POTENTIAL TRANSFORMER

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Engineering Department

WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED
পশ্চিমবঙ্গ রাজ্য বিদ্যুৎ সংবহন কোম্পানি লিমিটেড
(পশ্চিমবঙ্গ সরকারের একটি উদ্যোগ)

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Updates for WBSETCL / TECH SPEC / Rev.-2.2

1. No. of Core is increased from **2** to **3** for **132 KV GIS** in **Core Details of PT.**
2. The creepage distance has been changed for Very Heavily polluted atmosphere in SPECIFIC TECHNICAL PARAMETERS OF POTENTIAL TRANSFORMERS.
3. Burden for 132 and 220 KV GIS Bus PT and GIS Line PT is updated in **Core Details of PT.**
4. Burden and accuracy for 11 KV Indoor PT is updated in **Core Details of PT.**
5. A list of standard tests to be performed is included under **clause no 13.**

TECHNICAL SPECIFICATION FOR POTENTIAL TRANSFORMERS

1. SCOPE :

i) This specification covers the design, manufacture, assembly, testing at the manufacturer's works of potential transformers in three phase system of 400KV, 220 KV, 132 KV and 33 KV class.

ii) These potential transformers will be used as Bus-Bar P.T. for voltage indication by voltmeter through selector switch and supply of voltage to meters, high speed distance relays etc. for feeder protection and synchronisation devices.

2. STANDARD :

The potential transformers and accessories covered by this specification shall comply with the requirement of the latest edition of the following standards unless otherwise stated in this specification:

IS: 3156 Part (I-IV)	:	Specification for Voltage Transformer
IS: 4146	:	Application guide for Voltage Transformers
IS:2099 / IS: 5621	:	Specification for Bushings/hollow insulators for alternating voltages above 1000 volts
IS: 335	:	Specification for Insulating Oil
IS 3024	:	Specification for Core Materials

3. DEVIATION:

Normally the offer should be as per Technical Specification without any deviation. But any deviation felt necessary to improve performance, efficiency and utility of equipment must be mentioned in the Deviation Schedule with reasons duly supported by documentary evidence. Such deviations suggested may or may not be accepted by the Board. Deviations not mentioned in Deviation schedule will not be considered.

4. DESIGN & CONSTRUCTION OF POTENTIAL TRANSFORMERS:

The design features and construction details of potential transformers shall be in accordance with the requirement stipulated hereunder:

i) The potential transformers shall be complete in all respects and shall conform to the modern practice of design and manufacture.

ii) The potential transformers shall be electromagnetic, outdoor type, single phase, oil filled, self-cooled, having shaded porcelain bushing /Insulator as per IS:2099 / IS:5621, suitable for operation under the service conditions without protection from sun, rain and dust.

iii) The maximum temperature rise at 1.2 times rated primary voltages, rated frequency and rated burden, shall not exceed the following values over the above stated maximum ambient temperature.

Class of insulation	Maximum Temp. Rise ° C
For winding with class A Insulation immersed in oil (Measured by Resistance method)	50° C
Oil at the top of the tank (Measured by Thermometer)	40° C
With 1.5 times rated voltage for 30 seconds	10°C more than above value after application of 1.2 times rated voltage for a time sufficient to reach stable thermal condition
Maximum ambient temp. to be considered	50° C

iv) The potential transformer shall be capable to withstand line discharge effect and also the ferro resonance effect.

v) The potential transformers shall be suitable for up right mounting on steel structures. Necessary flanges, bolts, clamps fittings etc. for base of P.T. are within the scope of the supplier.

vi) The P.T. shall be complete with all accessories like Primary Terminals, weather proof terminal box for secondary connection, lifting lugs, grounding terminals, oil sight glass, pressure relief device, filling and draining plugs and name plate.

vii) The P.T. shall be oil immersed type provided with class A insulation. It shall be of hermetically sealed type construction to prevent air & moisture from entering the tank. viii) The core of the PTs shall be high grade non-aging, CRGO silicon Steel laminated steel of low hysteresis loss and high permeability to ensure high accuracy at both normal and over voltages conforming to IS: 3024.

ix) PT Characteristics shall be such as to provide satisfactory performance for burdens ranging from at least 25% to 100% of rated burden over a range of at least 5% to 110% rated voltage in case of protective cores and a voltage range of 80% to 120% (0.8 pf lagging) in case of measuring cores.

x) The P.T. secondary terminals shall be brought out through fuse of suitable rating in a weatherproof terminal box for easy access.

xi) Coils used shall be of copper.

xii) For 220KV, 132 KV &33 KV class P.T, connection between P.T junction Box to C & R panel (For metering core only) shall have to done with 25 sq mm 3½ core PVC copper or equivalent Al. control cable. Suitable termination arrangement is to be made in the P.T junction Box as well as in C & R panel.

