TECHNICAL SPECIFICATION FOR 10MVA 3-PH POWER 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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1. SCOPE:

- This specification covers design, engineering, manufacture, assembly, testing at manufacturer's works, supply, delivery at site, unloading (But, in case Plinth is not ready, supplier shall unload the transformer within Sub-station premises at suitable location as per direction of site-in-charge of customer), handling and storage at site of 10 MVA, 66/33 KV, 10 MVA 66/11KV and 10MVA 33/11KV Power Transformer as detailed in the specification, complete with all fittings and accessories required for efficient and trouble free operations.
- The Transformer offered shall be multi-winding, oil immersed complying as per Specific Technical parameters and suitable for outdoor installation.
- Rated capacity and voltage of the transformer shall 10 MVA, 66/33 KV, 10 MVA 66/11KV and 10MVA 33/11KV.

2. STANDARD:

The Power Transformer covered under this specification shall comply with the requirements of the latest edition of following IS:

i)	IS:2026	- Specification for Power Transformer
ii)	IS:2099	- Bushing for alternating voltage above 1000 volt
iii)	IS : 6600	- Guide for loading of oil immersed transformer
iv)	IS : 335	- Specification for transformer oil
v)	CBIP	- Manual on Transformer
vi)	IEC 60076	- Power Transformer
vii)	IEC 354	- Loading guide for Oil immersed Transformer
viii)	IEC 551	-Tr. Sound Level

3. A. 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 evidences and advantages of such deviation. Such deviations suggested may or may not be accepted. But deviations not mentioned in Deviation Schedule will not be considered.

B. TYPE TEST:

The transformers should be Type Tested as per IS 2026 or IEC 60076 in conjunction with their relevant Part. Necessary test documents of previously tested similar transformer within last 5 years from date of NIT shall have to be submitted with the bid. Submitted Type test report shall amply proof that the type test has been carried within five years from the date of opening of Bid on similar or higher rating transformer having identical voltage ratio in the Bid Document.

If any bidder fails to submit the Type Test Report during Bid submission, he has to carry successfully the type test for one no. 10 MVA, 66/33 KV, 10 MVA 66/11KV and 10MVA 33/11KV transformer at their own cost at any Govt. recognized test house or laboratory / NABL accredited Laboratory before offering of transformer without hampering the stipulated delivery schedule

4. GENERAL DESIGN:

4.1. The Transformer and accessories shall be designed to facilitate easy inspection, cleaning and repairs. All fittings and accessories shall be designed to ensure satisfactory operation under worst conditions of load and voltage as may be met under working conditions in the system.

4.2. All materials used shall be of best quality and of the class most suitable for working under the conditions specified. It shall withstand the variations of temperature and atmospheric conditions without undue stressing etc. i.e. not affecting the workability/durability of the various parts of the transformer.

4.3. All outdoor fittings and accessories, including bushings insulators with their mounting, shall be so designed as to avoid pockets in which water can collect. All electrical connections shall be of ample cross sections for carrying the specified currents continuously without undue heating. All fixing bolts and screws shall be reliable under worst conditions of operations.

4.4. Transformers shall be suitable for continuous operation with a frequency variation of (50 $^{+}$/-3%) Hz without exceeding specified temperature rise.

4.5. Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any winding.

4.6. Clearances of line terminals in Air:

The clearance of HV, LV terminal shall be maintained as specified below:

Highest Sys. Vol. of equip.(KVrms.)	Ph. to Ph.(mm) clearance	Ph. to earth (mm) clearance
72.5	700	660
36	350	320
12	280	140

4.7. Transformer shall be designed to withstand full lightning impulse voltage as per IS:2026 (Pt.-III).

5. VIBRATION AND NOISE:

Transformer shall have minimum hum and no abnormal noise. The manufacturer shall ensure that the noise level shall be as per the NEMA standard publication TR-1.

6. THE LOADING GUIDELINE:

Over loading of transformer shall be guided by latest IS-6600.

7. TEMPERATURE RISE:

Each Transformer shall be capable of operating continuously at its normal rating without exceeding temperature rise and hot spot limits.

Type of Cooling	Maximum Ambient Temp.	Maximum Top Oil Temp. Rise	Maximum Winding / Core Temp. Rise	Maximum Winding Temp.	Maximum permissible value of Avg. Temp. of Winding after 3 sec of short ckt.
ONAN	50^0C	50^0C	55^0C	105^0C	250^0C

8. DYNAMIC ABILITY TO WITHSTAND SHORT CIRCUIT:

8.1. Thermal ability to withstand short circuit shall be proved by calculation and shall be furnished along with the drawing after placement of L.O.A.

8.2. Designed time period for Short circuit will be taken as 3 (three) seconds and fault current will be taken as per General Technical Specification. The maximum permissible value of the highest average temp. of winding after withstanding the above stipulated Short Circuit shall not exceed 250^oC and the submitted calculations shall be as per Cl. No. 9.1 of IS: 2026 (Part-I)

9. DETAILED TRANSFORMER PARTICULARS.

TANK AND TANK COVER:

9.1. The tank and cover shall be fabricated from low- carbon mild steel plate of adequate size for welded construction. The tank so welded shall be reinforced by stiffener of structural steel for general rigidity. Each tank cover shall be of adequate strength and shall not distort when lifted.

9.2. The tank shall be designed to have sufficient strength to withstand without distortion (i) filling in full vacuum at an internal pressure of 3.33KN/sq.mm. absolute (25torr) for one hour and permanent deflection of flat plate after the vacuum has been released shall not exceed the values specified below:

Horizontal Length of flat plate (in mm.)	Permanent deflection (in mm.)
Up to and including 750	5.0
751 to 1250	6.5

1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.5
2501 to 3000	16.0
Above 3000	19.0

(ii) Transformer tank of each size, its radiator, conservator vessel and other fittings together or separately shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 KN/m^2 whichever is lower measured at the base of the tank and maintained for one hour. The permanent deflection of flat plates after the excess pressure has been released shall not exceed the figures specified under vacuum test above and (iii) The tank shall be designed to have sufficient strength to withstand mechanical shock during transport.

The internal and external surface including structural steel work and oil filled chambers are to be painted after removing all rust and scale of foreign adhering matter or grease by sand blasting or other approved method. All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant oil insoluble insulating paint.

9.3. All steel surface exposed to weather shall be given a primary coat of zinc chromate and shall be applied immediately after cleaning. The second coat shall be of an oil and weather resisting nature and of shade or colour easily distinguishable from the primary. The final coat shall be of epoxy paint of minimum thickness of 80 microns and weather resisting non-fading paint of shade No. 631 of IS:5 .

9.4. All paints shall be carefully selected to withstand heat and weather. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

9.5. The tank construction shall be of conventional type. Adequate number of inspection cover shall be provided to give easy access to the bushing or other parts as may be necessary. To make joints oil tight, nitrile rubber gaskets shall be cut to size and shape to avoid joints on gaskets as far as practicable. It shall be fitted with pockets for thermometer and for the bulbs of oil and winding temperature indicators. The thermometer pockets shall be fitted sufficiently above on the surface of the top cover of main tank with a captive screwed top to prevent ingress of water. The pockets shall be located in position of maximum temperature and it shall be possible to remove bulb without lowering the oil in the tank.

