

# **WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED**

## **TECHNICAL SPECIFICATION FOR 3.15 MVA POWER TRANSFORMER**

### **1.00: SCOPE OF SPECIFICATION : -**

**1.01:** This specification is intended to cover design, manufacture, assembly testing at manufacturer's works, supply and delivery upto placement on plinth of three phase 50HZ, 33/11 KV Delta/Star, Vector Group DYn11, two windings copper wound outdoor type, oil immersed, naturally air cooled Power Transformer with off load tap changer for 3.15 MVA transformer as per detail furnished hereafter.

**1.02:** The transformer offered shall be completed with all parts and accessories which are necessary for their efficient and satisfactory operation. Such parts and accessories shall be deemed to be within the scope of this specification whether specifically mentioned or not. Main tank body may be delivered in unpacked condition, but delicate parts like indicating meter, radiator, conservator, Pressure Relief Valve, equalizer pipe, buchholz relay etc. shall be packed to avoid damage due to transshipment.

### **2.00: LOCATION : -**

**2.01:** The transformer shall be installed outdoor anywhere in West Bengal.

The elevation of sites above mean sea level is not likely to exceed 1000 metre.

### **3.0: SYSTEM DETAILS :**

**3.01** 33 KV system is non-effectively earthed through earthing transformer, whereas 11 KV system is to be effectively earthed at neutral point of the star connected windings of the power transformer.

System voltage is subject to fluctuation of 10% of nominal voltage. Maximum system voltage for 33 KV and 11 KV system shall be taken as 36 KV & 12.0 KV respectively. The frequency for the purpose of this standard shall be 50HZ with tolerance of  $\pm 3$  %.

### **4.0 WEATHER CONDITION :**

For the purpose of designing, the following condition shall be considered :

- A) Elevation about Mean sea level : 1000 M.
- B) Maximum Ambient Air Temperature : 50 °C.
- C) Maximum daily Average Ambient Air Temperature : 40 °C.
- D) Minimum Ambient Air Temperature: ( -5 ) °C.
- E) Relative Humidity : 100%
- F) Pollution level : Heavily polluted .
- G) Average number of thunderstorm, days per annum : 100
- H) Number of months of tropical monsoon : 4-5
- I) Average Annual rainfall : 3000 mm.
- J) Maximum wind pressure : 250 Kg. Per sq.mtr.

#### **5.00 APPLICABLE STANDARDS :**

**5.01 Unless otherwise stated, transformer shall be designed, constructed and tested in accordance with provisions contained in latest revisions of following Indian standards and Rules.**

- i) IS : 2026
- ii) R.E.C. Manual 10/1976
- iii) C.B. I.P. Manual on Transformer  
Technical Report 1: Section : A.D. (Revised: 1987)
- iv) C.B.I.P. Technical Report No. 72 (June: 1989)
- v) Indian Electricity Rules, 1956 (Amended up to date)
- vi) IS : 2099 Bushing for alternating voltage above 1000 volt
- vii) IS : 6600 Guide for loading of oil immersed transformer
- viii) Specification for Transformer oil (IS-335 & IS-1866,1983)
- ix) Other applicable Indian Stand

## **DEVIATION FROM SPECIFICATION :**

**6.00 Normally the offer should be as per Technical Specification without any deviation.**

**But any deviation felt necessary to improve utility, performance and efficiency of equipment or to secure overall economy shall be mentioned in the "Schedule of Deviations" with full justification, supported by documentary evidence. Such deviations, suggested, may or may not be accepted. But deviations, not mentioned in the "Deviation Schedule" will not be considered.**

## **7.00 RATING AND GENERAL PARTICULARS :**

### **7.01 Type:**

**Core type, three phase, oil immersed, step down, two winding copper wound transformer for outdoor installation.**

### **7.02 Standard Rating :**

**Continuous with off circuit taps as mentioned in the schedule of requirement.**

### **7.03 Continuous Maximum Rating and Temperature rise :**

**As regards maximum rating and temperature rise, all transformers shall comply with the appropriate requirement of Indian Standards.**

**For the purpose of consideration of maximum temperature rise of oil and winding, the following ambient temperature are assumed.**

**i) Cooling medium : Air**

**ii) Maximum Ambient Air temperature : 50 °C.**

**iii) Maximum daily average ambient Air temperature : 40 °C.**

**iv) Maximum yearly weighted average temperature : 32 °C.**

**With the above ambient temperature condition allowable maximum temperature rise shall be as mentioned below :**

**a) Type of Cooling : ONAN**

**b) Maximum top oil temperature rise in °C. : 50**

**c) Maximum Winding/Core temperature rise in °C. : 55**

d) Maximum Winding temperature in °C. : 105

e) Maximum Permissible value of Average temperature of winding after 2 sec : 250  
of short circuit in °C.

**7.04 No load voltage Ratio :**

The no load voltage Ratio corresponding to principal (normal) tapping shall be 33,000/11,000 Volts.

**7.05 Winding connections and Vector Group etc. :**

i) Number of phases : Three

ii) Frequency : 50

iii) Type of Cooling : ONAN

iv) Winding connections :

The primary winding (HV) shall be connected in delta and secondary winding ( LV) shall be connected in star.

v) Vector Group :

Windings shall be connected as per Vector symbol : DYn11

(vi) Neutral Earthing :

The neutral point of Secondary (LV) winding shall be brought out to a separate insulated terminal and shall be solidly earthed.

**7.06 Off Load Tap Changer of the transformer :**

Voltage tapping range on H.V. side will be (+5%) to (-10%) in steps of 2.5%. The tap changing switch shall be located in a convenient position so that it can be operated from ground level. The switch handle shall be provided with a locking arrangement along with tap position, enabling the switch to be locked in position. The tap position marking should increase in clockwise direction and there should be a back stopper in between tap position 1(+5%) & 7(-10%) .

**7.07 Impedance Value :**

The percentage impedance at 75 °C & 50 Hz refer to the (normal) principal Tapping shall be as follows :

<u>Sl.No.</u>	<u>Rating</u>	<u>Voltage Ratio</u>	<u>% Impedance</u>
1.	3.15MVA	33/11 KV	6.25

The impedance value refer to the (normal) principal tapping are subject to a tolerance  $\pm 10\%$ .

#### **7.08 Losses :**

Standard losses will be as follows :

<u>Sl.NO.</u>	<u>Rating</u>	<u>Voltage Ratio</u>	No load loss (KW)at 50 HZ	Full load loss (KW) at 75 °C
1.	3.15 MVA	33/11 KV	4.0	22.5

Tolerance of losses shall be guided by the relevant clauses of relevant IS standard .The bidder shall state both no load loss and load loss at rated voltage and frequency and loss figures shall be firm and guaranteed.

#### **7.09 Evaluation of Losses:**

i) The bidder shall state the transformer losses viz. iron (core) and copper loss. The iron loss ( no load loss ) in KW at rated voltage and at rated frequency, and load losses ( Copper loss) in KW at rated full load capacity and at rated voltage and frequency shall be guaranteed at 75 °C.

ii) For the purpose of comparison of bids, the capitalised cost of iron loss (KW) and load losses (KW) shall be added to the quoted price of transformer at the following rates.