5. BUSHING:

i) Shaded porcelain bushing / Insulators conforming to latest edition of IS: 2099 / IS: 5621 shall be used for P.T.
ii) Cast metal end caps for the bushings shall be of high strength, hot-dip galvanised malleable iron. They shall have smooth surface to prevent discharge taking place between the metal parts and porcelain as a result of ionisation.
iii) The insulation of bushing shall be co-ordinated with that of the potential transformer such that the flashover, if any will occur only external to the PT.
iv) Each of the bushings shall be complete with the following:

a) Primary terminals suitable for connection through Rigid/Flexible Connectors for ACSR conductors/Aluminium Pipe bus.
b) Oil level gauge and convenient means of oil and nitrogen filling, sampling and draining of oil.
c) End shields for distribution of stresses, if required.
d) Cantilever strength of Bushing/insulator shall be as per Cl. No. 5.5 of IS:2099 (latest edition) for all voltage classes.

6. INSULATING OIL:

The quantity of insulating oil for filling of complete unit shall be stated. The oil shall comply in all respect with the provisions of the latest edition of IS: 335.

7. GROUNDING TERMINALS:

Two grounding terminals on diagonally opposite sides of adequate size suitable for connecting G.S. Flat of 50×10mm shall be provided for all voltage classes. HV Neutral terminal earthing and body earthing should be marked distinctly and be physically well separated. The terminal of high voltage winding intended to be earthed shall be brought out through a bushing, insulated from case or frame to be earthed by a separate arrangement.

8. SECONDARY TERMINAL BOX :

i) All secondary terminals shall be brought out in a compartment on one side of each potential transformer. P.T. Sec. terminal box shall be made of sheet steel having minimum thickness of 3mm. However, 2 mm. thicknesses having powder coated painting is acceptable.
ii) The exterior of this terminal box shall be hot dip galvanised/ weather proof paints as mentioned against Item no 10 below.
iii) The terminal box shall be provided with removable cable gland plates at bottom for mounting cable glands suitable for 1.1 KV grade steel wire armoured, PVC insulated, PVC sheathed 3Cx2.5 sq. mm. stranded copper conductor cables. The cable glands shall be included within the scope of supply.

iv) 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 ingress of moisture and rain water. Door shall be provided with braided copper wire connecting main body with door lid for earthing purpose. The degree of protection shall not be less than IP-55 as per IS:13947

v) All terminals shall be clearly marked with identification number to facilitate connection to external wiring in accordance with relevant Indian Standards.

9. PAINTING:

i) The tank and top metallic shall 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.

ii) Steel surface in contact with insulating oil shall be painted with heat resistant oil insoluble insulating varnish.

iii) External surface shall be given a coat of high quality red or yellow chromate primer and finished with two coat of synthetic enamel paints (light grey as per shade 631 of IS:5). Paint shall be carefully selected to withstand tropical heat rain etc. The paint shall not scale off or crinkle or to be removed by abrasion due to normal handling.

10. 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.

11. CONTRACT DRAWINGS AND MANUALS:

i) In the event of placement of LOA, the following drawings and manuals shall be submitted in six (6) copies for approval.

i) General outline dimension drawing of potential transformers furnishing front and side elevation, top and bottom plan, views showing all accessories, mounting arrangement on steel structures, spacing and size of the bolts, total creepage distance of bushing, electrical diagram for primary and secondary connections with polarity mark, terminal arrangement for secondary terminal box, size of primary terminals, grounding terminals and lifting lugs, quantity of insulating oil, net and shipping weight, shipping dimension etc.

ii) Name and rating plate diagram of P.T.

ii) After approval, four (4) sets of approved drawings and operating & maintenance manual including the instruction manual both in soft and hard format shall be submitted for our record and distribution to site.
Instruction manual should contain:

i) A brief description of P.T. furnishing the constructional features.
ii) Instruction for handling, storing, erection, commissioning and operation and maintenance of PTs
iii) General outline drawing of the PTs along with all components and accessories.
iv) Marked erection points identifying the component parts of P.T.
v) Detailed dimensions of assembly and description of all accessories.
vi) Detailed views of Core, winding assembly, winding connections and its tapings.
vii) List of spares and other necessary information for P.Ts.
viii) A set of approved test certificate.