9.6. Bi-directional flanged rollers for moving the transformer on rail gauge (1676 mm) shall be provided. The direction of the roller through 90°(degrees) can be changed by jacking up the assembly. Bidirectional rollers can be locked in required direction by bolting together the roller

mounting pad welded on the base of the tank and bi-directional flanged rollers bracket with bolts. The tank shall be provided with all fittings and accessories.

9.7. Lifting lugs shall be provided on all parts of transformer requiring independent handling during assembly or dismantling. In addition, the transformer shall be provided with lifting lugs and bosses properly secured to the side of the tank for lifting complete transformer assembly filled with oil either by crane or by pulley. Pulling lugs shall also be provided to facilitate movement of transformer horizontally.

9.8. The transformer tank shall be equipped with the following valves and plugs with standard screw connection for piping :

1) Drain valve at the bottom

2) Filter valve at top

3) Filter valve at bottom

4) Sampling valve at top

5) Sampling valve at bottom

6) Radiator shut off valve at top and bottom

7) Buchholz relay shut off valve at both ends of the relay

8) Air release plugs on tank.

9) 1 no oil inlet valve

Any other valves & plugs other than those mentioned above are also to be provided as per requirement.

Design shall be such that Tank cover can be lifted independently without lifting active part of core, winding etc.

10 CORE:

10.1 The magnetic circuit shall be core type. Each limb shall be joined with top and bottom yokes. The laminations shall be made from high grade non-ageing cold rolled grain-oriented silicon CRGO alloy of HI-B or equivalent grade steel. The insulation of lamination shall be coated with oxide/silicate coating or any coating inert to the action of hot transformer oil. Core should be bottom mounted.

10.2 All transformers shall be subjected to routine test and no load & load loss measurement as per relevant IS as mentioned in the Clause “TEST AT FACTORY AND TEST CERTIFICATES”.

Core materials should be directly procured from either the manufacturer or their accredited marketing organization of repute and not through any agent.

10.3 The core shall be of stepped cross-section. The yokes shall be clamped by means of end frames and yoke bolts and limbs shall be clamped by means of clamp plates. Sufficient number of lifting lugs is to be provided on end frames so that core with windings can be lifted when required.

10.4 The design of magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and production of flux component at right angles to the plane of lamination which may cause local heating.

10.5 The insulation for the core to bolts and core to clamps shall be such as to withstand a test voltage of 2 (two) KV rms at 50 Hz for one minute.

10.6 The maximum flux density in any part of the core and yoke at the rated MVA, voltage & frequency shall be such that under 10% continuous over voltage condition does not exceed 1.9 Tesla.

10.7 For consideration of over fluxing, the transformer shall be suitable for continuous operation for values of over fluxing at (i) 110% (ii) one minute for 125% and (iii) 5 seconds for 140% of rated voltage.

10.8 The prime core materials are only to be used. Bidder's should furnish following document as applicable as a proof towards use of prime Core material to be submitted before the stage inspection:

(a) Invoice of supplier

(b) Mill's test certificate

(c) Packing List

(d) Bill of lading

(e) Bill of entry certificate by Custom.

(f) Description of material, electrical analysis, physical inspection, certificate for surface defects, thickness and width of the materials.

(g) Place of cutting of core materials

11 WINDINGS:

11.1 The Material of winding conductor should be of electrolytic grade copper of 99.90% purity and free from scales, spills, splits and other defects. The windings shall be so designed that all coil assemblies of identical voltage ratings shall be interchangeable and field repair is possible. The coils shall be supported between adjacent sections by insulating spacers, and the barriers. Bracing and other insulation used in the assembly of the windings shall be arranged to ensure a free circulation of the oil and to reduce hot spots in the windings. The stacks of windings shall receive adequate shrinkage treatment before final assembly and the same shall be assembled in dust controlled chamber.

11.2 The insulation of the coils shall be such as to withstand the full electrical strength of the windings. All materials used in the insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil, and shall not soften or otherwise be adversely affected under the operating conditions. The dielectric strength of winding insulation shall confirm to values given in IS: 2026, as amended up to date, or as per specific Technical Parameters.

11.3 All threaded connections shall be provided with locking facilities. All leads from the windings to the terminal board and bushings shall be rigidity supported to prevent injury from vibration. Guide tubes shall be used where practicable.

11.4 The windings shall be clamped securely in place so that they will not be displaced or deformed during short circuits. The assembled core and windings shall be vacuum dried and suitably impregnated with insulating oil. The copper conductors used in the coil assembly shall be best suited to the requirements and all permanent current carrying joints in the windings and the leads shall be welded or brazed. Oil ducts shall be such as will not impede the free circulation of oil through windings assembly.

11.5 The conductor shall be transposed at sufficient intervals in order to minimize eddy currents and to equalize the distribution of currents and temperature along the winding.

12 TAP CHANGING MECHANISM:

For 10 MVA, 66/33 KV & 10 MVA 66/11KV Power Transformer, On Load Tap Changer is applicable. RTCC panel shall be provided if it is mentioned in the BOQ. If RTCC panel is provided it must be equipped with BCU. For 10MVA 33/11KV On Load Tap Changer is only applicable if it is mentioned in the BOQ

In the case of On Load Tap Changer, this shall be designed suitable for local manual as well as local electrical operation and Remote electrical operation including SCADA/SAS. The OLTC shall be housed in a separate tank so that oil of the OLTC chamber does not come in contact with the oil of main tank in any way. There should be separate conservator with the arrangement of having the dehydrating breather for OLTC tank.

For 66/33KV and 66/11KV 10MVA transformers, if not mentioned, no separate Remote Tap Changer Panel needs to be provided but tap changing switch with necessary rising and lowering and other indications shall be supplied for fixing those on the existing 66KV transformer control panel in the Control Room. Winding temperature, oil temperature repeaters, tap position indicator shall also be provided for incorporating in the same 66KV panel of the transformer in the control room. Sufficient terminals in the above said indicators shall have to be provided for sending inputs for SCADA/SAS (As per WBSETCL SCADA tech spec).

For 33/11KV 10MVA transformers, no separate Remote Tap Changer Panel needs to be provided but tap changing switch with necessary rising and lowering and other indications shall be supplied for fixing those on the existing 33KV transformer control panel in the Control Room. Winding temperature, oil temperature repeaters, tap position indicator shall also be provided for incorporating in the same 33KV panel of the transformer in the control room. Sufficient terminals in the above said indicators shall have to be provided for sending inputs for SCADA/SAS (As per WBSETCL SCADA tech spec).

