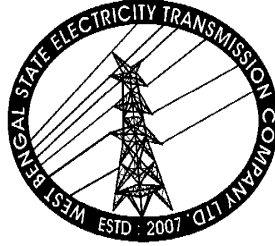


# CAPACITOR VOLTAGE TRANSFORMER

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*Engineering Department*

**WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED**

পশ্চিমবঙ্গ রাজ্য বিদ্যুৎ সংবহন কোম্পানি লিমিটেড  
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## **TECHNICAL SPECIFICATION FOR CAPACITOR VOLTAGE TRANSFORMER**

### **1. SCOPE :**

This section covers design, manufacture, assembly and testing at the manufacturer's works, supply, delivery at site of 420KV, 220KV & 132KV CVT complete with fittings and accessories. The CVTs shall supply voltage for metering, synchronizing and relaying services in 3-phase solidly grounded system and shall also be used for communication, teleprotection, telemetering and for line synchronization.

### **2. STANDARDS :**

Capacitor Voltage Transformers and accessories covered by this specification shall comply with the requirements of the latest edition of the IS/IEC standards. In the event of the equipment conform to any other internationally recognized standards which ensure better or equivalent quality are acceptable. Salient points of comparison shall be clearly brought out in the bid and a copy of the standard in English language shall be submitted.

### **3. DEVIATION :**

Normally the offer should be as per Technical specification without any deviation. But any deviation proposed must be mentioned in the "Deviation Schedule" with reasons and advantage of such deviation. Deviations not mentioned in "Deviation Schedule" will not be considered afterwards. Such deviation may or may not be accepted.

### **4. CONSTRUCTION :**

The features and constructional details of the capacitor voltage transformers shall be in accordance with the requirement stipulated hereunder:

- a) Capacitor Voltage Transformers shall be complete in all respects and shall conform to the modern practice of design and manufacture.
- b) Capacitor Voltage Transformers shall be outdoor type, single-phase, 50 Hz, housed in 220KV & 132KV class, oil filled, self-cooled shaded porcelain bushing suitable for operation under the service conditions as specified in general condition of service without protection from sun, rain and dust.
- c) Capacitor Voltage Transformers shall be suitable for upright mounting on steel structures and shall preferably be suitable for horizontal transportation. The bidder shall also offer suitable steel pedestal/stand for CVTs and other outdoor equipment i.e Coupling devices etc and the stand should have a minimum height of 2500 mm.

- d) The capacitor voltage transformers shall be complete with accessories like terminal connector for primary connection, weather proof terminal box for secondary connection, lifting lugs, grounding terminals, oil sight glass, filling and draining plugs and name plate.
- e) The capacitor voltage transformers shall be filled up with insulating oil having characteristic as per latest IS:335 as specified. Capacitor Voltage Transformers shall be hermetically sealed to eliminate breathing and to prevent ingress of air and moisture into the capacitor stack and into the tank of Capacitor Voltage Transformer. The tank shall have a built-in-provision to dissipate any excessive internal pressure.
- f) The capacitor voltage transformers shall consist of coupling capacitive dividers and electromagnetic units and shall be suitable for coupling the carrier equipment to the 220KV & 132KV overhead lines.
- g) The coupling of Capacitor Voltage Transformers shall be suitable for the entire carrier frequency range of 40 KHz to 500 KHz. Necessary arrangement for preventing the HF signal to flow to the other circuits shall be provided.
- h) The capacitor divider may consist of primary and secondary capacitance.
- i) The capacitor voltage transformers shall have two secondary windings, one of which are intended for protection and the other one for metering.
- j) Material for Primary and Secondary winding shall be of Copper.
- k) The Capacitor voltage transformer secondary shall be protected by HRC cartridge type fuses for all the windings.
- l) The HF terminal shall be kept earthed when not used for PLCC purpose. Earthing link with fastener to be provided for HF terminal.
- m) Capacitor Voltage Transformers shall be suitable for high frequency (HF) coupling required for power line carrier communication.
- n) Connection between coupling device and CVT shall be done by means of 6sq. mm copper wire taped with 11KV insulation

## **5. TEMPERATURE RISE :**

- The maximum permissible temperature rise of the capacitor voltage transformer windings at 1.2 times rated primary voltage, rated frequency and rated burden corresponding to the highest rated output at any power factor between 0.8 and unity, over an ambient temperature of 50°C shall not exceed the limits as specified in IEC standards.
- The temperature rise at 1.5 times rated primary voltage when supplied for 30 seconds starting at stable thermal conditions achieved by supplying 1.2 times the rated voltage continuously shall not exceed by more than 10°C the values specified in the clause above.
- For any ambient temperature above the reference ambient temperature, the permissible temperature rise shall be reduced by an amount equal to excess ambient temperature.

