



SUPPLY CHAIN MANAGEMENT THIRUVANANTHAPURAM

SPECIFICATION

66KV CURRENT TRANSFORMERS

APPLICABLE TO KSEBL	Rev#0	DOC. NO.: SCM-SPEC/XT/66kV CTs
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Technical Specification and Evaluation Committee for Transmission Material



SUPPLY CHAIN MANAGEMENT
Thiruvananthapuram

TECHNICAL SPECIFICATION

66KV CURRENT TRANSFORMERS

Doc. #: **SCM-SPEC/XT/66kV CTs**

Rev.#: 0

Effective Date :**31/05/2021**

(i) Document Approval & Control Status

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Date	14/05/2021	14/05/2021	31/05/2021
Signature	Sd/-	Sd/-	Sd/-

(ii) Amendments and History

Sec. #	Rev. #	Date	History of Change



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1. PURPOSE:

Purpose of this document is to document updates & history, upkeep and publish the specifications related to **66kV Current Transformers** in a professional manner

2. SCOPE:

The Scope of this document is to inform and alert all relevant stakeholders including KSEBL, Public, KSERC etc regarding the current specifications and historical changes adopted in specifications of **66kV Current Transformers** used in field by KSEBL

3. RESPONSIBILITY:

The Executive Engineer (T), Office of Chief Engineer, Supply Chain Management shall compile and take necessary steps to publish the specification in KSEBL website and shall inform relevant stakeholders regarding updates and revisions

4. PROCEDURE FOR REVISION:

Modifications if any, in the technical specification will be incorporated as **Revisions**. Any changes in values, minor corrections in pages, incorporation of small details etc. will be considered as Minor Modification. **The Revisions due to minor modifications will be assigned as Rev. No.0.1, 0.2 etc.**

A complete updation of the technical specification will be considered as Major modification. **The Revisions due to major modifications will be assigned as Rev. No.1.0, 2.0 etc.**

All the details of regarding the revisions (both minor and major) will be incorporated in **“(ii)-Amendments and history”** above.

The concerned officers, in consultation with the Technical Committee will review and suggest changes required and the revision suggestion will be approved by **Chief Engineer (SCM)**. Those who notice any discrepancy or have any suggestion regarding revision, may bring the matter to the attention of Chief Engineer (SCM) in writing or through e-mail id:cescm@kseb.in



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TECHNICAL SPECIFICATION

33/11KV 5MVA POWER TRANSFORMER WITH CABLE ENTRY BOX ON BOTH HV & LV

Doc. #: SCM-SPEC/XT/5MVA Trs.

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TECHNICAL SPECIFICATION OF 66kV CT

- 1 **Scope:-** This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply and delivery of outdoor Current Transformers for relaying and metering service in 66 kV 3 phase, neutral grounded system (Live Tank).
- 2 **Standards:-** Unless otherwise specified elsewhere in this specification, the Current transformers shall conform to all respect but not limited to the latest revisions and amendments available at the time of placement of order of all the relevant standards as listed hereunder.

Sl. No.	Standard No.	Title
1)	IS:2165	Insulation Co-ordination for equipment of 100kV and above.
2)	IS:2705 (I to IV)	Current Transformers.
3)	IS:2099	Bushings for alternating voltages above 1000Volts.
4)	IS:3347	Dimensions of porcelain transformer bushings.
5)	IS:2071	Method of High Voltage Testing.
6)	IS:335	Insulating oil for transformers Switch-gears.
7)	IS:2147	Degree of protection provided by enclosures for low voltage switch-gear and control.
8)	IS:2633	Method of testing hot dipped galvanized articles.
9)	IS:4800	Enameled round winding wires.
10)	IS:5561	Terminal connectors.
11)	IS:11065	Drawings.
12)	IEC 44-1	Current Transformers.
13)	IEC-270 (or IS:11322)	Partial Discharge & RIV Measurement
14)	IEC-44(4)	Instrument Transformer measurement of PDs.
15)	IEC-60071	Insulation co-ordination.
16)	IEC-60060	High voltage testing techniques.
17)	IEC-8263	Method for RIV test on high voltage insulators.
18)	IS:5621	Hollow porcelain insulators.

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19)	IEC 61869	Rated insulation level
20)	CEA Regulations	Accuracy class of instrument transformers

Equipment meeting with the requirements of other authoritative standards, which ensure equal or better performance than the standards mentioned above, shall also be considered. When the equipment offered by the supplier conforms to other standards salient points of difference between standards adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule.