On Load Tap Changer

The on-load tap changer shall include the following –

- An oil immersed tap selector and arching switch or arc suppressing tap selector, provided with reactor or resistor for reduction of make and break arcing voltages and short circuits.
- Motor driven mechanism.
- Control and protection devices.
- Local/Remote tap changer position indicator.
- Manual/Electrical operating device.
- Voltage tapping range on H.V. side will be (+5%) to (-15%) in steps of 1.25%.

a) The on-load tap changer shall be designed so that the contacts do not interrupt arc within the main tank of the transformer. The tap selector and arcing switch or arc suppressing tap selector switch shall be located in one or more oil filled compartments. The compartment shall be provided with oil surge relay. Those compartments shall be designed so as to prevent the oil in tap selector compartments from mixing with the oil in the transformer tank.
b) A suitable pressure relieving arrangement should be provided to take care of sudden pressure rise in the compartment. But this should, in no way, affect the performance of the Oil Surge relay provided for this compartment. Oil surge relay (0.49 kg/cm2.) with trip float arrangement shall be provided for OLTC compartment.
c) The manual operating device shall be so located on the transformer that it can be operated by a man standing at the level of the transformer track. It shall be strong and robust in construction.
d) The tap changer shall be in the independent mode. The control scheme for the tap changer shall be provided for independent control of the tap changers. In addition, alarm and visual indication system for out of step condition of the tap changer to be provided so that these can be incorporated in the same 66KV transformer panel. Visual indication during the operation of motor shall also be provided for incorporating it in the same panel. The tap change control must ensure step by step operation under all operating conditions. An indication lamp showing tap changing in a progress is to be provided for incorporating in the same transformer control panel.
e) The contactors and associated gear for the tap change driving motors shall be housed in a local kiosk mounted on the transformer. The motors shall be suitable for operation with 3- phase 415 volts, 50 cycle external power supply.
f) Winding & Oil temperature (O degree – 150 degree) repeaters, to be connected to winding and oil temperatures meters housed in the main Transformer Marshalling Box at out door.
g) An under-voltage relay shall be incorporated to monitor the 110 Volt AC control circuit voltage circuit supply the audible and visual indication shall be provided in the same 66KV or 33KV (in case of 33/11KV 10MVA transformer where OLTC is to be provided as per BOQ) transformer control panel.
h) The OLTC should have been Type Tested.

If Remote Tap Changer Control Panel **is provided as per BOQ (for 66/33KV & 66/11KV 10MVA Transformer), the following points to be noted.**

The supplier shall furnish, in addition to the equipment above, the following accessories mounted on a separate Remote Tap Changer Control (RTCC) panel to be installed in each of the WBSETCL's Control Room for remote operation. The RTCC panel must be equipped with the followings -

i. Raise and Lower Push Button Switch
ii. Remote tap position indicator and other required devices.
iii. One chart showing the voltage corresponding to tap position indicator shall be engraved on a metal sheet and the same shall be fixed near the tap position indicator on the RTCC (panel).
iv. **In Tap Position Indicator sufficient terminals are to be provided for sending inputs for SCADA/SAS.**
v. An indication lamp showing tap changing in a progress
vi. Winding & Oil temperature (O degree – 150 degree) repeaters, to be connected to winding and oil
vii. temperatures meters housed in the main Transformer Marshalling Box at out door.
viii. Provision for SCADA operation **(As per WBSETCL SCADA tech spec)**
ix. An under-voltage relay shall be incorporated to monitor the 110 Volt AC control circuit voltage circuit
x. supply and its audible and visual indication shall be provided in RTCC panel.
xi. A BCU of approved make is to be provided.

- Bay Control Unit (IED should be latest IEC61850 compliant having rear port).
- BCU shall be provided for data acquisition and control of Power Transformer.
- BCU must be supplied from Relay manufacturer, already enlisted in WBSETCL maker's list as on date of NIT conforming all the requirements of latest IS/IEC and the latest WBSETCL Control & relay specification. It is also to be taken into account that the sub-station may be required to run without air-conditioning plant.
- Live demonstration of offered IED has to be arranged by the Bidder at the laboratory of Central Testing Department of WBSETCL prior to approval, if felt necessary. The bidder shall be required to make necessary arrangement without any extra price.
- Communication Port: BCU shall be PRP compliant for SAS with latest 61850 protocol including one front port for direct access with proprietary protocol. Supply of Red Box is also to be considered for integration of the BCU to a non-PRP compliant network. All inputs and outputs must be user programmable. The bay control units shall be equipped with sufficient number of programmable I/O modules for interfacing with the process inputs and outputs. Extension should be possible with additional I/O s via fibre-optic communication and process bus.
- If it is designed with draw out type modules, it should take care of shorting all CT inputs automatically while drawing out. The CT / VT ratio shall be field programmable and Relay shall display the actual HV Voltage and current considering suitable multiplying factors. The system shall be self-sufficient and shall not require any additional devices like parallel balancing module etc.
- A graphic user interface (GUI) display shall be provided in each bay control unit. All alarms related to the respective bay shall be displayed in the BCU through its LED's or in its GUI display as an alarmist/scroll.
- The exact number of digital inputs shall be as per detailed engineering requirement. Apart from that, BCU wise 20% spare I/Os shall be kept for WBSETCL use in future.

Impedance Value:

The percentage impedance at 75 Deg. C & 50 HZ refer to the (normal) principal tapping shall be as follows:

Sl No	Rating	Voltage Ratio	% Impedance
1	10MVA	66/33, 66/11 KV and 33/11KV	8.35

The impedance value refers to the (normal) principal tapping are subject to a tolerance ±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.

13 INSULATING OIL:

Oil for first filling together with 5% extra oil shall be supplied with each transformer. The oil shall comply in all respect with the provisions of the latest edition IS:335 (as amended up-todate) of specification for New Insulation oils for transformers and switchgears. Particulars attention shall be paid to deliver the oil free from moisture having uniform quality throughout in non-returnable steel drums. The quantity of oil for first filling of each transformer shall be stated in the offer.

The oil should have the following characteristics :

SL. NO.	CHARACTERISTICS	REQUIREMENT
1.	Interfacial tension at 27^0C (min)	0.04 N/m
2.	Electrical strength (Breakdown voltage)	60 KV (rms) after treatment
3.	Resistivity at 90^0C/27^0C	$35x10^{12}$/$1500x10^{12}$ Ohm-cm
4.	Dielectric dissipation factor (tan delta at 90^0C max.)	0.002

After site processing through filtration and before commissioning, the moisture content shall be less than 25ppm.

14 CONSERVATOR VESSEL:

14.1 The conservator is a vessel for oil preservation. The oil level in the conservator shall not be below the level of the H.V. bushing caps unless the bushings are of oil sealed type construction. The size of the conservator tank shall have adequate capacity with highest and lowest visible level to meet the requirement of expansion of total cold oil volume in the transformer and cooling equipment from minimum ambient temperature to 100°C.

14.2 The conservator shall have required no. of filter valve in addition to the valve specified in the accessories for the main tank. The conservator with sump shall also have a small drain valve and sampling cock, the latter so arranged as not to interfere with oil lines. The oil level gauge shall be mounted on the conservator. The oil level at gauge shall have three indication viz., oil level at 30°C shall be marked on the gauge and indicating range shall be minimum to maximum level.

14.3 There shall be one "Atmoseal type" sealing to prevent direct contact of transformer oil with the atmospheric air to retard oxidation and contamination of oil.

14.4 The oil connection from the transformer tank to the conservator vessel shall be arranged at a rising angle of 3 to 9 degree to the horizontal up to the Buchhloz relay. The inside diameter shall be 50mm/ 80mm as per capacity of the transformer and IS: 3639.

14.5 Valves shall be provided at the conservator to cut off the oil supply to the transformer after providing a straight run of pipe for at least five times internal diameter of the pipe on the tank side of the Buchholz relay and at least three times the internal diameter of the pipe on the conservator side of the Buchholz relay. The pipe connecting the transformer tank with conservator will project above the lowest point in the conservator such that the portion below the pipe acts as a sump where the impurities in conservator will be collected.

14.6 Magnetic oil level gauge with low oil level alarm suitable for 220Volt $^{+}$/-10% DC supply shall be provided. In addition to magnetic oil level gauge there shall be one Plain oil level gauge.