- Capitalised value of iron loss per KW - Rs. 5,64,908.00
- Capitalised value of copper loss per KW - Rs. 1,69,470.00

iii) No bidder shall specify any tolerance limit in respect of these losses.

iv) If any or all , actual losses after test are found to exceed the guaranteed value, the penalty will be imposed on the excess loss over the corresponding guaranteed loss (any or all). The penalty shall be calculated for the excess of no load loss and for the excess of the load losses at rates specified above.

For fraction of a KW the penalty shall be applied prorata basis. If the test figure of losses are less than the guaranteed value, no bonus will be allowed. Any changes in the figure assigned for transformer losses will not be permitted after opening of bids and bid evaluation will be carried out on the basis of information made available at the time of bid opening.

#### **7.10 Terminals :**

Transformer shall be provided with bushing insulators on both H.V and L.V. sides. H.V and L.V. bushings shall be located on opposite side.

The electrical characteristics of bushing insulator shall be in accordance with IS ;2099.

Dimensions and type of bushing shall conform to IS:3347 and shall be as follows :-

H.V.Bushing (33KV Side)	36KV Class	Porcelain bushing with plain sheds for heavily polluted atmosphere.
L.V.Bushing (11KV Side)	12 KV Class	Porcelain bushing with plain sheds for heavily polluted atmosphere.
Neutral Bushing	Neutral of L.V. winding shall be brought out through porcelain bushing similar to L.V. Bushing for connection with earth terminal in line with LV bushing.	

#### **Provision of Current Transformer in L.V. side of Power Transformer :**

In order to achieve Restricted Earth fault in star connected L.V. Side of Power Transformer, current transformer having following particulars shall have to be provided between neutral terminal and neutral bushing of L.V. side of 3.15 MVA Power Transformer.

i) Type	: Suitable for installation in L.V. side of Power Transformer for REF protection
ii) Ratio	: 400/1A at Neutral side
iii) Accuracy Class	: PS.
iv) Knee Point Voltage $V_k$	: $V_k > 250$ volt
v) RCT at 75 °C	: RCT <4 Ohm
vi) Magnetising Current at knee point voltage	: < 30 mA at VK
vii) Additional winding for testing of the C.T.	: Not required.

#### **8.0 SHORT CIRCUIT LEVEL :**

8.01 Designed Maximum fault level of 33 KV and 11KV are 20KA and 16KA respectively.

#### **9.0 INSULATION LEVEL :**

9.01 The transformer and bushing shall be capable to withstand test voltage as specified below :

<u>Parameters</u>	<u>Transformer</u>		<u>Transformer</u>	
	<u>Winding</u>		<u>Bushing</u>	
Nominal voltage (in KV r.m.s)	11	33	11	33
Highest voltage for equipment (in KV r.m.s.)	12	36	12	36

<u>Parameters</u>	<u>Transformer</u>		<u>Transformer</u>	
	<u>Winding</u>		<u>Bushing</u>	
1.2/50 micro sec. impulse withstand voltage (in KV peak)	75	170	95	170
1 minute power frequency withstand voltage (in KV r.m.s.)	28	70	28	70
Minimum creepage distance (mm)	-	-	300	900
Minimum clearance (mm) : Phase to phase	255	350	-	-
Minimum clearance (mm) : Phase to earth	140	320	-	-

## **10.0 CORES :**

Core shall be constructed from high grade cold rolled non-aging grain oriented silicon steel laminations having magnite coating as insulation. Successful bidder will offer the core for inspection and/or approval by the purchaser during manufacturing stage. Manufacturer's call notice for the purpose should be accompanied with the following documents as applicable as a proof towards use of prime core materials:

- i) Invoice of the supplier
- ii) Mill's Test Certificate
- iii) Packing Lists
- iv) Bill of landing
- v) Bill of entry Certificate to Customs

**10.01** Core materials shall be procured either from the core manufacturer or through their accredited marketing organisation of repute.

**10.02** Bidder should preferably have in-house Core cutting facility for proper monitoring and Control on quality.

**10.03** The materials used for insulation shall have high inter lamination resistance and rust inhibiting property. It shall not have any tendency to absorb moisture or to react with insulating oil.

**10.04** The assembled core shall be securely clamped on the limbs and yoke with uniform pressure so as to minimise noise emission from it.

**10.05** The top main core clamped on the limbs and yoke with uniform pressure so as to

**minimise noise emission from it.**

**10.06 The top main core clamping structure shall be connected to the tank body by a copper strap. The bottom clamping structure shall be earthed by one or more of the following methods**

**(i) by connection through vertical tie rods to the top structure**

**(ii) by direct metal to metal contact with the 3 tank base by the weight of the core and windings,**

**iii) by a connection to the top structure on the same side of core the**

**10.07 All parts of the cores shall be robust design capable of withstanding any shocks to which they may be subjected during lifting, transport, installation and service.**

**10.08 Adequate lifting lugs shall be provided to enable the core and winding to be lifted.**

**10.09 Adequate provision shall be made to prevent movement of the core and winding relative to the tank during transport and installation or while in service.**

**10.10 The supporting frame work of the cores shall be so designed as to avoid the presence of pockets which would prevent complete emptying of the tank through the drain valve or cause trapping of air during filling.**

**10.11 The insulation structure for the core to bolts and core to clamp plates shall be such as to withstand a voltage of 2000 VAC at 50HZ for one minute.**

#### **11.00 FLUX DENSITY OF CORE :**

**11.01 The maximum flux density in any part of the core and yokes at principal (normal) tapping and at rated frequency shall not exceed 1.6 Tesla (16000 lines per sq.cm) at normal voltage and 1.9 Tesla (19000 lines per sq.cm) under overvoltage condition.**

**Prior to inspection and testing of the Transformer the supplier shall submit on request following curves of the core manufacturer.**

**i) Flux density vs Core loss.**

**ii) Flux density vs Excitation**

#### **12.00 WINDING:**

**12.01 All windings shall be fully insulated.**

**12.02 Power transformer shall be designed to withstand the impulse and power frequency test voltages specified in clause no. 9.01.**

**12.03 The windings shall be designed to reduce to a minimum the out of balance forces in the transformer at all voltage ratios.**

**12.04** The insulation of Transformer winding and connections shall be free from insulating material liable to soften, ooze out shrink or collapse and shall be non - catalytic and chemically inactive to transformer oil during service.

**12.05** The stacks of windings shall receive adequate shrinkage treatment before final assembly. Adjustable device shall be provided for taking up any possible shrinkage of coils in service.

**12.06** All the insulating materials to be used in the transformer shall preferably be of class-A insulation as specified in Indian Standards. The test certificate of the raw materials shall be made available by the Transformer manufacturer on request during inspection and testing.

**12.07** The coil clamping arrangement and the finished dimensions of any oil ducts shall be such that it will not impede the free circulation of oil through the ducts.

**12.08** The windings and connection of transformer shall be braced to withstand shocks which may occur during transport or due to switching short circuit and transient conditions during service.

other

**12.09** Coil clamping rings, if provided shall be of steel or suitable insulating material. Axially laminated material other than backelised paper shall not be used.

#### **13.0 INTERNAL EARTHING ARRANGEMENTS:**

**13.01** General : All metal parts of the transformer with the exception of the individual Core laminations, core bolts and associated individual clamping plates shall be maintained at fixed potential.