- 3 **Type and Rating:-** The current transformers shall be of the outdoor **live** tank type, single phase, 50Hz. Oil immersed and self-cooled and suitable for operation in humid atmospheres and in the tropical sun with temperature up to 40°C. Ambient temperature class of -5/40°C shall be adopted. They should be suitable for use in areas subject to heavy lightning, storms and heavy rains.

The 66kV Current Transformers shall have the following ratings:

Description of Parameters		66 kV CT
1.	Maximum System Voltage	72.5kV.
2.	Rated Frequency	50 Hz.
3.	No. of phases	3
4.	Rated insulation level	
i.	Full wave impulse withstand voltage (1.2/50micro sec) (kV _p)	325
ii.	Switching impulse withstand voltage (250/2500microsec.) dry and wet	NA
iii.	One minute dry power frequency dry & wet withstand voltage (kV _{rms})	140
5.	Minimum Creepage Distance	25 mm/kV (1813 mm)
6.	Rated short circuit current for 1 sec. Duration	31.5kA
7.	System neutral earthing	Solidly earthed
8.	Rated continuous Thermal current	120%
9.	Transformation ratio	a) 600/1-1-1-1A (4C) b) 600/300/150/75/1-1-1-1A(4C)

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DETAILS OF 66kv CTs (600/1-1-1-1 A) NUMBER OF CORES – 4

Sl. No.	Core No.	Current Ratio (A)	Output burden (VA)	Accuracy class as per IEC 185	Minimum Knee point voltage	Max CT Secondary resistance at 75°C	Maximum Exciting Current (mA)	ISF/ ALF
1)	Core-1	600/1	-	PS	600	<4ohms	30mA at Vk/2	-
2)	Core-2	-do-	-	PS	600	<4ohms	30mA at Vk/2	-
3)	Core-3	-do-	-	PS	600	<4ohms	30mA at Vk/2	-
4)	Core-4	-do-	20	0.2	-	-	-	<=5

DETAILS OF 66kv CTs (600-300-150-75/1-1-1-1 A) NUMBER OF CORES – 4

Sl. No.	Core No.	Current Ratio (A)	Output burden (VA)	Accuracy class as per IEC 185	Minimum Knee point voltage	Max CT Secondary resistance at 75°C	Maximum Exciting Current (mA)	ISF/ ALF
1)	Core-1	600-300-150-75/1	-	PS	600 @ 600/1A	<4ohms @ 600/1A	30mA at Vk/2 @ 300/1A	-
2)	Core-2	-do-	-	PS	600 @ 600/1A	<4ohms @ 600/1A	30mA at Vk/2 @ 300/1A	-
3)	Core-3	-do-	-	PS	600 @ 600/1A	<4ohms @ 600/1A	30mA at Vk/2 @ 300/1A	-
4)	Core-4	-do-	20	0.2S	-	-	-	<=5

4 Climatic Conditions:- The climatic conditions prevailing at site are as follows:

Maximum temperature of Air in shade	:	40 ^o C.
Minimum temperature of air in shade	:	15 ^o C
Maximum relative humidity	:	100 %
Average no. of thunderstorm days per annum	:	50
Average no. of rainy days per annum	:	180
Average annual rainfall	:	3000mm
Maximum wind pressure	:	100kg/Sq.m
Altitude not exceeding	:	1000m above MSL.

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5 **General:-** The current transformers shall be of single phase, oil immersed and self cooled suitable for the services indicated complete in all respects conforming to the modern practice of design and manufacture. The current transformers shall be sealed to eliminate breathing and prevent air and moisture from entering the tank. These shall be provided with oil level gauge and shall be provided with a pressure-relieving device / Explosion vent capable of releasing abnormal internal pressures. The temperature rise should be as specified in IEC60044-1. Oil level indicator should be of prismatic type oil sight window at front side of the top tank at suitable location so that level of oil can be viewed clearly from ground. Hermetically sealed drain plug for Oil with sampling cock and oil filling plug with cap should also be provided. Lifting lug should also be provided to lift the unit without damage to the instrument.