14.7 OLTC Conservator shall have oil indicator made of glass.

14.8 Atmoseal type conservator shall be filled with oil to a level appropriate to the filling temperature. The oil shall be separated from atmosphere by a flexible aircell of nitrile rubber reinforced with nylon cloth air cell. Flexible aircell of nitrile rubber shall be able to withstand max temp of oil considering continuous operation as well as considering overloading of transformer as per relevant IS/IEC. The connection of air cell to the top of the conservator is to be made by air proof seal to prevent entry of air to the conservator.

Dehydrating Filter Breather:

Conservator shall be fitted with a dehydrating filter breather. It shall be so designed to facilitate the followings:

i) Passage of air through silica gel.

ii) Silica gel is isolated from atmosphere by an oil seal.

iii) Two breathers (of identical size) shall be connected in parallel for main conservator tank. A stop valve shall be provided for each breather and also for the common pipe line.

iv) Breathers are to be maintained approx.. at a height of 1200 mm. above rail top level.

v) **Moisture absorption indicated by a change in colour of the silica gel can be easily observed from ground level**.

15 BUSHING:

15.1 Bushing shall have high factor of safety against leakage to ground and shall be so located as to provide adequate electrical clearances between bushing and grounded parts. Bushings of identical voltage rating shall be interchangeable. All bushings shall be equipped with suitable terminals of approved type and size and shall be suitable for bimetallic connection, if necessary. All main windings and neural leads shall be brought out to outdoor through bushings which shall be so located that the full flashover strength will be utilised and phase to phase and phase to earth clearance shall be more than minimum value specified below. Location and arrangement of bushing shall follow Indian Standards.

Each bushing shall be so coordinated with the transformer insulation that flashovers will occur outside the tank.

Rated System Voltage (KVrms)	Wet & Dry Power Frequency withstand Voltage (KVrms)	Basic Insulation Level (KV-peak)	Minimum Clearance	
			Phase to Phase	Phase to Earth
			(mm)	
11	28	75	280	140
33	70	170	350	320
66	140	350	700	660

15.2 All porcelain used in the bushings shall be made of the wet process, be homogeneous and free from cavities or other flaws. The glazing shall be uniform in colour and free from blisters, burns, and other defects. Upper portion of Bushing made of Porcelain & lower portion made of Epoxy/Porcelain is also acceptable.

15.3 Rating plate of bushing shall be provided near each type of bushing with terminal marking and physical position as per IS:2026. Bushing for 66 KV shall be Oil Impregnated Condenser type bushing for 36KV & 12KV shall be Solid porcelain or oil communicating type.

15.4 Bushings shall conform to IS: 3347, IS:2099. The characteristic of the oil used in the bushing shall be the same as that of the oil in the transformer.

15.5 Main terminals shall be solderless and “Terminal Connectors” shall be as per relevant clause of Clamps and Connectors. The spacing between the bushings must be adequate to prevent flashover between phases under all conditions of operation.

15.6 All bushings shall be suitable for heavily polluted atmosphere and minimum creepage distance shall be taken as 25 mm per KV.

15.7 The voltage and current rating of the bushings shall be as follows :

Highest System Voltage (KVrms)	Current Rating(Amps.)
66 KV (HV)	400
36 KV (LV)	250
12KV (LV)	630
12KV (LV Neutral)	630

15.8 Bushing Current Transformer:

i) Current transformer shall comply with IS:2705/IEC-185.

ii) It shall be possible to remove the turret mounted current transformers from the Tr. Tank without removing the tank cover. Necessary precautions shall be taken to minimize eddy currents and local heat generated in the turret.

iii) Current transformer secondary leads shall be brought out to a weather proof terminal box near each bushing. These terminals shall be wired out to marshalling box using separate cables for each core.

iv) **HV Bushing CT detail as follows:**

a Ratio : 200/1A, Single Core

b Accuracy Class : PS

c Minimum knee point voltage Vk (at highest ratio) : 250 V,

d Maximum CT Secondary winding resistance RCT : <4 ohm,

e Maximum excitation current at knee point voltage : 30 mAmps

15.9 **LV Bushing CT & Neutral Bushing CT for 33 KV side of 10 MVA 66/33 KV Transformer:**

a Ratio : 300/1A, Single Core

b Accuracy Class : PS

c Minimum knee point voltage Vk (at highest ratio) : > 600 V,

d Maximum CT Secondary winding resistance RCT : <4 ohm,

e Maximum excitation current at knee point voltage : 30 mAmps

LV Bushing CT & Neutral Bushing CT for 11 KV side of 10 MVA 66/11 KV and 33/11KV Transformer:

a Ratio : 600/1A, Single Core

b Accuracy Class : PS

c Minimum knee point voltage Vk (at highest ratio) : > 400 V,

d Maximum CT Secondary winding resistance RCT : <6 ohm,

e Maximum excitation current at knee point voltage : 30 mAmps

16 TERMINAL CONNECTOR:

16.1 The bushing shall be equipped with suitable terminals for connector as specified herein.

16.2 Each terminal (including the neutral) shall be distinctly marked on both the primary and secondary side in accordance with the diagram of connection supplied with the transformers.

16.3 Universal type bi-metallic, rigid connector for bushing stud shall be provided.

16.4 Clamp and connector shall be made from Cold forged Aluminum Alloy Plate i.e Extruded Aluminum Clamp and Connector shall be processed through Cold forging.

16.5 The Nuts & Bolts associated with equipment of connector pieces shall be MS Hot dip galvanized. Quality of Nuts & bolts shall conform to relevant IS of latest edition.

16.6 Minimum thickness at any point of current carrying part of any clamp & connector shall not be less than 12mm.

16.7 From outermost hole edge to nearest edge of any clamp & connector the distance shall not be less than 10mm.

16.8 The current density of Aluminum/Copper shall be considered as 0.75/1.75 A/sq.mm.

16.9 Minimum thickness of Bimetal in bimetallic connection shall be 2mm.

16.10 Name of approved vendor for Clamp & Connector are from Maker's list of WBSETCL available in website.

17 COOLING SYSTEM:

Two winding transformer (66/33,66/11 & 33/11 KV) of 10 MVA capacity transformer shall employ ONAN type cooling.

18 RADIATORS:

The transformer of all capacities shall be fitted with detachable radiator consisting of a series of separate circular/elliptical/rectangular, etc. tubes or fins, welded at their top and bottom into headers which in turn are connected to the tank by means of bolted, oil tight, flanged joints. There shall be indicating butterfly or similar valves fitted in between the tank and the headers which can be kept in open or closed position. There shall also be filter valves for circulation of oil, at each of top and bottom header. One air release plug at the top header shall be provided. There shall be air release plug & drain

plug for each radiator. No drain valve is mandatory in radiator unit of transformer. Oil drainage plug/cap may be used instead.
The radiator tubes/fins shall be seamless and made of mild steel/CRCA and in order to prevent rusting epoxy paint of 80 micron shall be applied and minimum wall thickness not less than 1.2 mm, with a clean bright internal surface free from rust and scale. They shall be suitably braced to protect them from mechanical shocks normally met in transportation.

A separate blanking plate shall be supplied to permit the blanking of the main oil connection to each cooler unit when the same is detached. Each cooler unit shall have a lifting eye, oil drain valve at the bottom and a vent at the top.