**13.02** Earthing of core clamping structure : Core clamping structure shall be earthed in terms of clause no. 10.04.

**13.03** Earthing of coil clamping rings : Where coil clamping rings are of metal at earth potential, each ring shall be connected to the adjacent core clamping structure on the same side of transformer as the main earth connection.

#### **14.00 TANKS:**

**14.01** Construction : Conventional type tank shall be constructed.

The Transformer tank and cover shall be fabricated from good commercial grade low Carbon steel suitable for welding and of adequate thickness. The tanks of all transformers shall be complete with all accessories and shall be designed so as to allow the complete transformer in the tank and filled with oil, to be lifted by crane or jacks, transported by rail, road without overstraining any joint and without causing subsequent leakage of oil. The main tank body shall be capable of withstanding vacuum gauge pressure 68.0 KN per Sq. metres ( 500 mm. of HG). The under carriage of the tank shall be made of channel of suitable size and design.

The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding in any direction without injury when using plate or rails.

Where the base is of a channel construction, it shall be designed to prevent retention of water.

Tank stiffeners shall be designed to prevent retention of water.

Wherever possible the Transformer tank and its accessories shall be designed without pockets wherein gas may accumulate. Where pockets cannot be avoided, pipes shall be provided to vent the gas into the main expansion pipe.

All joints other than those which may have to be broken shall be welded when required they shall be double welded. All bolted joints to the tank shall be fitted with suitable oil tight gaskets which shall give satisfactory service under the operating conditions and guaranteed temperature rise conditions. Special attention shall be given to the methods of making hot oil tight joints between the tank and the cover as also between the cover and bushing and all other outlets to ensure that the joints can be remade at site satisfactorily.

- 14.02 TANK COVER :** Each tank cover shall be of adequate strength and shall not distort when Lifted. Inspection openings shall be provided as necessary to give easy access to bushings or or tap changer assembly or testing the earth connection. Each inspection opening shall be of ample size for the purpose for which it is provided. The tank cover and inspection cover shall be provided with suitable lifting arrangement.

The tank cover shall be fitted with pockets for thermometer and for the bulbs of Oil and Winding temperature indicators. The thermometer pocket shall be fitted with a captive screwed top to prevent the ingress of water. Protection shall be provided, where necessary, for each capillary tube. The pocket shall be located in the position of maximum oil temperature and it shall be possible to remove the instrument bulbs without lowering the oil in the tank. Turrets should provided on tank cover to house the bushings. The turrets of both HV & LV bushings should be connected through pipes with main tank Buchholz Relay pipe to drive out trapped.

## **15.0 CONSERVATOR VESSELS :**

- 15.01** The conservator should be air cell / atmoseal type to prevent direct contact of Transformer oil with atmospheric air for retarding oxidation contamination of oil. The Air cell shall be made from suitable material with inner coating resistant to transformer oil & outer coating resistant to ozone & weathering.

The conservator shall be provided with necessary valves to drive out the air in the space between conservator wall & air cell during filling of oil, drain valves for complete draining of oil and cut off valves etc.

The conservator complete with necessary valves shall be provided in such a position as not to obstruct the electrical connections to the transformer from H.V & L.V SIDE.

The conservator shall be capacity to meet the requirement of expansion of the total cold oil volume in the Transformer & cooling equipment and if should be such that oil level always become visible through the plain oil level gauge and should correspond to the marking of the respective temperature.

The conservator shall be designed so that it can drain oil completely by means of the drain valve provided when mounted. One end of the conservator shall be bolted into position so that it can be removed for cleaning purpose.

The conservator shall be provided with different valves as per enclosed Figure-1 for filling of oil manually at site.

**15.02 OIL GUAGES :** One Magnetic type oil guage shall be provided. The oil level at 30 Deg. C. shall be marked on the gauge. A plain oil level gauge is also to be provided on the opposite side of the conservator on which M.O.G. is provided with marking as per ISS

**15.03 CONNECTION :** The oil connection from the transformer tank to the conservator vessel shall be arranged at a raising angle of 3 to 9 degrees to the horizontal up to the Buchholtz Relay and shall consist of pipe with inside diameter 50 mm./80 mm. as per capacity of the Transformer and as per IS:3639. Two valves shall be provided between the conservator & Transformer main tank to cut off the oil supply to the transformer after providing a straight run of pipe for at least a length of five times the internal diameter of the pipe on the tank side of the Gas and Oil actuated Relay and at least three times the internal diameter of the pipe on the conservator side of the Gas and Oil actuated Relay. The valves should be fitted on both side of the Gas and Oil Actuated Relay.

**15.04 BREATHER :**

Each conservator vessel shall be fitted with a glass container type breather in which silicagel is dehydrating agent and so designed that

- i) The passage of air through the silicagel.
- ii) The external atmosphere is not continuously in contact with the Silica gel.
- iii) The moisture absorption indicated by a change in colour of the tinted crystals can be easily observed from the distance.
- iv) All breathers shall be mounted at approximately 1400 mm above ground level .

**16.00 BUSHINGS :**

**16.01** Pollution free type insulator should be used for the bushings as specified In clause 7.11. The bushing should be located on suitable turrets. Adjustable Arcing horns should be provided on the Bushings. Bushings of Identical voltage rating shall be Interchangeable. All bushings shall be equipped with suitable terminals of approved type size and shall be suitable for bimetallic connection.

The bushing shall have high factor of safety against leakage to ground and so located as to provided adequate electrical clearance between bushings & grounded parts.

Both HV & LV Bushing should be suitable for use in heavily polluted atmosphere as per IS 8603 (Part I & III) 3 Nos. H.V Bushings & 4Nos.

L.V.Bushing should be supplied extra with the transformer as spare.

**17.00 FILTER AND DRAIN VALVES, SAMPLING DEVCES AND AIR RELEASE PLUGS :**

**17.01 Each Transformer shall be fitted with the following :**

- i) The filter and drain valves as specified.
- ii) A drain valve as specified below shall be fitted to each conservator.  
For diameter upto 650 mm : Size of the valve 15 mm .  
For diameter above 650 mm : Size of the valve 25 mm.
- iii) Suitable oil sampling device shall be provided at the top and bottom of the main tank. The sampling device shall not be fitted on the filter valves specified under (2) above.
- iv) One 15mm air release plug on the main tank top cover and another on the top of the inspection cover.
- v) All other valves opening to atmosphere shall be fitted with blank flanges.
- vi) The drain valve and the off circuit tap changing handle should be provided with a protective cover with fixing arrangement by nuts & bolts.

**18.0 COOLING PLANT :**

**18.01 General :Radiators shall be so designed as to avoid pockets in which moisture may collect and shall withstand the pressure tests.**

The radiator tubes / fins shall be seamless, made of mild steel having as minimum wall thickness of approx. 1.2mm and a clean bright internal surface free from dust and scale. They shall be suitably braced to protect them from mechanical shocks, normally met in transportation and to damp the modes of vibration transmitted by the active part of the transformer in service. Each cooler unit shall have a lifting eye.

**18.02 Radiator Valves: The butterfly or similar metal valves shall be provided for isolating detachable radiator assembly.**

One cock each at the bottom of radiator stack shall be provided for draining oil from radiator stacks.

Air release plug each at the top of radiator stack shall be provided for release of locked air from radiator stack.