## **6. BUSHING OF CVT:**

- a) The bushing shall have insulation, mechanical strength and rigidity for the condition under which then will be used at site and shall be designed to prevent accumulation of explosive gases and provide adequate oil circulation to remove internal heat.
- b) There shall be no undue stressing of any part of the bushing due to temperature change and adequate means shall be provided to accommodate conductor expansion.
- c) The bushing shall not cause any radio interferences when operated at rated system voltage.
- d) All ferrous parts of the bushing including lifting hooks, cast metal end caps, bolts, nuts etc. used on the bushing shall be of high strength and hot dip galvanized as per IS:2633 as amended up to date.

- e) Porcelain used, shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture.
- f) The glazing of porcelain shall be of uniform brown or dark brown colour, free from blisters, burns and other similar defects and shall have smooth surface arranged to shed away rain water. The porcelain shall have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- g) The insulation of the porcelain shall be coordinated with that of the capacitor voltage transformers such that the flash over, if any, will occur only external to the voltage transformer.
- h) The porcelain shell of the bushing shall be as per IS:5621 or IEC:815.
- i) The porcelain shed shall be alternate long and short as per IEC:815.
- j) Capacitor Voltage Transformers must withstand mechanical stresses resulting from wind pressure of 150Km per hour.

## **7. INSULATING OIL :**

The quantity of insulating oil for filling complete unit shall be stated and the insulation oil shall comply in all respects with the provisions of the latest edition of IS:335 or IEC Publication 296 (as amended up-to-date).

## **8. TERMINAL CONNECTORS :**

- a) Capacitors Voltage Transformers shall be supplied with primary terminal connector suitable to connect twin Moose ACSR/approved drawings Conductor.
- b) The terminal connectors should conform to the respective specification for clamps and connectors.

## **9. GROUNDING TERMINALS :**

Two grounding terminals shall be provided on the diagonally opposite sides of the tank of each capacitor voltage transformer. The grounding conductor shall be MS flat of size 75 mm x 6 mm.

## **10. SECONDARY TERMINAL BOX :**

- i) All secondary terminals of the capacitor voltage transformers shall be brought out in a weather proof terminal box provided at one side of each voltage transformer for easy access. CVT sec. terminal box shall be made of sheet steel having minimum thickness of 3 mm. However, 2 mm. thickness having powder coated painting is acceptable.
- ii) The terminal box shall be hot-dip galvanized/painted.
- iii) The terminal box shall be provided with a removable cable gland plate at the bottom for mounting three cable glands suitable for 1100V grade, steel wire armoured, PVC sheathed 4 x 2.5 sq. mm. stranded copper conductor cables. The cable glands shall be included within the scope of supply and shall be screw on type and made of brass.

- iv) The terminal box shall be provided with a door on the front so as to permit easy access to secondary terminals. The door shall be provided with locking arrangement to prevent ingress of moisture and water into the terminal box.
- v) The terminal box shall be provided with a terminal board. The terminals shall be so staggered that connection of external cable to any terminal block should be possible without disturbing the rest of the connections. The terminal block arrangements shall be such as to provide maximum accessibility to all conductor terminations.
- vi) The terminal blocks shall be fully enclosed and made of moulded, non-inflammable plastic material and barriers moulded integrally.
- vii) Terminal block arrangements shall be such that it will be possible to connect or disconnect terminals on live circuits.
- viii) All terminals shall be clearly marked with identification number to facilitate connection to external wiring.
- ix) One secondary terminal other than three winding shall be connected through impedance to avoid ferroresonance.
- x) A protective surge arrester shall be provided to prevent breakdown 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 alternate arrangement, bidder shall bring out details in the bid.

#### **11. NAME PLATE :**

Capacitor Voltage Transformers shall be provided with name plate. Name plate shall conform to the requirements of the relevant IEC incorporating the year of manufacture.

#### **12. PAINTING :**

- i) The tank shall either be hot dip galvanized or painted. All steel surfaces shall be cleaned by sand blasting or chemical process as required to produce a smooth surface, free of scale, grease and dirt. Steel surfaces in contact with insulating oil shall be painted with heat resistant oil insoluble insulating varnish.
- ii) External surfaces shall be given a coat of high quality red or yellow chromate primer and finished with two coats of synthetic enamel paints (Light gray as per shade 631 of IS:5).
- iii) Paints shall be carefully selected to withstand tropical heat, rain etc. The paints shall not scale off a crinkle or be removed by abrasion due to normal handling.