19 COOLER GROUPS:

The whole cooler plant shall be grouped as indicated below : For ONAN cooling : 100% cooling banks consisting of radiators

20 ACCESSORIES:

Each transformer shall be provided with the following accessories and only type tested accessories shall be supplied. All accessories mounted out door shall have contact enclosure tested with IP-55 as per IS:2147 in order to avoid mal operation during rain or condensation.

21 TEMPERATURE METERS:

21.1 Dial type gas thermometer for oil temperature indication: One dial type indicating thermometer (having 270°C scale with accuracy of 1.5% of FSD) of robust design and in weather proof casing shall be housed in transformer tank mounted marshalling box at a convenient height to read the hot oil temperature and shall have contacts for alarm and trip for ONAN type transformers with capacity 10 MVA 66/33,66/11KV and 10 MVA 33/11 KV. Maximum oil temperature indicating pointer shall also be provided. Oil temperature indicator shall be mounted in tank mounted marshaling box for transformer of 10MVA capacity and shall be connected to one phase of HV winding.

21.2 Indicating type winding temperature indicator: All transformers shall be provided with a device for indicating the combination of top oil temperature and heating by winding current calibrated to follow the hottest spot temperature of the transformer winding. The device shall have a dial type indicator, and in addition an indicating pointer to register the hottest temperature reached. The temperature indicator shall be connected to CT secondary current in one phase of each winding of the transformer.

21.3 Separate winding temperature indicators, with potential free mercury contacts for control, indication, alarm and trip shall be provided, with independent facility for setting the contacts at any temperature over the whole working range of 20°C to 150°C. Each mercury contact shall have adjustable 10°C overlapping (between ON & OFF). The winding temperature indicator

shall be mounted in tank mounted marshalling box for transformers of 10 MVA capacity and shall be connected to one phase of each HV windings. The accuracy class of WTI shall be ±1.5% or better temperature indicator did shall have linear gradation to clearly read at least every 2°C.

22 **VALVES:**

(i) Oil inlet valves located in suitable locations

(ii) One oil drain valve each suitably located at top and bottom

(iii) One filter valve suitably located near the top of the tank

(iv) One filter valve suitably located near the bottom of the tank

(v) One valve each for oil sampling suitably located at bottom and top

(vi) Radiator shut off valve at top and bottom.

(vii) Buchholz relay and shut-off valves at both ends of the relays

(viii) Conservator – filter, drain and sample valve, air release valve & release plug.

(ix) **OLTC Conservator – Oil filling valve, Drain valve, Suction** v**alve**

(x) **One drain valve for OLTC**

(xi) Any other valves other than those mentioned above for improvement of operation and maintenance facility shall be within the scope of supply of contractor

23 **PRESSURE RELIEF DEVICES:**

23.1 One no. of pressure relief device with two sets of electrically insulated NO contacts shall be provided for Alarm/Tripping. It shall be of sufficient size to release pressure rapidly that may be generated within the tank to prevent damage to any part of the transformer. It shall operate at a static pressure less than the hydraulic test pressure of the tank. Design shall be such as to prevent ingress of rain water. It shall be mounted on the cover of main tank and shall be designed to prevent gas accumulation.

23.2 Gas actuated relay:
One double float gas detector relay (Buchholz relay) of reputed make with alarm and tripping contacts to detect accumulation of gas and sudden changes of oil pressures, complete with two shut-of valves and flange coupling to permit easy removal without lowering oil level in the conservator tank. A bleed valve for gas venting and a test valve are to be provided. Pressure relief device & Buchholz relay shall be tested for IP:55 protection in accordance with IS: 13947 to avoid maloperation due to ingress of moisture.

24 **GROUNDING TERMINALS:**

24.1 Two grounding terminals capable of carrying for 3 (three) seconds the full short circuit current of the transformer shall be provided at positions close to the bottom at two corners of the tank for bolting the earthing terminals to the tank structure to suit local condition.

24.2 Neutral Earthing Arrangement:

The neutral terminal of two winding transformer shall be brought to the ground level by adequate sized brass/tinned copper grounding bar (considering the system fault level as stated in STP) supported from the tank by using porcelain insulators. The end of the tinned copper bar shall be brought to the bottom of the tank at the convenient point for making bolted connection to two nos. galvanized steel grounding flat connected to sub-station grounding mat.

25 RATING, DIAGRAM AND PROPERTY PLATES:

The following plates shall be fixed to the transformer tank at an average height readable from the transformer base level.

25.1 A rating plate bearing the data specified in the appropriate clauses of IS: 2026

25.2 A diagram plate showing the internal connections and also the voltage vector relationship of the several windings in accordance with the IS and in addition, a plan view of the transformer giving the correct physical location of the terminals. No load voltage shall be indicated in each tap. The winding temperature C.T. and the thermometer pocket shall also be indicated in the said plate.

25.3 A plate showing the location and function of all valves and air release plugs and plate material preferably in stainless steel.

25.4 A separate rating plate embossing different losses obtained after relevant test for each transformer is to be provided. 25.5 A rating plate for each type of bushing shall be provided and to be fixed at the base of the bushing.

26 TANK MOUNTED MARSHALLING BOX:

26.1 This box shall be provided on the body of the tank at a suitable height to accommodate winding and oil temperature indicators, terminals of temperature indicator and Buchholz relay etc. for alarm and trip. Suitable cover with glass window shall be provided for taking reading. Tank mounted marshalling box shall be provided for transformer of capacity 10 MVA.

26.2 Marshalling box of each type shall be tested for **IP-55** protection in accordance with **IS:13947**.

26.3 All terminal blocks for cable connection shall be located in this box. Terminal blocks shall be of 1100 Volt grade “Elmex/Connectwell” make and have continuous rating to carry the maximum expected current on the terminals. The terminal block shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barrier shall be provided between the terminals. The terminal blocks shall have locking arrangement to prevent its escape from the rails. 20% spare terminals are to be provided. These spare terminal blocks shall be uniformly distributed on all the terminal block column. All terminal blocks shall be numbered for easy identification. Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks.

26.4 The marshalling box shall be provided with cubicle lamp with door switch, space heater with differential thermostat and removable cable gland plate etc. Cable shall enter from the bottom of the box.

26.5 All internal wiring shall be carried out with 1100 Volt grade PVC insulated stranded copper conductor of 2.5 sq. mm or larger size as per scheme requirement.

27 WIRING:

All control, alarm and indicating devices provided with the transformer shall be wired up to the terminal blocks in the marshalling box.

27.1 Wiring from transformer to the cubicle shall be done with PVC wires in conduit or by PVC armoured cable of 1100 V grade. Minimum wire size shall be 2.5mm² copper. Not more than two wires shall be connected to a terminal. 20% spare terminals shall be provided.

27.2 All devices and terminal blocks within the marshalling box shall be identified by marking corresponding to the circuit in schematic or wiring diagram. All fuses shall be of cartridge type and IS marked.

27.3 Phase marking on each terminal bushing (including neutral) shall be distinctly made on both the primary, secondary and tertiary winding side in accordance with the connection diagram of the transformer.

27.4 Interconnection of wires in between transformer and marshalling box will be in the scope of the contractor.

29 CENTER OF GRAVITY:

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. Location of Centre of Gravity shall be shown on the outline general arrangement drawing.