Removable blanking plates shall be provided to permit the blanking off the main oil Connection of each cooler.

**18.03 Radiator fixing bands in top & bottom of radiators to be provided to minimise the vibration of the same.**

**19.00 LIFTING AND HAULAGE FACILITIES :**

**19.01 Each tank shall be provided with**

- (i) Lifting lugs suitable for lifting of transformer complete with oil.
- (ii) A minimum of four jacking lugs, in accessible positions to enable the transformer complete with oil to be raised or lowered using hydraulic or screw jacks. The

minimum height of the lugs above the base shall

(a)transformers up to and including 10 tones weight-300mm

(b)Transformers above 10 tones weight - 500 mm.

(iii) Suitable haulage holes shall be provided.

## **19.02 INSULATING OIL :**

**19.03 The Transformer and all associated oil filled Equipment shall be supplied complete**

with insulating new oil required for first filling including 5% extra oil for future use during commissioning. The Transformer tank shall be dispatched completely filled with oil and the balance oil shall be supplied in non returnable sealed drums along with the Transformers.

The Insulating oil shall conform to the requirement of IS:335.

## **20.0 PRESSURE RELIEF DEVICE :**

**20.01 Pressure relief device shall be provided of sufficient sizes for repaid release of any**

pressure that may by generated within the tank, and which might result in damage to the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure for transformer tank. Means shall be provided to prevent ingress of rain. It shall be mounted on the cover of the main tank and shall be designed to prevent gas accumulation.

Spring loaded setting type Pressure Relief Valve having suitable opening Port hole according to the capacity of the transformers should be provided. The pressure relief valve should have provision of visual indication for opening of the valve and also Contract/Micro Switch arrangement for alarm/Tripping Function.

## **22.0 AXIS AND WHEELS :**

**22.01 The Transformer shall be provided with flanged bi-directional wheels as mentioned below :**

**22.02 Transformer rating**

**Type**

**3.15 MVA**

**Flanged heel suitable for use on a  
1435 mm guage track.**

The wheels shall be suitable for being turned through an angle of 90 Deg. and Locked in that position when the tank is jacked up.

All wheel shall be detachable and shall be made of Cast Iron or Steel.

Suitable locking arrangement shall be provided to prevent the accidental movement of the transformer.

### **23.0 CLEANING & PAINTING :**

**23.01 Before painting or filling with oil all galvanised parts shall be completely cleaned and free from rust, scale and grease and all external surface cavities on castings shall be filled by metal deposition.**

The interior of all transformer tanks and other oil filled chambers and internal structural steel work shall be thoroughly cleaned of all scale and rust by sand blasting or other approved method. These surfaces shall be painted with hot oil resisting varnish or paint. Unexposed welds need not be painted.

Except for nuts, bolts and washers, which may have to be removed for maintenance purposes, all external surfaces shall receive a minimum of three coats of paint.

The primary coat shall be applied immediately after cleaning. The second coat shall be of oil paint of weather resisting nature and preferably of a shade or colour easily

distinguishable from the primary and final coats shall be applied after the primary coats have been touched up where necessary. The final coat shall be of glossy oil and weather resisting non fading paint of Dark Admiralty Grey shade no. 632 of IS:5. Primer paint shall be ready made zinc chrome as per IS: 104: Intermediate and final coats of paint shall be as per IS: 2932.

All interior surfaces of mechanism chambers and kiosks except those which have received anti-corrosion treatment shall receive three coats of paint applied to the thoroughly cleaned metal surface as per procedure mentioned above. The final coat shall be of a light coloured anti-condensation mixture.

Any damage to paint work incurred during delivery shall be made good by the manufacturer by thoroughly cleaning the damage portion and applying the full number of coats of paint that had been applied before the damage was caused.

### **24.00 : EARTHING TERMINAL :**

**24.01 : Two Two earthing terminals capable of carrying the full amount of lower voltage short circuit current of transformer continuously for a period of 5 Second Provision shall be made at positions close to each of the bottom two corners of the tank for bolting the earthing terminals to the tank structure to suit local condition**

### **25.00 : TEMPERATURE INDICATING DEVICES :**

**25.01 : Oil temperature indicator with two electrical contacts for alarm and trip purposes,**

shall be provided with anti vibration mounting. The oil temperature indicator shall be housed in the marshalling box.

**25.02 :** The winding temperature indicator with two electrical contacts for alarm & trip

purposes shall be provided with anti vibration mounting. The winding temperature indicator shall be housed in the marshalling Box.

The Oil and Winding temperature indicator should be of renowned make preferably of "Perfect Control" or "Pecimeasure". The scale on the dial of the thermometer should be 0 °C to 150 °C. The angular displacement of thermometer should be 270 Deg. The signaling contact of WTI & OTI shall be set to operate at the following temperature:

**OIL** : Alarm - 85 °C, Trip - 95 °C

**WINDING** : Alarm - 100 °C, Trip - 110 °C

**25.03:** The tripping contacts of indicator shall be adjustable to close the winding temperature

indicator between 60 °C and 120 °C. The alarm contacts of indicator shall be adjustable to close between 50 °C & 100 °C.

All contacts shall be adjustable on a scale and shall be accessible on removal of the cover. The Temperature indicators shall be so designed that it shall be possible to check the operation of contacts and associated Equipments.

For measuring winding temperature a heater coil fed from a C.T. has to be provided on the pocket for winding temperature indicator bulb. The connection from C.T. to heater should be through a link arrangement on the tank cover suitably housed in a weather proof box so that C.T. current and heater coil resistance can be checked. WTI C.T. secondary should be of 5 Amps, rating.

**26.00:** **MARSHALLING BOX**

**26.01:** A sheet steel vermin proof, well ventilated and weather proof marshalling box of a suitable construction shall be provided for the transformer ancillary apparatus. The box shall have domed or sloping roofs and the interior & exterior painting shall be in accordance with clause no. 23

The marshalling box shall accommodate.

- i) Winding and oil temperature indicator.
- ii) Terminal Blocks and gland plates for incoming and outgoing Cables.
- iii) Terminal box in the marshalling box should be at least of 10 sq. mm size and the size of the marshalling should be such that if and every point it may easily accessible and connection and adjustment may be made easily. There should be minimum 10 nos. of additional plinth and those plinths where C.T. secondary connected should of star type.
- iv) One space heater operated by 220 V A.C. Aux. Supply , Cubicle illuminating

lamp with door switch.

All the above equipment shall be mounted on panels and back of panel wiring shall be used for Interconnection. The temperature indicators shall be so mounted that the dials are visible by standing at ground level.

Door of the compartment shall be provided with glass window of adequate size. Ventilation louvers shall be provided.

Suitable removable cable glands plate shall be provided at the bottom of kiosk for passage of Incoming and outgoing cable.

## **27.00 GAS AND OIL ACTUATED RELAYS :**

Each transformer shall be provided with gas and oil actuated Relay (Buchholtz Relay) equipment conforming of IS:3637 double float type with one set of alarm contacts, one set of trip contacts and a testing pet cock. The contacts shall be wired with a P.V.C. cable.

A machined surface shall be provided on the top of Relay to facilitate the setting of Relay and to check the mounting angle in the pipe and cross level of the Relay.

The pipe work shall be so arranged that all gas arising from the Transformer shall pass into the gas and oil actuated Relay. The oil circuit through the Relay shall not form a delivery path in parallel with any circulating oil pipe.