12. TESTS AT FACTORY AND TEST CERTIFICATES:

i) Each P.T. shall comply with the requirements of routine test as specified in the relevant Part (I to III) of IS:3156 and IS:4146.
ii) Routine test at manufacturer's works shall be carried out and Test Reports are to be submitted to WBSETCL.
iii) All Acceptance tests shall be carried out at the manufacturer's works on every lot offered for inspection as per relevant IS in presence of representatives of WBSETCL. In addition to above, all routine tests are also to be carried out on Potential Transformer as per relevant IS. Selection of samples for acceptance test as well as rejection and retesting shall be guided by relevant IS. The entire cost of acceptance and routine tests that are to be carried out as per relevant IS shall be treated as included in quoted price of Potential Transformer. Three (3) copies of test reports shall be submitted for approval and adequate extra copies for distribution to site.
iv) The contractor shall give at least 15 (fifteen) days advance notice intimating the actual date of inspection and details of all tests that are to be carried out.

13. TEST REPORTS AND TYPE TESTS:

Only type tested P.T. from the maker's list of WBSETCL are to be offered conforming to our technical specification, and relevant IS and IEC. P.T. offered should be similar with ones on which type testing has been carried out as per relevant IS and 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 by successful bidder positively along with submission of drawings during detailed Engineering. Successful bidder may require to produce original copies 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) Compete identification, date and serial no.
ii) Relevant drawings as documented with test report.
iii) Method of application, Where applied, duration and interpretation of each test

Tests for Potential Transformers [R2.2]
The flowing tests are to be performed as per as per IS 3156 (Part 1): 1992

Type Test	1. Verification of terminal markings and polarity
	2. Power-frequency withstand test on primary and secondary windings
	3. Lightning Impulse voltage withstand test on primary winding and switching Impulse voltage test (420 kV and above)
	4. Temperature-rise test
	5. Determination of limits of voltage error and phase displacement
	6. Determination of capacitance between primary and secondary windings
	7. Short-time current test (if applicable to wound-type VT)
	8. Radio interference voltage (RIV) test (if applicable)

Routine Tests	1. Verification of terminal markings and polarity
	2. Power-frequency withstand test on primary and secondary windings
	3. Partial discharge measurement
	4. Determination of limits of voltage error and phase displacement

Acceptance Tests	1. All routine tests as listed above
	2. Dimension measurement and other physical parameters verification with approve drawings
	3. Impulse test (may be waived if a valid type test certificate is available)

SPECIFIC TECHNICAL PARAMETERS OF POTENTIAL TRANSFORMERS

SNO	DESCRIPTION	TECHNICAL PARAMETERS			
		400 KV	220 KV	132 KV	33 KV
i)	Rated system voltage KV (rms)	400	220	132	33
ii)	Highest system voltage KV (rms)	420	245	145	36
iii)	System frequency (Hz)	50			
iv)	System neutral earthing	Effectively Earthed			-
v)	Installation	Outdoor			
vi)	Voltage variation	10%			
vii)	Voltage factor	1.5 times for 30 sec, 1.2 continuous			1.9 times for 8 Hrs, 1.2 continuous
viii)	Rated insulation level a) 1.2/50 microsecond impulse withstand outage KV (Peak) b) One min. dry power frequency withstands voltage KV (rms)	1425 630	1050 460	650 275	170 70
ix)	Power frequency over voltage withstands requirements for secondary winding	3 KV			
x)	Creepage Distance (Very Heavily polluted atmosphere) Total (mm) [R2.1]	~~10500~~ 13020	~~6125~~ 7595	~~3625~~ 4495	~~900~~ 1116
xi)	Accuracy	PTs shall be of accuracy class 0.2 for metering and 3P for protection as per IS:3156 / IEC 186			
xii)	Ratio a) Primary side (KV) b) Secondary Side (V)	400/√3 110/√3	220/√3 110/√3	132/√3 110/√3	33/√3 110/√3
xiii)	Type of connector suitable for Pipe bus	4" Al. pipe/ACSR Conductor	3 inch/ACSR conductor	2.5 inch /ACSR conductor	1.5 inch/ACSR conductor/XLPE Cable.
xiv)	Partial discharge	Max. 10 (PC)		-	-
xv)	Class of insulation	-		A	-