5.1 **Limit of temperature rise:-** The temperature rise of a CT Winding when carrying a primary current equal to the rated continuous thermal current at a rated frequency and with rated burden, shall not exceed the appropriate values given in the following table. The temperature rise of the windings is limited by the lowest class of insulation either of the windings itself or of the surrounding medium in which it is embedded. The temperature rise of the oil at the top of the tank shall not exceed 50^oC.

<u>Class of Insulation</u>	<u>Maximum temperature rise in °C</u>
1. All classes immersed in Oil	60
2. All classes immersed in Bituminous compound.	50
3. Classes not immersed in Oil or bituminous compound Class-A insulation.	60

5.2 **Bushing:-** CTs shall be mounted on oil filled bushings conforming to IS:2099/73 suitable for outdoor use and upright mounting on steel structures. They shall ensure ample insulation, mechanical strength and rigidity for operation under site conditions. Porcelain housing shall be of single piece without coupling or joint. Housing shall be made of homogeneous porcelain of high mechanical and dielectric strength. Glazing of porcelain shall be uniform brown or dark brown with smooth surface. Profile of porcelain must conform to IEC:815. Creepage Distance shall be according to EC:60815-1,2,3 for heavy pollution.

5.3 **Marking:-** Polarity shall be marked indelibly on block letters marked on each CT and at the lead terminals of the associated terminal block. It should not be peeled off during the life span of the CT.

5.4 **Name Plate:-** Instrument transformer shall be provided with stainless steel name plates as per IS:2705 incorporating year of manufacture and all relevant information as per IEC:60044-1 engraved or printed. The supplier's Serial No: shall also be punched on tank for easy

identification in case of loss of nameplate. Resistance of the secondary winding corrected at 75⁰C and value of tan δ obtained during testing corrected at 20⁰ C shall be recorded on the name plate.

6 Construction:-

6.1 Core:- The core shall be of high grade, non-ageing, electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over currents. The current transformer core to be used for metering and instrumentation shall be of accuracy class specified or appropriate class (CRGO silicon steel or Nickel alloy) suitable for precision metering. The saturation factor of this core shall be low. Current Transformer cores to be used for protective relaying purposes shall be of accuracy class specified or appropriate class suitable for Differential & REF protection, over current protection. The protection class cores shall be designed for a minimum saturation factor of 10 for the highest setting.

6.2 Tank:- The metal tank shall have minimum number of welded joints and shall be made of mild steel. The metal tank including top cover shall be coated with coats of Zinc rich epoxy painting of thickness 50 microns. All ferrous parts shall be hot dip galvanized. Expansion chamber at the top of the porcelain insulator should be suitable for expansion of oil and provision of primary terminals. Between expansion chambers of primary terminals leak proof and temperature resistant five play gasket shall be used.

6.3 Gaskets:- The gasket material used shall be Neoprene based rubberized cork type RC 70-C as per IS:4253 Part II-1980.

1)	Specific gravity	-	0.7 to 0.8
2)	Hardness, IRHD	-	70 \pm 5
3)	Compressibility at 28 kg/cm ² , %	-	30 \pm 5 (for 6.4t) - 33 \pm 5 (for 9.6t)
4)	Compressibility at 60 kg/cm ² , %	-	40 \pm 5 (or 6.4t) - 45 \pm 5 (or 9.6t)
5)	Recovery at 28kg/cm ² , % min	-	80
6)	Recovery at 60kg/cm ² , % min	-	70
7)	Tensile Strength, Kgcm ² , min.	-	18
8)	Compression Set, % Max.	-	80 (110 to 120 ⁰ C)
9)	Flexibility	-	Shall pass
10)	Chemical test on water extract	-	
	a) PH	-	5 to 8.

b) Chloride Content as chloride ion - 0.2% max.

c) Sulphate Content as sulphate ion - 0.2% max.

The gaskets provided on all openings of CTs should be clamped properly with stoppers of optimum torque to avoid permanent setting, no over tightening should be carried out causing loss of spring effect. Porcelain bottom gaskets shall be placed on suitable grooves.

Primary and secondary winding shall be made up of hard drawn electrolytic copper as per standards.

6.4 Winding:- The rating of the secondary winding shall be one ampere as specified in the schedule. Secondary terminals shall be brought out in a compartment on one side of Current Transformer for easy access. The secondary terminals shall be provided with short circuiting arrangements. The secondary taps shall be adequately reinforced to withstand normal handling without damage. All fixing nuts, bolts, washers in electrical current path shall be made of stainless steel. CTs / NCTs the primary terminals shall be made out of rods not less than 30mm dia. copper or equivalent as per IS / IEC.