## **28.00 RATING DIAGRAM AND PROPERTY PLATES :**

**28.01:** The following plates shall be fixed to the transformer tank at a suitable height so that the particulars could be read by standing at ground level.

- i) A rating plate bearing the data specified in the relevant clauses of IS:2026 including figures of temperature rise of oil and winding and high voltage test values.  
The guarantee no load loss at 50 HZ and load loss at 75 degree C. should also be noted in the name plate
- ii) A diagram plate showing the internal numbering of taps, tapping switch connection of windings and also the voltages vector relationship in accordance with IS:2026 and in addition a plan view of the transformer giving the correct physical relationship of the terminals. No load voltage shall be indicated for each tap. Details of C.T particulars i.r.o phase, Neutral & WTI CT.
- iii) A property plate showing that the equipment belongs to West Bengal State Electricity WBSEDCL with reference of purchase order.

## **29.00: CENTRE OF GRAVITY :**

**29.01:** The centre of gravity of the assembled transformer shall be low and as near the vertical centre line as possible. The transformer shall be stable with or without oil. If the centre of gravity is eccentric relative to track either with or without oil, its location shall be shown

on the outline drawing.

**30.00: OPERATION :**

**30.01** The transformer shall be suitable for operating in WBSEDCL's Sub-Stn. Independently or in parallel with one or more transformers.

**31.00 DUTY UNDER FAULT CONDITION :**

**31.01:** It is to be assumed that normal voltage will be maintained on one side of the Transformer when there is a short circuit between phases or to earth on the other side.

The transformer may be directly connected to an underground or overhead line and may be switched into and out of service together with or without its associated incoming/outgoing line.

The thermal ability to withstand short circuit shall be Two seconds (2 Sec.) without injury for 3 phase dead short circuit at the terminals.

**32.00: RATED VOLTAGE OF OPERATING DEVICE :**

**32.01:** Rated voltage for indicating & operative device shall be 30 volts D.C./110 volts D.C./240 Volts D.C./230 volts A.C. with variation as specified in the relevant I.S.

**33.00: FITTINGS :**

**33.01:** Fittings as listed in schedule 'A' shall be provided.

**34.00: FOUNDATION :**

**34.01:** The tenderer shall furnish foundation plan of the transformer showing the fixing arrangement of the transformer so that the purchase may be able to finalise the foundation drawings.

**35.00: TESTING AND INSPECTION :**

**35.01:** Routine Tests :

**All transformers shall be subjected to the following routine tests at the manufacturer's works. The tests shall be carried out in accordance with the details specified in IS:2026.**

- i) Measurement of winding resistance.**
- ii) Measurement of turns ratio for all sets windings on each tap**
- iii) Polarity and phase vector relationship.**
- iv) Measurement of no load loss and no load current.**
- v) Measurement of impedance voltage at normal , maximum and minimum tap**
- vi) Measurement of insulation resistance between windings and between windings and earth**
- vii) Measurement of load loss.**
- viii) Induced over voltage withstand test.**
- ix) Separate source voltage withstand test.**
- x) Oil Leakage gas collection, oil surge and voltage test on gas and oil actuated relay for on load tap changer.**
- xi) Magnetic balance test.**
- xii) Testing of Phase & Neutral C.T., as applicable, in accordance with provisions in the relevant I.S.**
- xiii) Oil leakage test of transformer tanks at a pressure equals to the normal pressure plus 35 KN/ sq.m measured at the base of tank.**

**35.02 Type Test :**

In addition to routine Tests mentioned above the transformer shall be subjected to all kinds of Type and Acceptance Test in accordance with Relevant I.S. (IS:2026) with latest amendment if any.

1) Bidder should submit Type Test and special test report from CPRI /NABL( Third Party) /Govt. approved Laboratories along with their offer having identical technical parameters as that of the tendered item, carried out within five years , as per pre-requisites of this tender , failing which their offer may not be technically accepted.

2) However, after placement of order , Type test and special test after successful routine test shall have to be done on the transformer Designed as per specification of WBSEDCL and approved drawings . Such Type tests/special tests, required to be carried out at CPRI / NABL( Third Party) /Govt. approved Laboratories in presence of WBSEDCL engineers for which no extra cost shall be charged to the WBSEDCL.

3) Routine & Temperature rise test shall have to be carried out in presence of WBSEDCL engineers before carrying out type test.

4) Temperature rise Test shall have to be conducted on one no. transformer against the order.

### **35.03: INSPECTION AND TESTING :**

Inspection and testing as already mentioned the equipment shall be subjected to routine and other acceptance tests as per provisions in the relevant I.S.

The WBSEDCL reserves the right to send its Engineers if so desires to witness manufacturing process and to reject either raw materials or finished products found to be not complying with the requirement of the specification and also shall have the right to select any/all equipment from the lot offered for tests .The manufacturer shall give at least (21) twenty one days' advance notice regarding readiness of such inspection and testing and shall submit six sets of the works test certificates of the materials/equipment offered for inspection and testing indicating probable date of inspection and testing.

The Supplier shall arrange all possible facilities for such inspection and testing at any time during the course of manufacture free of cost.

### **35.04: TEST CERTIFICATE :**

Seven copies of the approved Test Certificates as mentioned above are to be furnished to the WBSEDCL before dispatch of the equipment.

36.01 The following drawings and details shall be furnished in triplicate along with the tender :

i) General Arrangement outline drawing with plan, elevation and end views

showing various dimensions of transformer and its vital component including height of the bottom most portion of bushing from the bottom of base channel and also indicating thereon physical centre line and position of centre of gravity.

- ii) Three copies of sketches for height of crane hook above ground for lifting and untanking core, shipping dimensions, complete lists of fittings and devices, net weights of core, winding, tank, radiator, oil, conservator and total weight, fixing arrangement of transformer in foundation.
- iii) Marshalling Box drawing.
- iv) Installation, operation and maintenance manual.

**36.02:** The following drawings and manuals in six sets shall be submitted for approval within 15 (fifteen) days from date of placement of L.O.I./ORDER.

- i) As stated in clause no.36.01.
- ii) Cross sectional details with plan, elevation, and views showing all internal clearances.
- iii) Drawing of Name & rating plate.
- iv) Drawing of Diagram & property plate.
- v) Drawing of Instruction plate for oil filling at site as per Annexure – A
- vi) Installation, operation and maintenance manual of transformer, associated equipment like buchholtz Relay, temperature indicators, oil level indicator etc.

The manual shall clearly indicate the installation method, check-ups and tests to be carried out before and after commissioning of the transformer.

One copy of manual, set of approved drawings shall be submitted to the Dy. C.E. (Testing), Distribution Testing Laboratory, Avikhyan Bldg., Salt Lake, Kolkata-91 before dispatch of the Transformer.

In addition one set of approved drawing, manual for transformer shall be send to the respective consignee officer in water proof folder at the time of delivery of the transformer.

**37.00: GUARANTEED TECHNICAL PARTICULARS :**

**37.01:** Bidder shall furnish guaranteed technical particulars of equipment offered as per

Schedule 'B' To be provided alongwith final NIT specification), Performance Guarantee shall be based on guaranteed technical particulars.

