt loss/kg. for the core materials at the operating flux density(W/kg) (g) Total weight of the core(kg) (h)Whether B-H curve for core material enclosed? (i)Whether specific loss vrs. Flux density curve enclosed ?						
26	INSULATION. .[For 220KV, 132KV & 33KV IVT] (a) Insulation between core						

	<p>and secondaries.</p> <p>(b) Insulation between secondaries.</p> <p>© Insulation between secondary and primary.</p> <p>(d) Insulation between primary and core.</p>						
27	<p>DIMENSIONS OF CORE AND WINDINGS. .[For 220KV, 132KV &amp; 33KV IVT]</p> <p>(a)Diameter of the core (mm)</p> <p>(b)Inner diameter of the secondary windings(mm)</p> <p>(c) Outer diameter of the secondary windings (mm)</p> <p>(d) Inner diameter of the primary winding(mm)</p> <p>(e) Outer diameter of the primary winding(mm)</p> <p>(f) Minimum clearance from primary winding to tank(mm)</p> <p>(g) Minimum clearance from secondary winding to tank(mm)</p>						
28.	<p>Percentage voltage ratio (error)/phase displacement (min.)at 100% rated burden at 0.8PF lagging</p>						

	<p>for measuring winding.</p> <p>(a) 80% of rated voltage at frequency:-</p> <p>(b) 120% of rated voltage at frequency:-</p> <p>(c) Accuracy of standard PT to be used. during determination of errors (0.05 or better.</p>						
29.	<p>Percentage Voltage ratio /phase displacement (min.)at 25% rated burden at 0.8PF lagging for measuring winding.</p> <p>(a) 80% of rated voltage at rated frequency:-</p> <p>(b) 120% of rated voltage at rated frequency:-</p>						
30.	<p>Percentage voltage (ratio)error /phase displacement (min.) at 100% rated burden at 0.8PF lagging for protection winding</p> <p>(a)5% of rated voltage.</p> <p>(b)1.2 times rated voltage</p> <p>( c)1.5 times rated voltage</p> <p>(d) 2% of rated voltage..</p>						

31.	Percentage voltage (ratio) error /phase displacement (min) at 25% of rated burden at 0.8PF lagging for protection winding  (a)5% of rated voltage (b)1.2 times rated voltage. ©1.5 times rated voltage. (d) 2% of rated voltage.						
32.	Whether IVT/CVT is suitable for horizontal transportation.						
33.	Quantity of oil per IVT/ CVT (Ltrs/kg)						
34.	Standard to which oil conforms.						
35.	Characteristic of oil(Prior to filling)						
35. 1.	Breakdown voltage (kv-rms)						
35. 2.	Dielectric dissipation constant tan delta)						
35. 3	Water content(PPM)						
35. 4	Gas content(PPM)						
35. 5	Interfacial tension at 27 degree C(N/m)						
35. 6	Specific resistance.						
35. 6.1	At 90 deg.C(ohm-cm)						
35. 6.2	At 27 deg.C(ohm-cm)						

36.	Whether IVTS are hermetically sealed ? If so how ?						
37.	Total Weight (kg)						
38.	Transport weight (kg)						
39.	Dimensional details.						
40	Whether IVT characteristic curves enclosed?						
41.	TANK AND SECONDARY TERMINAL BOX.						
41. 1	Material of the IVT/ CVT tank						
41. 2	Material of the secondary terminal box.						
41. 3	Thickness of the IVT/ CVT tank material.						
41. 4	Thickness of the secondary terminal box material.						
41. 5	Zinc coating of IVT/ CVT tank(g/sq.m)						
41. 6	Zinc coating of the secondary terminal box (g/sq.m)						
41. 7	Weather proof rating of secondary terminal box.						
41. 8	Weight of tank fitting and other accessories.						
	TERMINAL CONNECTORS						
01.	Manufacturer's name						
02.	Applicable standards.,						

03.	Type.						
04.	Material of connector. (a) Clamp body. (b) Bolts and Nuts. (c ) Spring Washers						
05.	Rated current.						
06.	(a) Rated terminal load(kg) (b) Factor of safety.						
07.	Minimum thickness of any part(mm)						
08.	Weight of connector complete with hardware.						
09.	Type test reports as per IS enclosed.						
10.	OGA drawing enclosed.						
	BUSHING/SUPPORT INSULATOR						
01	Manufacturer's name						
02.	Type.						
03.	Applicable standards.						
04	Dimensions: (i) Height(mm) (ii) Diameter(top)(mm) (iii) Diameter(bottom)(mm)						
05	Total creepage distance (mm).						
06.	Rated voltage(KV)(rms)						
07.	Power frequency withstand						



	voltage for (1 minute dry and wet(KV/rms)						
08.	1.2/50 micro- second Impulse withstand voltage (KVP)						
09.	Corona Extinction voltage(kv)						
10.	Weight(kg)						
11.	Maximum allowable span (mm)						
12.	Cantilever strength(kg)						
13.	OGA drawing enclosed.						