6.5 Insulation:- The current transformers shall withstand satisfactorily the dielectric test voltages corresponding to basic insulation level of 325kVp / 140kV rms, PD voltages as per IEC:270, 61869-1. The IR value should be more than 50000MΩ at 5000V DC.

6.6 Insulation oil:-The first fill of oil complies with the requirement of latest edition of IS 335 / IEC 60296. Current Transformer shall be vacuum filled with oil and thereafter hermetically sealed to eliminate breathing and to prevent air and moisture to enter the tank. For compensation for variation of oil volume due to temperature, nitrogen cushion shall be provided.

The oil shall conform to the requirements of Indian Standard 335 / IEC60296, subject to the requirements of the contractor's specification being fulfilled; the actual oil to be used shall be at the discretion of the Board.

6.7 Type of mounting:-The current transformers shall be suitable for mounting on hot dip galvanized steel support structures. The necessary flanges, bolts etc..., for the base of the CT shall be supplied and these shall be hot dip galvanized.

The supporting structure (galvanized) for the current transformers is **not** included in the scope of this specification. The details of supporting structures should also be furnished along with dimensional drawing. The height of the supporting structure shall be such that clearance between ground and live part shall not be less than the statutory requirements.

Adequate factor of safety shall be provided in the design of structure. The structure shall be of Lattice Type. Bottom PCD of CT shall be as per relevant IS so that Transformer can be replaced on damage. Structure shall be made of 4 No's of 65x65x6 mm mainframe and 32 No's of 50x50x6 mm cross pieces. Preferably bottom plate size shall be 600x600x8 mm or tubular post

with adequate design in ASTM standard. The weight of structure with and without galvanising to be furnished. The galvanising thickness shall be >87 micron or 610 gm/m².

6.8 Terminal connectors:- Bimetallic Terminal Connector suitable for ACSR “Kundah” shall be supplied. Metal tank of CT shall be provided with two separate earthing terminal for bolted connections. The terminal connectors shall meet the following requirements:

- 1) Terminal connectors shall be manufactured and tested as per IS:5561 or equivalent IEC.
- 2) All castings shall be free from blowholes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 3) No part of a clamp shall be less than 10mm thick.
- 4) All ferrous parts shall be hot dip galvanized conforming to IS:2633 or equivalent IEC.
- 5) For bimetallic connectors, copper alloy liner of minimum 2mm thickness shall be cast integral with aluminium body.
- 6) Flexible connectors shall be made from tinned copper / aluminium sheets.
- 7) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 8) Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS:5561 or equivalent . Bolt and nut are also included in the scope of supply.

6.9 Secondary Terminal Box:-CT secondary terminals shall be brought out in weatherproof terminal box. The terminal box shall be provided with removable cover and 4 No’s of cable gland. Cable gland shall be suitable for 1100 V grade PVC insulated PVC sheathed two core stranded 4 mm² copper conductor . Dimension and opening of box shall be adequate for easy access and working space with normal tool. Provision should be made for short-circuiting and grounding CT terminal, inside the box. Connect well make 32 A CST terminal connector shall be used for terminating leads from CT secondary board and outgoing cable.

6.10 Test Tap:- Test Tap shall be provided for all CTs to measure dielectric dissipation factor ($\tan \delta$) at field and shall be shown in GA Drawing. Provision shall be made of a screw on 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 necessity of its solid earthing as per prescribed method before energizing the equipment. The value of $\tan \delta$ shall be preferably less than 0.005 at ambient temperature as per IEC 60044-1. Any deviation in $\tan \delta$ value will be accepted only on production of substantiating international standards. The value shall be recorded on the nameplate. The test tap shall have minimum 2 kV insulation level. KSEBL accepted value of $\tan \delta$ by our inspecting crews are:

- At commissioning < 0.5% @ 10 kV.
- Routine test <4% @ 10 kV.

7 **Tests:-** The offered product shall be type tested as per IS 2705 and IEC 60044-1 at lab accredited by “National Accreditation Board for testing and Calibration Lab” and shall comply with all relevant standards. The Bidder must submit copies of Type test reports with the bid as per latest edition of IS:2705 (Part-1,11,111 &1V), IEC:60044-1. Each current transformer shall be subjected to routine tests as specified in Indian Standard 2705, IEC:60044-1. All routine tests shall be made prior to dispatch in the presence of the representative of the purchaser if so desired by the purchaser on samples random selected and the test results in quadruplicate shall be supplied to the purchaser for approval. Also 24 hours pressure test to check for leakage shall be done in the presence of Board’s representative if so desired by the Board.