### **38.00 SHORT CIRCUIT CALCULATIONS :**

**38.01** Manufacturer shall submit theoretical calculations in support of the ability to withstand short circuit on consideration of highest value that may attain in triplicate within 15 (fifteen) days from the date of placement of L.O.I./Order.

### **39.00: PERFORMANCE CERTIFICATES :**

**39.01:** Copies of performance certificates of similar Equipment supplied to various organizations shall have to be furnished along with Tender.

### **40.00: CREDENTIALS :**

**40.01:** Tenderer shall furnish documents in support of Supply, Delivery of similar Equipment indicating thereon names of the organization, quantity ordered, quantity supplied along with tender.

### **41.00: DEVIATION :**

All deviations from the Specification shall be recorded in the "Deviation Sheet" with reference to respective clauses of the Specification by drawing Specification for the same. Unless deviations are recorded in the Deviation Sheet and submitted with the offer, it will be taken for granted that the offer is made in conformity with Specification.

### **42.00: SPARE PARTS:**

The Tenderer shall submit a recommended list of spare parts for five years of operation along with item wise price for each item of spares.

### **SCHEDULE – A**

<b>Sl. No.</b>	<b><u>FITTINGS &amp; ACCESSORIES :</u></b>
<b>0.01</b>	All screw threads and nuts shall be made as per ISS and all valves shall be of standard tested quality and leak-proof.
<b>0.02</b>	The following fittings and accessories shall be supplied with each Transformer :
<b>1.</b>	Outdoor type bushing – HV - 3 Nos. and LV - 4 Nos.
<b>2.</b>	Conservator with atmoseal and supporting bracket or structure as the case may be.
<b>3.</b>	Isolating valve for conservator in between conservator and Buchholtz Relay and in between Buchholtz relay and main tank..
<b>4.</b>	Conservator valves for driven out air between air cell & wall of conservator & connection to breather.
<b>5.</b>	Conservator drain valve.

6.	Dial type oil level indicator complete with alarm contact.
7.	Silica gel breather with oil seal and connecting pipe. The breather shall be accessible for inspection from ground.
8.	Spring loaded setting type pressure relief Valve having suitable opening Port. Hole & provision of visual indication for opening of the valve & Alarm/Trip contact arrangement.
9.	Access/inspection holes with bolted cover for access to inner ends of bushing.
10.	Cover lifting eyes.
11.	Lifting eyes for core frame with windings.
12.	Tap changing arrangement with hand wheel for Off-Load tap-switch and OLTC Driving mechanism Box for on load type..
13.	Air release plugs on top of cover and pressure equalizer pipe for bushing turret.
14.	Upper filter valve and bottom filter valve.
15.	Drain valve.
16.	Top and bottom oil sampling devices. Provision for oil sample collection during process of filtration should be made.
17.	Lifting lugs.
18.	Jacking pads with handling holes at four corners.
19.	Transport lugs.
20.	Under carriage base channel.
21.	Tank earthing terminals – 2 Nos.
22.	Bachholtz relay double float type with one set of alarm contacts, one set of trip contacts and testing pet cock. The contacts should be wired with a PVC armoured cable.
23.	Dial thermometer for winding temperature with alarm contacts and Trip contacts.
24.	Dial thermometer for oil temperature with alarm contacts and Trip Contacts.
25.	An additional pocket for inserting thermometer for oil temperature indication.
26.	Weather proof control cabinet for marshalling terminal connections from protective and indicative devices. The cabinet shall be provided with incandescent filament lighting, plugs etc.
27.	Neutral Bushing C.T. suitable for installation in L.V. side of Power Transformer for Power Transformer.
28.	Rating plate, as per I.S.S.
29.	Diagram Plate : As per clause 28.

30.	Property label.

SCHEDULE – B

(As per Clause No.37 of the Specification )

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS :**

( To be furnished and signed by the tenderer for each category of Transformer ).

<b><u>GUARANTEED TECHNICAL PARTICULARS</u></b>			
<u>Sl.No.</u>	<u>Particulars</u>		
1.	Name and address of the manufacturer	:	
2.	Country of origin	:	
3.	Applicable standard	:	
4.	Maximum continuous rating (in MVA)	:	
5.	No load voltage ratio at Principal (Nominal) tap (in KV/KV)	:	
6.	Rated frequency (in Hz)	:	
7.	Number of phases	:	
8.	Type of Cooling	:	
9.	Connections	:	
	(i) H.V. Winding	:	

**GUARANTEED TECHNICAL PARTICULARS**

	(ii) L.V. Winding	:	
10.	Vector Symbol	:	
11.	Tappings	:	
	(a) Range	:	
	(b) Number of steps		
	© Variation of voltage in each step (in KV)		
	(d) No load voltage ratio in each tap (in KV/KV) for 3.15 MVA 33/11KV Transformer.		
	Tap Number	Voltage ratio in KV/KV	Tap Number      Voltage ratio in KV/KV
	1.		5.
	2.		6.
	3.		7.
	4.		---
12.	(i) Temperature rise under normal operating		:

**GUARANTEED TECHNICAL PARTICULARS**

	condition above ambient temperature		
	(a) Top oil (in Degree C)	:	
	(b) Windings (in Degree C)	:	
	(ii) Maximum hot spot temperature of Copper windings (in Degree C)	:	
13.	Magnetising current referred to H.V. at rated frequency	:	
	(a) at 90% rated voltage : (in Amps)	:	
	(b) at 100% rated voltage : (in Amps)	:	
	© at 110% rated voltage 9in Amps)	:	
14.	Power factor of magnetizing current at 100% rated voltage & frequency	:	
15.	No load current at rated voltage and Rated frequency (in Arms)	:	
16.	No load loss in KW at rated frequency and voltage	:	
	(a) at Lowest tap	:	
	(b) at principal tap	:	
	© at highest tap	:	
17.	Load loss in KW at 75 Deg. C. at Rated output and frequency	:	

**GUARANTEED TECHNICAL PARTICULARS**

	(a) at Lowest tap	:	
	(b) at principal tap	:	
	© at highest tap	:	
18.	Percentage Regulation at full load at 75 Deg.C	:	
	(a) at unity power factor	:	
	(b) at 0.8 power factor lagging	:	
19.	Efficiencies at 75 Deg.C (in percentage)	:	
	a) at full load (i) at unity power factor	:	
	(ii) at 0.8 power factor lagging	:	
	(b) at $\frac{3}{4}$ full load (i) at unity power factor	:	
	(ii) at 0.8 power factor lagging	:	
	(c) at $\frac{1}{2}$ full load (i) at unity power factor	:	
	(ii) at 0.8 power factor lagging	:	

**GUARANTEED TECHNICAL PARTICULARS**

20.	Impedance voltage on rated MVA base at rated current and frequency for the Principal tapping 75 Deg.C. (in percentage)	:	
21.	a) Reactance voltage at rated current and frequency for the principal tapping at 75 Deg.C. (in percentage)  b) Resistance voltage at rated current and frequency for the principal tapping at 75 Deg.C. (in percentage)	:  :	
22.	Resistance at H.V. base at 75 Deg.C.		
	(a) at Lowest tap	:	
	(b) at principal tap	:	
	© at highest tap	:	
23.	Reactance at H.V. base at 75 Deg.C.		
	(a) at Lowest tap	:	
	(b) at principal tap	:	
	© at highest tap	:	
24.	Withstand time without injury for three phase	:	