**ADDITIONAL TECHNICAL REQUIREMENT FOR 132KV, 220KV,& 400 KV CVT.**

1. Rated capacitance of the CVT
2. High frequency capacitance for entire carrier frequency range.
3. Equivalent series resistance over the entire frequency.
4. Stray capacitance and stray conductance of the LV terminal over entire carrier frequency range.
5. Capacitance (PF) /Tan delta between:-
  - a) HV-HF point
  - b) HF point-Ground point of International Transformer.
  - c) HV-Ground point of Intermediate Transformer winding.
6. Capacitive reactance of the two parts of the divider i.e. High voltage capacitor, and Intermediate voltage capacitor, connected in parallel.

7. Total Inductive reactance, offered by CVT.
8. Voltage ratio of the capacitor divider.
9. Open circuit Intermediate voltage.
10. Rated open circuit Intermediate voltage.
11. Reference range of temperatures within which the CVT complies with the relevant accuracy requirements.
12. Protective device, in-corporate in the CVT for limiting over voltages and/or to prevent sustained Ferro resonance.
13. Rated voltage of Surge Arrester, connected at the secondary of CVT.
14. Natural frequency of coupling (KHZ).
15. Self tuning frequency of CVT (KHZ).
16. Bandwidth (KHZ).
17. Temperature rise over ambient.
18. One minute power frequency test voltage of secondary winding (KV).
19. One minute power frequency test voltage of H.F. terminal (KV).
20. One minute power frequency test voltage of capacitor (dry & wet) (KV).
21. 1.2/50/micro second Impulse withstand test voltage of capacitor (KVP).
22. 250/2500 micro second switching surge withstand voltage of capacitor (dry & wet).
23. Literature  
Whether the followings are enclosed?
  - 23.1 Type Test reports as per IEC 186.
  - 23.2 OGA drawing of CVT and terminal connector.
  - 23.3 Characteristic curves.
  - 23.4 Drawing showing clearance from earthed object.
  - 23.5 Details of Surge Arrester, connected at secondary winding of CVT.
24. **ELECTROMAGNETIC UNIT:-**
  - 24.1 **CORE:-**
    - a) Core diameter (mm)
    - b) Window Weight (mm)
    - c) Leg centre (mm)
    - d) Net cross sectional area of iron

	In the core (mm <sup>2</sup> )			
	e) Core lamination thickness (mm)			
	f) Type & grade of core.			
	g) Design flux density at rated voltage. And rated frequency (Tesla)			
	h) Design flux density at highest system voltage & lowest system frequency (Tesla).			
	i) Minimum knee point voltage (volts).			
24.2	<b><u>PRIMARY WINDING:-</u></b>			
	a) No. of turns.			
	b) Bare size of conductor			
	c) Insulated size of conductor.			
	d) Area of cross section.			
	e) Current density (A/ mm <sup>2</sup> ).			
	f) Conductor material.			
	g) Class of insulation.			
	h) Power frequency withstand level. (KV-rms).			
	i) Impulse withstand level (KVP).			
24.3	<b><u>Secondary Winding</u></b>	<b><u>Protection</u></b>	<b><u>Protection</u></b>	<b><u>Metering</u></b>
		<b><u>Winding</u></b>	<b><u>Winding</u></b>	<b><u>Winding.</u></b>
	a) No.of turns			
	b) Bare conductor size (mm)			
	c) Insulated conductor size (mm)			
	d) Cross-sectional area (sq.mm)			
	e) Current density (A/ mm <sup>2</sup> )			
	f) Conductor material.			
	g) Class of Insulation.'			
	h) Power frequency withstand Level (KV-rms).			

**ANNEXURE –B.**

**CALIBRATION STATUS OF TESTING EQUIPMENTS AND INSTRUMENTS/METERS.**

Name of the test	Meters and equipments required for the corresponding test with range, accuracy, make and Sl. No.	Date of Calibration.	Due date of Calibration	Name of the Calibrating Agency.	Whether Calibrating Agency is Govt. Approved.
1	2	3	4	5	6

Whether documents relating to Govt. Approval of the calibrating Agency furnished ?	Whether the meters/ equipment 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).	Remarks
7	8	9	10	11	12

Signature of the tenderer with seal and date.

**ANNEXURE-C**

**CHECK LIST TOWARDS TYPE TEST REPORTS.**

Name of the Type Test.	Date of Test.	Name of the Laboratory where the Test has been conducted.	Whether the Laboratory is Government Approved.	Whether the Test reports are valid as per Clause No.8.1 of T.S.	Whether the copy of Test Report in complete shape alongwith drawings etc. furnished or not ?	Whether the Tested I.V.T/ CVT fulfills the technical require-ments as per TS.	<b>If the type tested I.V.T/ CVT</b> does not fulfill the technical requirements as per this specification, whether the bidder agrees to conduct the particular test(s) again at their own cost without any financial liability to OPTCL in the presence of OPTCL's representative within the specified delivery period.	Remark
1	2	3	4	5	6	7	8	

Signature of the Tenderer with seal and date.