7.1 **Type tests:-**

7.1.1 **Test on CT unit**

1. Short Time Current test
2. Temperature rise test
3. Lightning impulse test
4. Wet & Dry Power Frequency withstand test.
5. Determination of errors of measuring and protection core

The test reports of the type tests and the following additional type tests shall be submitted:-

- i) Seismic withstand test
- ii) Thermal stability test, i.e. application of rated voltage and rated extended thermal current simultaneously by synthetic test circuit.
- iii) tan delta measurement.

7.1.2 **Test on Insulator**

1. Visual Inspection.
2. Mechanical Performance test.
3. Electro-Mechanical Falling Load test.
4. Porosity test.

7.2 **Routine tests:-**

1. Verification of terminal marking

2. Power frequency withstand test on primary winding
3. Partial discharge test on primary winding
4. Power frequency withstand test on secondary winding
5. Power frequency withstand test between sections
6. Inter turn voltage test
7. Determination of errors of measuring and protection core
8. V_{kn} , I_0 and R_{ct} measurement of class X core.
9. Insulation Resistance Test:
 - a) The IR value should be more than $50G\Omega$ at 5000V DC when measured between primary to earth and primary to secondary
 - b) The IR value should be more than $50G\Omega$ at 5000V DC when measured between secondary to primary.



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TECHNICAL PARTICULARS OF 66kV CT
RATIO 600/300/150/75/1-1-1-1A (4C) (LIVE TANK TYPE)

Particulars	Guaranteed Values			
	Core I	Core II	Core III	Core IV
1. Type				
2. Manufacture's Design Type				
3. Rated Voltage				
4. Rated Primary Current				
5. Rated Secondary Current				
6. No. of Cores				
7. Core Details	Core I	Core II	Core III	Core IV
Rated Output VA (Core-IV-20)				
Accuracy Class (Core-I,II&III-PS, IV-0.2)				
ISF (Core-IV - ≤5)				
Knee Point Voltage V (600V minimum)(Core-I, II & III)				
Secondary Limiting Voltage				
	Required		Guaranteed	
8. Rated short circuit current for 1 sec	31.5 kA			
9. Rated current dynamic (peak value)	78.75 kA			
10. Rated continuous thermal current.	120%			
11. One minute power frequency dry withstand test voltage	140 kV			
12. One minute power frequency wet withstand test voltage	140 kV			
13. Full wave lightning impulse withstand voltage 1.2/50 microseconds	325 kVp			

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Particulars	Guaranteed Values
14. One minute power frequency withstand test voltage on secondary	3 kV
15. Type Tests	Complied and test report attached? (Furnish test report date and testing agency)
a) Short time current test.	
b) Temperature rise test	
c) 1.2/50 microsecond lightning impulse withstand test	
d) Wet & Dry Power Frequency withstand test for outdoor instrument transformers	
e) Determination of errors of measuring and protection core	
f) Seismic withstand test	
g) Thermal stability test	
h) tan δ measurement.	
i) Tests on Insulator	
1. Visual Inspection	
2. Mechanical Performance test.	
3. Electro-Mechanical Falling Load test	
4. Porosity test.	
16. Current density in the primary winding at (A/mm ²)	
a) Normal rating	
b) Short time rating for 1 sec.	
c) Short time rating for 3 sec.	
d) Dynamic rating	
17. Flux density at knee point voltage	

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Particulars	Guaranteed Values
18. Variation in ratio and phase angle error due to variation in	
a) Voltage by 1%	
b) Frequency by 1 Hz.	
19. Whether pressure relief device is provided	
20. Weight of Oil	
21. Total weight	
22. Magnetization curve of CT cores	
23. Mounting details	
24. Overall dimensions	
25.	
a) Maximum exciting current at knee point voltage at $V_k/2$ (30mA)	
b) Resistance of the secondary winding corrected to 75°C (<4 Ω)	
c) Resistance of the secondary winding corrected to 35°C	
26. Total / protected creepage in mm	
27. Any other details required as per IS.2705	
28. Method of ratio change	
29. Grade of Oil	