**GUARANTEED TECHNICAL PARTICULARS**

	dead short circuit at terminal (in seconds)		
25.	Short time current rating for short circuit with duration	:	
	a) H.V. winding (in K. Amps)	:	
	b) L.V. winding (in K Amps)	:	
	c) Duration (in seconds)	:	
26.	Permissible overloading with time	:	
27.	Core :		
	i) Type	:	
	ii) Flux density of Core and yoke at principal tap	:	
	a) at rated voltage at 50 Hz (in lines/sq.cm	:	
	b) at 100% rated voltage at 50 Hz (in lines/sq.cm.)	:	
	iii) Thickness of Stamping (in mm)	:	
	iv) Type of insulation between core laminations	:	
	v) Core bolt withstand Insulation (in KV rms for 1 min)	:	
	vi) Approximate area of Cross Section of Core and yoke (in sq.mm.)	:	

<b><u>GUARANTEED TECHNICAL PARTICULARS</u></b>			
	vii) Material of Core clamping plate	:	
	viii) Thickness of Core clamping plate (in mm)	:	
	ix) Insulation of Core clamping plate	:	
	x) Describe location/Method of Core grounding	:	
28	Terminal Arrangement	:	
	i) High Voltage	:	
	ii) Low Voltage	:	
29	Positive Sequence Impedance between HV & L.V. winding on rated MVA base at rated Current and frequency at 75 Deg.C. winding temperature	:	
	i) AT principal tapping (in percent)	:	
	ii) At lowest tapping (in percent)	:	
	iii) At highest tapping (in percent)	:	
30	Zero Sequence Impedance at reference temperature of 75 Deg.C at principal tap (in percent)	:	
31	Details of windings	:	

<b><u>GUARANTEED TECHNICAL PARTICULARS</u></b>				
	i) Type of Winding	:		
	(a) High Voltage	:		
	(b) Low Voltage	:		
32	Winding conductor	:		
	i) Material of the winding conductor			
	(a) High Voltage	:		
	(b) Low Voltage	:		
	ii) Conductor Area :			
	(a) High Voltage (in sq.cm)	:		
	(b) Low Voltage (in sq.cm)	:		
iii)	Current density of windings at rated MVA	At principal tapping	At lowest tapping	At highest tapping
		1	2	3
(a)	High voltage (Amp. per sq.cm)			
(b)	Low voltage (Amp. per sq.mm)			

**GUARANTEED TECHNICAL PARTICULARS**

iv)	Insulating material used for	:		
	(a) High voltage winding	:		
	(b) Low voltage winding	:		
v)	Insulating material used between	:		
	(a) High voltage and low voltage winding	:		
	(b) Low voltage winding and core	:		
vi)	Whether adjustable coil clamps are provided for H.V. & L.V. winding (if yes, details may be given) :			
vii)	Type of Axial Coil Supports	:		
	(a) H.V. winding	:		
	(b) L.V. winding	:		
vii)	Type of Radial Coil Supports	:		
	(a) H.V. winding	:		
	(b) L.V. winding	:		

GUARANTEED TECHNICAL PARTICULARS					
32	Insulation withstand Test voltages	:	H.V.	L.V.	
	i) Lightning Impulse withstand test voltage 9kv Peak)	:			
	(ii) Power frequency withstand test voltage (in KV rms for 1 min)	:			
	(iii) Induced over voltage withstand test voltage (in KV rms)	:			
33	Current in the winding at rated MVA	:	At principal <u>tapping</u>	At lowest <u>tapping</u>	AT highest <u>tapping</u>
	(i) Low voltage (in Amps)	:			
	(ii) High voltage (in Amps)	:			
34	Voltage per turn (KV per turn)	:			
35	Ampere turn	:			
36	Number of turns	:	At principal <u>tapping</u>	At lowest <u>tapping</u>	AT highest <u>tapping</u>
	(i) Low Voltage	:			
	(ii) High Voltage	:			
37.	Details of Tapchanger	:			

<b><u>GUARANTEED TECHNICAL PARTICULARS</u></b>			
	i) Number of steps	:	
	ii) Number of Plus taps	:	
	iii) Number of minus taps	:	
	iv) Position of taps on HV	:	
	v) Type of tap changing arrangement	:	
38.	Bushing :		<div>High voltage</div> <div>Low voltage</div>
i)	Make	:	
ii)	Type	:	
iii)	Applicable standard	:	
iv)	Insulation withstand test Voltage	:	
a)	Lightning Impulse withstand test voltage (1.2 x 50 micro seconds in KV peak)	:	
b)	Power frequency withstand test voltage (in KV rms for 1 min)	:	
	1)Dry	:	

<b><u>GUARANTEED TECHNICAL PARTICULARS</u></b>					
	2)Wet	:			
v)	Creepage distance				
	a) Total (in mm)	:			
	b) Protected (in mm)	:			
vi)	Minimum height of the bushing	:			
39.	Minimum clearance (in mm)	:			
			<u>In Oil</u>		<u>In Air</u>
			Between n Phases	Phase to Ground	Between Phases  Phase to Ground
	i) H.V.				
	ii) L.V.				
40.	Particulars of Bushing & Neutral C.T.				
	i) Type	:			
	ii) Ratio	:			
	iii) Accuracy Class	:			

**GUARANTEED TECHNICAL PARTICULARS**

	iv) Knee Point Voltage	:	
	v) RCT at 75 Deg.C		
	a) at Lower Ratio	:	
	b) at Higher Ratio	:	
	vi) Magnetising Current at Knee Point Voltage	:	
	vii) Additional winding particulars of testing on the C.T.	:	:
	viii) Short Time Rating	:	
	ix) Reference Standard	:	
	Approximate weight of Transformer (in Kgs)	:	
	i) Core with clamping	:	
	ii) Coil with insulation	:	
	iii) Core and winding	:	
41.	Tank and fitting with accessories	:	
	v) Untanking weight	:	
	vi) Oil required for first filling	:	
	vii) Total weight with Core, Winding, Oil Fittings	:	

**GUARANTEED TECHNICAL PARTICULARS**

42.	Details of Tank		
i)	Type of tank	:	
ii)	Approximate thickness of Sheet (in mm)	:	
	a) Sides	:	
	b) Bottom	:	
	c) Cover	:	
	d) Radiators	:	
iii)	Vacuum recommended for hot oil circulation (in torr.)	:	
iv)	Vacuum to which the tank can be subjected without distorsion (in torr.)		
v)	Under carriage dimensions	:	
	a)No. of bidirectional wheels provided	:	

<b><u>GUARANTEED TECHNICAL PARTICULARS</u></b>			
	b) Track gauge required for the wheels	:	<u>Axis</u>
			Transverse      Longitudinal
	Dimension of base channel (in mm x mm)		
	vi) Type of Pressure relief device / Explosion Vent and pressure at which it operates	:	
43.	<u>Conservator</u>		
	i) Total volume (in Litres)	:	
	ii) Volume between the highest and Lowest visible oil level (in litres)	:	
44.	<u>Oil Quality</u>		
	i) Applicable standard	:	
	ii) Total quantity of oil (in Litres)	:	
45.	Radiator	:	
	i) Number of Radiator Bank	:	
	ii) Number of tubes/fins in	:	