30 LOSSES OF 10 MVA 66/33, 66/11 KV AND 10 MVA 33/11KV TRANSFORMERS:

Standard Max losses at 75^0C will be as follows:

Rating of Transformer	Guaranteed Maximum No LoadLoss on principal tap at Rated Voltage and frequency (in KW)	Guaranteed Maximum Load Loss (Copper + stray loss) at rated current on principal tap at75 ^{O}C (in KW)	
		Load Loss	I^2R Loss
10 MVA – 66/33KV, 66/11KV, 33/11 KV	7	40	34

The bidder shall state losses at rated voltage and frequency and loss figures shall be guaranteed.

- Loss capitalisation will not be done.
- The losses shall be firm and no positive tolerance should be allowed.
- No weightage shall be given for supply of transformer with losses less than the specified value.
- Bidder must specify the offered losses as "FIRM".
- REJECTION: WBSETCL may reject any transformer during tests or in service if any of the individual loss exceeds the permissible maximum value specified in the table.

31 CLEANING AND PAINTING:

Before painting or filling with oil, all non-galvanised parts shall be completely clean and free from rust, scale and grease and all external rough surfaces on castings, shall be made smooth. The interior of all transformer tanks and other oil filled chambers and internal structural steel work shall be cleaned of all scale and rust by sand blasting or other approved method. These surfaces shall be painted with an oil resisting varnish or paint.

31.1 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 of a shade or colour easily distinguishable from the primary, and the final coats shall be applied after the primary coat has been touched up where necessary. The final coat shall be of a glossy, oil and weather resisting non-fading paint of battle ship grey colour.

31.2 All interior surfaces of mechanism chamber and kiosks except those which have received anti-corrosion treatment shall receive three coats of paints applied to the thoroughly cleaned metal surface. The final coat shall be of light coloured anti-condensation paint.

32 PACKING & TRANSPORATIONT LIMITATIONS:

32.1 Power Transformer is to be transported in an atmosphere of nitrogen or dry air at positive pressure.

32.2 Necessary arrangement shall be ensured by the manufacturer to take care of pressure drop of nitrogen or dry air during transit and storage till completion of oil filling during erection. The nitrogen or dry air cylinder provided to maintain positive pressure can be taken back by the contractor after oil filling. A gas pressure testing valve with necessary pressure gauge and adaptor valve shall be provided

32.3 The transformer Main Tank with Core-coil assembly shall be shipped/ transported filled with inert gas due to transport weight regulation. If the transformer is equipped with inert gas pressure system, then a low-pressure alarm device is to be provided. The alarm device shall be required for extended storage at site.

32.4 Special attention shall be paid in packing the accessories & spares to avoid moisture ingress. All parts shall be adequately marked to facilitate field erection. Boxes and crates shall be marked with the contract number and shall have a packing list enclosed showing the parts contained therein.

32.5 The Bushings shall be crated & packed and transported as per standard guide line of the Bushing Manufacturer. All care should be taken to avoid any damage of the porcelain due to vibration during transport.

32.6 The weights & dimensions of the packages to be transported to site shall be governed by facilities available for the routes by road/rail/ship.

33 LABELS:

33.1 Labels shall be provided for all apparatus such as relays, switches, fuses contained in marshalling box.

33.2 Descriptive labels for mounting indoor or inside cubicles and kiosks shall be of material that will ensure permanence of the lettering. A mat or stain finish shall be provided to avoid dazzle from reflected light. Labels mounted on dark surfaces shall have white lettering on a black background Danger notices shall have red lettering on a white background. All plates shall be of material which will not be corroded. Labeling shall be clear, concise and adequate.

33.3 Labels for mounting outdoors shall be weather and corrosion proof formed by etching to ensure permanence.

33.4 Labels shall be attached to panels with brass screws or with steel screws which have received rust preventive treatment.

33.5 Labels should have lettering sizes of at least 1 to 1.5mm stroke width and 3 to 6mm height.

34 CONTRACT DRAWINGS AND MANUALS:

After placement of P.O., six copies of following drawings, manuals and literatures shall be submitted to the Chief Engineer, Engg. Deptt., Bidyut Vhaban (9 floor), Salt Lake, Kolkata - 700091.

34.1 Drawing for Controls:

i) General arrangement of tank mounted Marshalling Box for all type of transformer.

ii) Wiring diagram of tank mounted Marshalling Box for each type of Transformer.

Drawings other than there mentioned above if required as per provision of Technical Specification for Erection & Maintenance are also to be submitted.

34.2 Drawings of Transformer:

i) General outline drawing showing front, side elevation, plan of the transformer and accessories with detailed dimensions and detailed legend.

ii) Detailed foundation plan.

iii) Drawing of each type of bushings, lifting dimensions, clearance between Terminals of different voltage level and ground, quantity of insulation oil, name plate, details etc.

iv) Operation and maintenance guide for transformer.

v) Transport Outline Drawing

vi) Valve Schedule Plate

vii) Measured Loss Plate

viii) Clamp & connectors

ix) Rating Plate diagram

x) Oil filling instruction plate

xi) Roller locking arrangement

xii) Foundation Plan drawing

Drawings other than those- mentioned above if required as per provision of Technical Specification for Erection & Maintenance are also to be submitted.

Six (06) copies of approved drawings and literatures for each transformer shall be submitted for our record and distribution to site.

34.3 Instruction manuals:

Six (06) copies of operation, maintenance and erection manuals in English language shall be supplied for each transformer against each P.O. The manuals shall be bound volumes and shall contain the drawings and information required for erection, operation and maintenance of the power transformer. The manuals shall include amongst other, the following particulars.

a) Marked erection prints identifying the components parts of the power transformers as despatched, with assembly drawings.

b) Detailed dimensional drawings, assembly and descriptions of all the components.

35 TEST AT FACTORY AND TEST CERTIFICATES:

All Routine and Acceptance tests at manufacturer's works shall be carried out in presence of WBSETCL's representative in compliance with IS:2026/ IEC 60076 (as amended up-to- date) on the transformers. The entire cost of acceptance test, routine test and special test as follows that are to be carried out as per relevant IS shall be treated as included in quoted price of transformer. The Contractor shall give at least 15 (fifteen) days advance notice intimating the actual date when the tests will be carried out. Six (6) copies of test results of each transformer shall be submitted to the Chief Engineer, Engg. Deptt. for approval.

The following tests are to be carried out as a part of routine tests as per IS:2026/ IEC 60076 and as per our standard requirement:

i) Resistance of each winding at all taps (wherever applicable).

ii) Turns ratio for all sets of windings on each tap

iii) Polarity and phase vector relationship

iv) Measurement of No Load Loss and No Load Current at 90, 100 and 110 percent rated voltage.

v) Impedance voltage at normal, maximum and minimum tap for each pair of winding.

vi) Measurement of insulation resistance between windings and between windings and earth. IR value is to be measured before and after impulse test.

vii) Regulation at rated load and at unity, 0.8 lagging power factors

viii) Efficiencies at u.p.f. and 0.8 p.f. at 50%, 75% and 100% loading.

ix) Measurement of Load Losses.

x) Separate source voltage withstand test.

xi) Induced over voltage withstand test.

xii) Magnetic Balance test.

xiii) Oil leakage test on tanks and all oil filled compartment of transformer shall be tested as per CBIP for 12 hours (minimum) filled with oil for which no oil leak shall occur.

xiv) Test on pressure relief device.

xv) Measurement of Tan Delta Capacitance of Windings.

xvi) Zero Sequence Impedance measurement.

xvii) Test on tank mounted marshalling box.

xviii) BDV measurement of transformer oil.

xix) Visual, dimensional checking of transformer.