#### **13. CONTRACT DRAWING AND MANUALS :**

After placement of Purchase Order or Letter of Award (LOA) the contractor shall submit six (6) copies of drawing/catalogue to the Chief Engineer, Tr. Project, Vidyut Bhavan, 10<sup>th</sup> floor, Salt Lake, Kolkata – 91 for approval.

- i) Outline general arrangement dimensional drawing of Capacitor Voltage Transformer furnishing front and side elevations, top and bottom plan views, cross sectional view, all accessories and external feature, mounting arrangement on steel structure, spacing and size of the mounting bolts, total and protective creepage distance of the bushing, internal circuit diagram with polarity marks, terminal arrangement for secondary terminal box, size of primary terminals, grounding

terminals and lifting lugs, quantity of insulating oil, net and shipping weights, shipping dimensions etc.

- ii) Name and rating plate diagram of the Capacitor Voltage Transformers.
- iii) Foundation and anchor details including dead load and impact load with direction and point of application and also location of Centre of Gravity of CVT.
- iv) Technical catalogue, operation and maintenance manual.
- v) Any other drawings found necessary in addition to those stated above.
- vi) Ten(10) sets of approved drawings and ten(10) copies of erection, operation and maintenance manual for the capacitor voltage transformers in English language shall be submitted for each substation for our record and distribution to site. The manual shall contain the following :
  - a) A brief description of Capacitor Voltage Transformers furnishing the constructional features.
  - b) Operation and maintenance of Capacitor Voltage Transformers.
  - c) Outline general arrangement drawing of Capacitor Voltage Transformers furnishing all the components and accessories.
  - d) Marked erection prints identifying the component parts of Capacitor Voltage Transformers.
  - e) Detailed dimensions, assembly and description of all the accessories.
  - f) Diagram plate, internal circuit diagram of the component parts of the CVT's and terminal arrangement of the secondary terminal box.
  - g) Any other information found necessary in addition to those stated above.
  - h) In all drawings reference of L.O.A. No. shall be mentioned.

#### **14. TEST AT FACTORY AND TEST CERTIFICATES :**

The following acceptance test shall be carried out on every lot of Capacitor Voltage Transformers offered for inspection as per latest edition of IS:3156 (Part I to IV) and IEC:358. The entire cost of acceptance and routine test that are to be carried out as per relevant IS & IEC shall be treated as included in quoted price of CVT. Six copies of test reports shall be submitted to the Chief Engineer, Tr. Project, Bidyut Bhavan, 10<sup>th</sup> floor, Salt Lake, Kolkata-700091 for approval and adequate extra copies for distribution at site. The contractor shall give at least 21 (twenty-one) days notice in advance of the date when the test will be carried out. Six(6) copies of routine test results of capacitor voltage transformer shall be submitted to the Chief Engineer, Engineering, for approval.

- i) Verification of terminal markings and polarity as per clause 15 of IEC:186 as amended up to date.
- ii) Power frequency test on the primary winding as per clause 16 of IEC:186 as amended up to date.
- iii) Power frequency test on the secondary winding as per relevant clause of IEC:186 as amended up to date.
- iv) Determination of error according to the requirement of the appropriate accuracy class as per clause 26 and 36 of IEC:186 as amended up to date.
- v) Capacitance and loss angle measurement before and after voltage test as per clause 7 and 8 of IEC:358 as amended up to date.
- vi) Partial discharge test on capacitor dividers as per clause 13.1 of IEC:358 as amended up to date.
- vii) Sealing test as per clause 15 of IEC:358 as amended up to date.

Any other acceptance test not mentioned above but required as per relevant IS & IEC shall also be carried out. Selection of samples for acceptance test as well as rejection and retesting shall be guided by relevant IS & IEC.

## 15. ERECTION AND MAINTENANCE TOOLS :

Special tools and equipment, if any, required for installation and maintenance of Capacitor Voltage Transformers shall be supplied by the Contractor with the Capacitor Voltage Transformers without any extra cost. Quantity of special tools and tackles to be supplied will be decided by the purchaser from the list given by them with the bid.

## 16. TEST REPORTS AND TYPE TESTS :

Only type tested CVT from the maker's list of WBSETCL are to be offered for all voltage classes CVT conforming to our technical specification and relevant IS & IEC. CVT offered should be identical with ones on which type testing has been carried out as per relevant IS & IEC. Three sets of complete type test reports carried out in Govt. recognized Test House or Laboratory/NABL accredited laboratory shall have to be submitted. Successful bidder may require to produce original copies of the type test reports at the time of detail Engineering if asked by WBSETCL.