<b><u>GUARANTEED TECHNICAL PARTICULARS</u></b>				
	each radiator Bank			
	iii) Thickness of tubes/fins (in mm)	:		
	iv) Overall dimensions (in mm)	:		
	a) Length	:		
	b) Breadth	:		
	c) Height	:		
	iv) Type of mounting	:		
	v) Vacuum withstand capability	:		
46	Gas And Oil Actuated Relay	:		
	i) Make	:		
	ii) Type	:		
	iii) Number of float contacts	:		
47	Temperature Indicators		Oil Temperature Indicator	Winding Temperature Indicator

**GUARANTEED TECHNICAL PARTICULARS**

i)	Make	:	
ii)	Type	:	
iii)	Permissible setting ranges for alarm and trip	:	
iv)	Number of contacts	:	
v)	Current rating of each contact	:	
48.	Approximate overall Dimensions (in mm)	:	
	a) Length	:	
	b) Breadth	:	
	c) Height	:	
	From bottom most portion of of base channel	:	
49.	Minimum clearance height for lifting tank cover (in mm)	:	
50.	Whether agreeable to carry out Type Tests, in line with specification at your Cost ?		

<b><u>GUARANTEED TECHNICAL PARTICULARS</u></b>			
51.	Whether all particulars against sl. No. 1 to 50 furnished?		

SIGNATURE OF THE TENDERER  
WITH COMPANY'S SEAL

### **OIL FILLING PROCEDURE FOR A CONSERVATOR**

#### **EQUIPPED WITH A FLEXIBLE SEPARATOR**

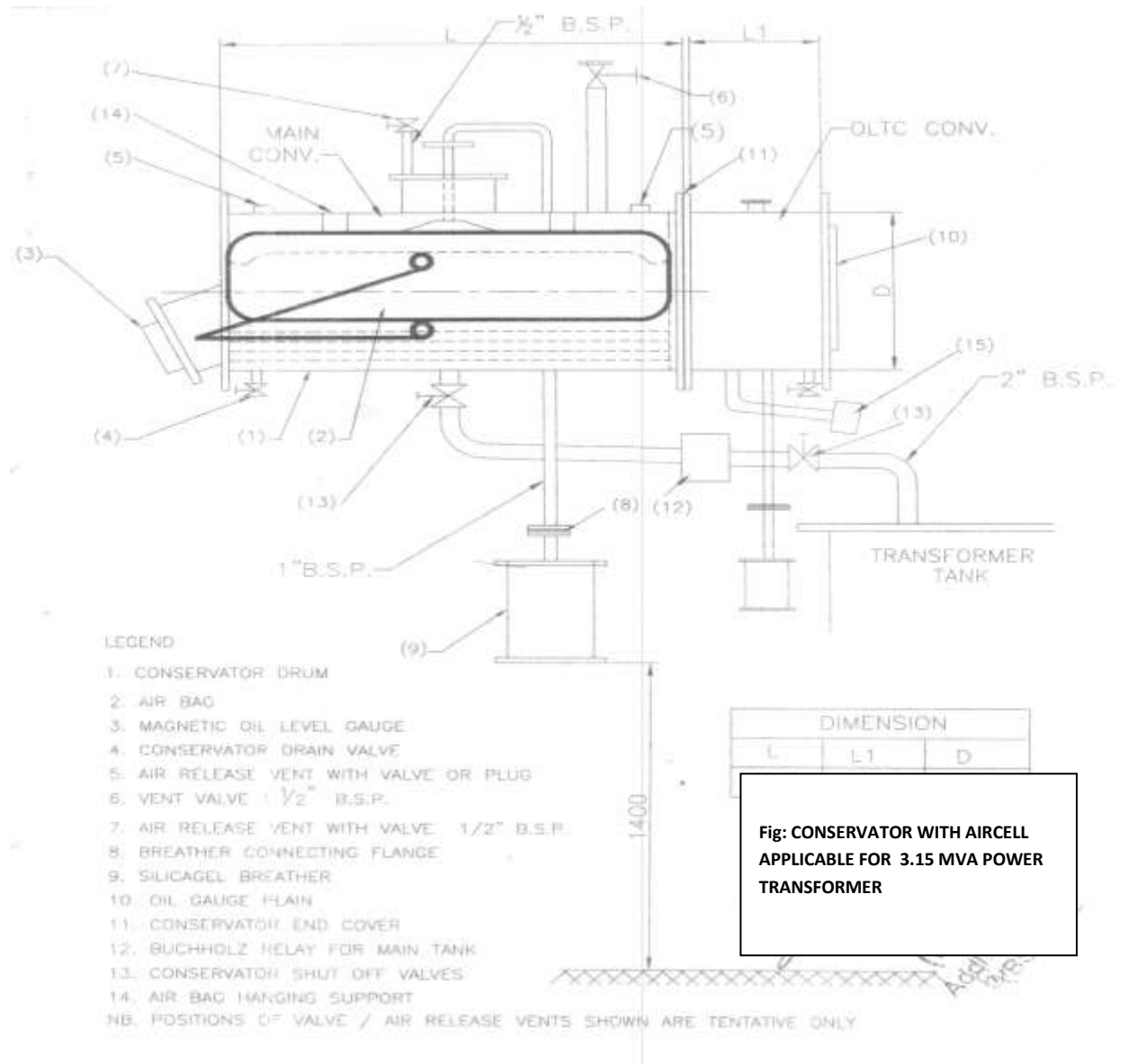
- Close the conservator side shut-off valve between main transformer tank and the conservator. Fill the oil in transformer under vacuum up to the level of the buchholz relay.
- Inflate the air bag slowly through pressure gauge connection valve as to maintain a positive pressure of 0.07 to 0.1 KG/CM (1 to 1.5 psi) read by a pressure gauge. The air bag must remain in an inflated condition during the oil filling procedure.
- Open the air release valves/plugs provided on the top of the conservator.
- Slowly pump transformer oil into the conservator through the conservator drain valve or through the main transformer by opening the conservator shut-off valve. Stop filling operation for the time being when oil starts coming out from all the vents on the conservator. Close these vents after ensuring that no air bubbles come out through them.
- Continue oil filling till oil starts coming out from air release vent on the air bag connection flange on the conservator. Stop filling oil and close this vent after ensuring that no air bubbles come out of it.
- Release the air pressure inside the air bag through the breather connection arrangement and continue oil filling until M.O.G. indicates the desired level.
- Remove oil pump and connect the air bag to the breather from breather connection flange. Also close the pressure gauge connection valve and remove the pressure gauge along with air pump connection.
- The system is now properly filled Air pressure vents are to remain closed during normal operation.

#### **IMPORTANT WARNING**

- Oil filling in the conservator and also draining operations whenever required must be carried out very slowly. During oil filling pressure in the air bag must never exceed 0.1 KG/CM (1.5 psi).
- If a pressure or vacuum is required to be applied anytime to the main tank .The conservator must be is connected and a blanking plate fitted on the shut off valve.

- No welding operations shall be carried out on the conservator with the air bag fitted in order to avoid damage to the air bag.

Once all the air has been removed from the conservator during oil filling operations do not open the air release vents as otherwise air will be sucked inside the conservator.



SIGNATURE OF THE TENDERER  
WITH COMPANY'S SEAL