The following Type tests are to be carried out for at least on one of each type of transformer against each purchase order without any price implication:

1. Temperature rise test(cl.no.16.8 of IS 2026)
2. Checking of acoustics noise level.
3. Full wave Lightning Impulse withstand Tests in all phases (including chopped and reduced chopped wave) (IEC 60076-3/ IS:2026, Part- III,2009)

Pressure & vacuum test on finished empty tank during stage inspection.

The pressure & vacuum test on remaining finished empty tank of each type against each P.O. shall also to be carried out at the tank manufacturer premises in presence of representative of transformer manufacturer and test report are to be submitted to the Chief Engineer, Engg. Deptt, for approval and clearance towards use of the said tank.

STAGE INSPECTION:

Stage inspection will be carried out by the customer on Core, Coil & Tank during the manufacturing stages of the transformer. The manufacturer will have to call for the stage inspection an d shall arrange the inspection at manufacturer's premises or manufacturer's bidders premises free of cost. Stage inspection of core and coil will be carried out on **1 (one) number Transformer** against each Purchase order or a particular design. On the basis of satisfactory Stage Inspection, manufacturer will proceed further. The following stage inspection shall be carried in one inspection. Prior to stage inspection following documents shall have to be submitted by manufacturer for verification:

1) Document related to prime core, procurement establishing traceability vide relevant Cl. of Technical Specification of Power Transformer.
2) Documents for coil establishing traceability.

Following tests have to be carried out in stage inspection.

I. On Core

1) Flux density checking of assembled core (without having any insulating tape etc. rapped around the core) vis-à-vis measurement of step thickness, lamination width etc.
2) Window height, leg center dimension, core diameter of assembled core.
3) Physical verification of core in respect of lamination thickness, bend, camber and waviness etc.
4) Carlite test, Watt loss and ageing test on the sample of prime core. (Core sample shall be selected during stage inspection and sent to any NABL accredited laboratory for tests)
5) Loss measurement of Prime core (Loss/Kg).
6) 2KV test between core and Yoke clamps.

II. On Coil

1) Physical verification of HVand LV wound coil
2) Measurement of resistance of each finished coil (HV& LV).
3) Measurement and current density calculation of each winding.
4) Copper purity test (after cutting from finished coil offered for inspection).

Calibration Certificates of all measuring instrument to be used during stage and final inspectio n shall be produced and that will be in conformity to our relevant Clauses of GCC/Technical Specification.

III. On Tank

1) Physical inspection & Dimension Checking of Main Tank
2) Vacuum Withstand Test on the Main Tank.
3) Pressure Withstand Test on the Main Tank.
4) Leakage Test of the main Tank.

37 TEST AT FACTORY AND TEST CERTIFICATE:

Routine and Acceptance test at manufacturer's works shall be carried out in presence of WBSETCL and representative in compliance with IS:2026/IEC-60076 (as amended up-to-date) on the transformer.

38 TENDER DRAWING, LITERATURE AND TYPE TEST CERTIFICATES:

One copy of each drawings incorporating the following particulars along with one set of complete type test report on similar transformer carried out as per IS & IEC in Govt. Recognized Test House or Laboratory/NABL accredited Laboratory shall be submitted by each bidder with each copy the bid to the Purchaser for the purpose of evaluation of bid as follows:

38.1 General outline drawing showing dimensions, net weights of transformers, tap changing gear, marshalling box and their shipping weights.

38.2 Sectional views showing the general construction features and disposition of various fittings and accessories.

38.3 Bushing drawing showing full details of construction of HV/LV condenser bushing and other technical data, weight of bushing assembly etc.

38.4 Dimension of the largest part to be shipped and the position in which these are to be transported.

38.5 Technical literature on general construction feature for winding temperature indicators, Buchholz relays, oil temperature indicator, pressure release device etc. 39.6 Transformer similar to offered one should have type tested as per relevant IS.

39 TEST REPORTS:

After all the tests have been completed, 6 (six) certified copies of each test report shall be submitted for approval. Each report shall supply the following information:

a) Complete identification, where applied, duration and transformer.

b) Method of application, where applied, duration and interpretation of results for each test.

c) Bidder shall quote price for type test as per schedule for type test charges so that the same can be carried out as per option of WBSEB. This price shall be considered for the purpose of evaluation of bid.

40 TEST ON ASSOCIATED EQUIPMENT:

Porcelain Bushings, Windings Temperature Indicating Devices. Dial Thermometers, Buchholz Relays, Auxiliary Meters, Motor Starting Contactors, Control devices, insulating oil and other associated equipment covered by the contract shall be certified by the contractor to have been tested in accordance with the relevant IS specification by the manufacturer. The contractor shall furnish a certificate of compliance of the relevant tests, for all auxiliary apparatus. Six certified copies of the aforesaid test reports shall have to be furnished.

41 DRYING OUT AT THE MANUFACTURER'S WORKS:

All the Tests shall be conducted after complete Drying out at the works. The transformer shall be dispatched complete after being dried out under vacuum and filed with inert gas, ready to be put into commission, without further drying out at site.

42 GUARANTEED TECHNICAL PARTICULARS:

The Bidder shall furnish all guaranteed technical particulars as called for in this specification. Bids lacking information in this respect may not be considered.

43 INSTRUCTION MANUALS:

Sufficient copies of operation, maintenance and erection manuals in English language shall be supplied. The manuals shall be bound volumes and shall contain and the drawings and information required for erection, operation and maintenance of the power transformer. The manuals shall include amongst other, the following particulars.

a) Marked erection prints identifying the components parts of the power transformers as dispatched, with assembly drawings.

b) Detailed dimensional drawings, assembly and descriptions of all the components.

SPECIFIC TECHNICAL PARAMETERS

SNO	DESCRIPTION	TECHNICAL PARAMETERS
1	Rated capacity and type a) 10 MVA	3-ph Two winding
2	Rated capacity and type a) 10 MVA	66/33 KV 66/11 KV 33/11 KV
3	Maximum system voltage (KV)	72.5/36/12
4	Rated capacity at type of cooling (MVA)ONAN	100%
7	i) System frequency (Hz) ii) No. of phases in system	50 3
8	System Earthing	Effectively earthed, except for 33 KV systems which is earthed through grounding transformer.
9	Insulation level of the winding (withstand) Voltage Class 66/33/11 i) 1.2x50 micro-second lightning impulse (KVP) ii) Power frequency withstand (KVrms)	350/170/28 155/70/75
10	Maximum hot spot temperature (^{0}C) for weighted average temp of 32 ^{0}C	98 ^{o} C
11	Type of tap changer i) 10 MVA ii) Tapping range	OLTC (If mentioned in BOQ for 33/11KV 10MVA Transformer) (+) 5% to (-) 15% in step of 1.25% for 10 MVA.
12	Vector group i) 10	DYN11