Each type test report shall comply the following information with test result.

- i) Complete identification, date and serial no.
- ii) Method of application, where applied, duration and interpretation of each test.
- iii) Relevant drawings as documented with test report.

## 17. GUARANTEE:

Electrical characteristics shall be guaranteed by the bidder. In case of failure of materials to meet the guarantee, WBSETCL shall have right to reject the material. Guaranteed Technical Particulars are to be submitted by successful bidder during detailed engineering along with submitted drawings/documents. However, format for submission of GTP shall be handed over to intending bidders at the time of sale of tender documents.

## CORE DETAILS

Sl. No.	Description of Core	Number of Core	Core I	Core II & III
1	400000/ $\sqrt{3}$ : 110 / $\sqrt{3}$ , 110/ $\sqrt{3}$ , 110/ $\sqrt{3}$	3	100 VA, 0.2	200 VA , 3P
2	220000/ $\sqrt{3}$ : 110 / $\sqrt{3}$ , 110/ $\sqrt{3}$ , 110/ $\sqrt{3}$	3	50VA, 0.2	50VA , 3P
3 a)	AIS:- 132000/ $\sqrt{3}$ : 110 / $\sqrt{3}$ , 110/ $\sqrt{3}$ , 110/ $\sqrt{3}$	3	50VA, 0.2	50VA , 3P
b)	GIS:- 132000/ $\sqrt{3}$ : 110 / $\sqrt{3}$ , 110/ $\sqrt{3}$ , 110/ $\sqrt{3}$	2	50VA, 0.2	50VA, 3P
4 a)	AIS:- 33000/ $\sqrt{3}$ : 110 / $\sqrt{3}$ , 110/ $\sqrt{3}$	2	100 VA, 0.2	100 VA, 3P
b)	Indoor Switchgear: 33000/ $\sqrt{3}$ : 110 / $\sqrt{3}$ , 110/ $\sqrt{3}$	2	50 VA, 0.2	50 VA, 3P

**Note : The accuracy of 0.2 on winding I should be maintained up to and including the total simultaneous burden of 100VA together.**

### SPECIFIC TECHNICAL PARAMETERS

The capacitor voltage transformers shall be suitable for carrier coupling.

			<u>420KV</u>	<u>220KV</u>	<u>132KV</u>
a)	Highest system voltage KV (rms)	:	420	245	145
b)	Rated system voltage KV (rms)	:	400	220	132
c)	Rated frequency HZ	:	50	50	50
d)	System fault level KA (rms)	:	50	40	31.5
e)	System neutral earthing	:	Effectively earthed	Effectively earthed	Effectively earthed
f)	Installation	:	Outdoor	Outdoor	Outdoor
g)	Service condition	:	As per general condition of service	As per general condition of service	As per general condition of service
h)	Limits of Temperature rise (immersed in oil)	:	55°C	55°C	55°C
i)	Voltage factor	:	1.5 for 30 Sec. 1.2 continuous	1.5 for 30 Sec. 1.2 continuous	1.5 for 30 Sec. 1.2 continuous
j)	Rated insulation level :	:			
	4.1.1 1.2/50 microsecond impulse withstand voltage KV (peak).	:	1425	1050	650
	4.1.2 One minute Dry & Wet power frequency withstand voltage KV (rms)	:	630	460	275
k)	Total capacitance (picofarad)	:	4400 + 10% - 5%		
l)	a) High frequency capacitance for the entire carrier frequency range.	:	Within 80% to 150% of rated capacitance		
	b) Equivalent series resistance over the entire carrier frequency range (Ohms)	:	Less than 40		
m)	Stray capacitance (Pico farads) & stray conductance (micro Siemens) of the low voltage terminal of a complete CVT including Electro Magnetic Unit over the entire carrier frequency range.	:	520 (max)		
		:	50		
n)	One minute power frequency test :	:			
	a) Withstand voltage between HF (low voltage) terminal of intermediate transformer & earth terminal, KV (rms).	:		4	
	b) Withstand voltage for secondary windings & earth terminal, KV (rms).	:		3	
	c) Withstand voltage between HF(LV) carrier coupling terminal & earth terminal, KV(rms)	:		10	
o)	Creepage distance Total (mm)	:	10500	6125	3625
p)	Partial discharge level, Pico coulombs	:	10	10	10
q)	Suitable for carrier coupling	:	Yes	Yes	Yes