Core Details of PT

Sl. No.	Description of Core	No. of Core	Core Details of Core I	Core Details of Core II & III
1	400000/√3: 110/√3, 110/√3, 110/√3	3	100 VA, 0.2	100 VA, 3P
2.a)	AIS: - 220000/√3: 110 /√3, 110/√3, 110/√3	3	200 VA, 0.2	200 VA, 3P
b)	GIS: - 220000/√3: 110 /√3, 110/√3, 110/√3 (For Bus PT) [R2.1]	3	100 VA, 0.2	100 VA, 3P
c)	GIS: - 220000/√3: 110 /√3, 110/√3, 110/√3(For Line PT) [R2.1]	3	50 VA, 0.2	50 VA, 3P
3.a)	AIS: - 132000/√3: 110 /√3, 110/√3, 110/√3	3	200 VA, 0.2	200 VA, 3P
b)	GIS: - 132000/√3: 110 /√3, 110/√3,110/√3(For Bus PT) [R2.1]	3 [R2.1]	100 VA, 0.2	100 VA, 3P
c)	GIS: - 132000/√3: 110 /√3, 110/√3,110/√3(For Line PT) [R2.1]	3 [R2.1]	50 VA, 0.2	50 VA, 3P
4 a)	AIS: - 33000/√3: 110 /√3, 110/√3	2	100 VA, 0.2	100 VA, 3P
b)	Indoor Switchgear:33000/√3: 110 /√3 3, 110/√3	2	50 VA, 0.2	50 VA, 3P
5 a)	Indoor Switchgear:11000/√3: 110 /√3	1	50VA, 0.5[R2.1]	

GUARANTEED TECHNICAL PARTICULARS OF POTENTIAL TRANSFORMERS

(To be filled in and signed by the Bidder)

SL	DESCRIPTION	FOR 400 KV	FOR 220 KV	FOR 132KV	FOR 33KV
1	VT: GENERAL				
1.01	Name of Manufacturer				
1.02	Type & Model of the Manufacturer				
1.03	Conforming Standard				
1.04	Date of Last Type Test				
1.06	Oil Filled Insulation or Gas filled Insulation				
1.07	Diameter of High Voltage Stud (mm) x Length (mm)				
1.08	Total Height of the VT				
1.09	Total Weight of the VT				
1.10	Material Used in Primary Winding				
1.11	Material Used in Secondary Winding				
1.12	Rated voltage (KV)				
2	VT : INSULATION LEVEL				
2.01	1.2/50 micro second Impulse withstand voltage (dry) on primary winding (KV peak)				
2.02	One minute power frequency withstand voltage(Dry) on primary winding (KV rms)				
2.03	One minute power frequency withstand voltage(Wet) on primary winding (KV rms)				

2.04	One minute power frequency withstand test voltage in secondary winding (KV rms)				
2.05	250/2500 us switching surge (KVP)		NA	NA	NA
2.06	Rated voltage factor and time between line & Earth with Effective earthing System. (For Continious / 30 secs)				
2.07	Temperature rise at 1.5 time the rated voltage for 30 sec. after operation with 1.1 times the rated voltage (^{0}C)				
2.08	Temperature rise at 1.1 time the rated voltage for continuous operation (^{0}C)				
3	VT :Bushing				
3.01	Minimum creepage distance (mm)				
3.02	Whether CT bushing is hermetically sealed or not				
3.03	Cantilever Strength (Kgf)				
4	VT :Details of Cores				
4.01	Ratio				
4.02	Burden				
4.03	Maximum phase angle error with rated burden & 5% voltage (degree) for Meetering Core				
4.04	Maximum ratio error with rated burden & 5% voltage forMeetering Core.				