13	Short circuit level (KA) i) 66 KV (-do-) ii) 33 KV (-do-) iii) 11 KV (-do-)	25 31.5 25
14	Minimum creepage Distance (mm) of bushing i) 66 KV ii) 33 KV iv) 11 KV	1815 900 300
15	Impedance voltage at normal tap (percent) (The impedance volt at HV-IV for 3 winding transformer and HV-LV for 2 winding transformer shall be guaranteed.) i) 10 MVA	HV-LV 8.35
16	Type of insulating media	Mineral insulating oil immersed.
17	Indoor or outdoor type	Outdoor
18	Insulation level to earth of neutral terminal	Similar to 11 KV bushing for 10 MVA transformer.
20	Auxiliary DC supply for alarm and tripping (volt)	220 +/-10%
21	Altitude above mean sea level	Less than 1000 mtr.
22	Terminal Connectors i) 33 KV / 11 KV Transformer	For ACSR Panther
24	Acoustic noise level (DB) of all transformers	As per NEMA Publication TR-1.
25	Insulating level of bushing i) Rated Voltage (KV) ii) Minimum Creepage distance (mm) iii) 1.2/50 micro second lightning impulse withstand voltage (KVP)	66 KV / 33 KV / 11KV 72.5 / 38 / 12 1815 / 900 / 300 350 / 170 / 75 155 / 70 / 28

	iv) One minute Power frequency withstand voltage (KVrms)	
26	Width of Rail Gauge (mm)	1676

FITTINGS & ACCESSORIES:

A. All screw threads and nuts shall be made as per ISS and all valves shall be of standard tested quality and leak-proof.

B. The following fittings and accessories shall be supplied with each Transformer:

1. Outdoor type bushing – HV-3 Nos. and LV-4 Nos. suitable for heavily polluted atmosphere.
2. Conservator with atmoseal and supporting bracket or structure as the case may be.
3. Isolating valve for conservator in between conservator and Buchholtz Relay and in between Buchholtz relay and main tank.
4. Conservator valves for driven out air between air cell & wall of conservator & connection to breather.
5. 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. Another Silica gel breather with oil seal shall also be provided in the conservator for OLTC tank.
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 both in the main & OLTC tank
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 OLTC Driving mechanism Box and with matching RTCC Panel.

13. Air release plugs on top of inspection cover of main tank top cover and a pipe shall be provided connecting the top of bushing turrets to the Buchholz relay so that any trapped air in those parts may be accumulated in the Buchholz relay. The connecting pipe shall have suitable sections so that the bolted turret covers can be opened to attend the C.T. provided therein.
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 & Ladder with anti-climbing locking arrangement.
20. Under carriage base channel.
21. Tank earthing terminals – 2 Nos.
22. Buchholz 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 & repeater for remote indication
24. Dial thermometer for oil temperature with alarm contacts and Trip Contacts & repeater for remote indication.
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 6.3 MVA and Bushing C.T. suitable for installation in L.V. side in r,y,b phases and also neutral C.T. of 10 MVA Power Transformer.
28. Rating plate, as per I.S.S.
29. Diagram Plate : As per clause 28.
30. Property label.
31. Oil filling instruction plate shall be provided at

    i) conservator body,

    ii) tank body along with rating and diagram plate.

32 Oil Surge Relay for OLTC tank and to be placed in between OLTC tank and OLTC Conservator

GUARANTEED TECHNICAL PARTICULARS FOR 10MVA, THREE PHASE POWER TRANSFORMER				
(To be filled in and signed by the Bidder)				
SL	PARTICULARS			
1	Name of Manufacturer & Address			
2	Type and Designation			
3	Conforming Standard			
4	Voltage Rating (KV) / Current Density (Amp./ S q. c m.)			
	HV Winding			
	LV Winding			
5	Highest System Voltage (KV)			
	HV Winding			
	LV Winding			
6	Connection (Auto/Two Winding)			
	HV Winding			
	LV Winding			
7	Rated frequency (Hz)			
8	Number of phases			
9	Vector Group (Symbol)			
10	Tapping Range No. of Step Voltage Variation	Step	Voltage Variation (+/-)	(%)
11	Whether tap changing is suitable for local-manual			
12	Type of Conservator			
13	i)Type of transformer tank			

	ii) Thickness of (in mm.) : a) side plate : b) bottom plate : c) cover plate : d) tube/fin radiator		
	iii) Vacuum to which transformer can be subjected without distortion		
14	Type of Bushing (with Bushing CT) : a) HV side : b) LV side : c) LV Neutral :		
15	Hot Spot temperature over 50oC ambient temperature (^oC)		
16	Limit for Hot Spot temperature for which the transformer is designed (^oC)		
17	Type of cooling ONAN		
18	Temperature rise (^oC)at winding rated current above 50oC ambient temperature		
	By Thermometer		
	By Resistance Measurement		
19	Total losses at rated voltage, at normal tapping and at rated frequency and at 75°C winding temperature including auxiliary losses (KW)		
20	Component of losses at normal tapping and at rated frequency and at 75oC average winding temperature (KW) i) No load loss (core loss) : ii) Load loss (excl. auxiliary loss) :		
21	Percentage Impedance voltage for highest/normal/lowest tap	HV	LV
22	Zero sequence Impedance at 75oC for highest/normal/lowest tap (Ohm)		

23	No load current at rated voltage and rated frequency (percent of full load current at normal tap)		
24	Insulation level of winding : a) separate source power frequency withstand value (KVrms)	HV Winding	LV Winding
	b) Induced over voltage withstand (KVrms)		
	c) Full wave lightning Impuls withstand value (KVP)		
25	Efficiency at 75°C at Aunity At At 3/4 At 1/2 power factor (percent) full load		
26	Regulation at full load at 75oC (percent) At unit power At 0.8 lagging factor power factor		
27	Radiator Connection : Radiator on Separate enclosed tank type cooler		
28	Rating at respective cooling (percent) ONAN		
29	Width of Rail gauge suitable for Bi-directional flanged rollers of Tr. for its movement.		
30	Core Particulars : i)Material & grade of core : ii) Thickness of stamping (mm) : iii)Flux density at rated voltage(Tesla): iv)Flux density at 110% rated voltage (Tesla)		
31	Bushing Particulars : a) Name of Manufacturer : b) Conforming Standard : c) Type & Designation d) Insulation Level : i) Rated Voltage (KV) : ii) Rated Current (Amp) : iii) 1.2/50 microseconds Lightning Impulse withstand volt. (KVp) : iv) 1 min. Power Frequency withstand voltage (KVrms) : a) Dry :		

	b) Wet : e) Creepage Distance (mm) : f) Min. clearance bet. phases : i) In Oil : ii) In Air : g) Min. Clearance between bushing terminal to earth (mm) :			
32	Confirm compliance to technical specification w.r.t. Sl. No. Particular i) Transformer Oil (Yes/No) : ii) Bushings (Yes/No)			
33	Terminal arrangement	i) HV	ii) LV	iii) Neutral
34	Approx. masses : i) Core & winding (Kg) : ii) Tank, fittings & auxiliaries (Kg) : iii) Oil (Kg) : iv) Total mass (Kg) :			
35	Approx. quantity of oil for first filling (litres)			
36	Approx. overall dimension (mm) : i) Length : ii) Breadth : iii) Height			
37	Despatch details : i) Approx. mass of heaviest package (Kg) : ii) Length (mm) : iii) Breadth (mm) : iv) Width (mm)			
38	Whether similar equipment is type tested (Yes/No). : If yes furnish details			