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TECHNICAL SPECIFICATION OF 6.30 & 10 MVA; 33/11 KV ONAN COOLED Power

Transformer WITH OLTC & SCADA COMPATIBLE RTCC PANEL

Power Transformers

1. SCOPE

1.1. This specification provides for design, engineering, manufacture, assembly, stage inspection, final inspection and testing before dispatch, packing and delivery at destination stores by road transport, transit insurance of 3.15/5/6.3/8/10/12.5 MVA, 33/11 KV Power Transformer(s), complete with all fittings, accessories, associated equipments, spares, 10% extra Transformer Oil, required for its satisfactory operation in any of the sub-stations of the purchaser.

1.2. The core shall be constructed either from high grade, non-aging Cold Rolled Grain Oriented (CRGO) silicon steel laminations conforming to HIB grade of BIS certified with lamination thickness not more than 0.23mm to 0.27mm or better(Quoted grade and type shall be used). The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall be such that it should under 10% overvoltage condition should not be more than 1.9 Tesla. The supplier shall provide saturation curve of the core material, proposed to be used. Laminations of different grade(s) and different thickness (s) are not allowed to be used in any manner or under any circumstances.

1.3. The scope of supply includes the provision of type test. The equipment offered should have been successfully type tested within five years from date of tender and the designs should have been in satisfactory operation for a period not less than three years as on the date of order. Compliance shall be demonstrated by submitting, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

1.4. The Power Transformer shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the employer shall have the power to reject any work or material, which, in his judgment, is not in full accordance therewith. The Transformer(s) offered, shall be complete with all components, necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of supply, irrespective of whether those are specifically brought out in this specification and/or the commercial order or not.

The Engineer reserves the right to reject the transformers if on testing the losses exceed the declared losses beyond tolerance limit as per IS or the temperature rise in oil and / or winding exceeds the value, specified in technical particular or impedance value differ from the guaranteed value including tolerance as per this specification and if any of the test results do not match with the values, given in the guaranteed technical particulars and as per technical specification.

2. SPECIFIC TECHNICAL REQUIREMENTS

1.	Rated MVA (ONAN rating)	3.15/5/6.3/8/10/12.5MVA
2.	No. of phases	3
3.	Type of installation	Outdoor
4.	Frequency	50 Hz (± 5%)
5.	Cooling medium	Insulating Oil (ONAN)
6.	Type of mounting	On Wheels, Mounted on rails.
7.	Rated voltage	
	a) High voltage winding	33KV

	b) Low voltage winding	11KV
8.	Highest continuous system voltage	
	a) Maximum system voltage ratio (HV / LV)	
	b) Rated voltage ratio (HV / LV)	33KV /11 KV
9.	No. of windings	Two winding Transformers
10.	Type of cooling	ONAN (Oil natural / Air natural)
11.	MVA Rating corresponding to ONAN Cooling system	100%
	Method of connection:	
	HV	Delta
	LV	Star
13.	Connection symbol	Dyn 11
14.	System earthing	Neutral of LV side to be solidly earthed.
15.	Intended regular cyclic overloading of windings	As per IEC –76-1, Clause 4.2
16.	a) Anticipated unbalanced loading	Around 10%
	b) Anticipated continuous loading of windings (HV / LV)	110 % of rated current
17.	a) Type of tap changer	(For3.15, 5, 6.3, 8, 10 &12.5 MVA only) On or Off load tap changer as per BOQ
	b) Range of taping	+5% to (–)15% in 9 equal steps of 2.5% each for Off-load tap and in 17 equal steps of 1.25% each for On-load tap changer on HV winding
18.	Neutral terminal to be brought out	On LV side only
19.	Over Voltage operating capability and duration	112.5 % of rated voltage (continuous)
20.	Maximum Flux Density in any part of the core and yoke at rated MVA with +12.5% combined voltage and frequency variation from rated voltage and frequency.	1.9 Tesla

21.	Insulation levels for windings	33KV	11KV
	1.2 / 50 microsecond wave shape Impulse withstand (KVP)	170	75
	Power frequency voltage withstand (KVrms)	28	

22.	Type of winding insulation		
a)	HV Winding	Uniform	
b)	LV Winding	Uniform	
23	Withstand time for three phase short circuit	2 Seconds	
24.	Noise level at rated voltage and frequency	As per NEMA Publication No. TR-1.	
25.	Permissible Temperature rise over ambient temperature shall be as per IS-2026		
26.	Minimum clearances in air (mm)	Phase to Phase	Phase to ground
a)	HV	400	320
b)	LV	280	140

27. Terminals

a) HV winding line end 36 KV oil filled communicating type porcelain bushings (Anti-fog type)

b) LV winding 12 KV porcelain type of bushing (Anti-fog type) – for outdoor 11 KV breakers **(11KV Power cables shall be used for extending supply to 11KV breakers in case of indoor circuit breakers. The termination of 11 KV cables on LV bushing shall be through extended copper bus bars suitable to hold power cables termination. A metallic cable termination box, completely sealed, shall be installed on LV side of the transformer in which cables shall enter from bottom gland plates.)**

28.	Insulation level of bushing	LV	HV
a)	Lightning Impulse withstand (KVP)	170	75
b)	1 Minute Power Frequency withstand voltage (KVrms)	70	28
c)	Creepage distance	900	300
29.	Material of HV & LV Conductor	Electrolytic Copper	
30.	Maximum current density for HV and LV winding for rated current	As per best practice	
31.	Polarization index (HV to LV, HV to Earth & LV to earth)		

IR Test = 1 minute value/ 15 sec value will not be less than 1.5

IR Test = 10 minutes value / 1 minute value will not be more than 5 and less than 1.5

32.	Core Assembly	Boltless type
33.	Temperature Indicator	
a)	Oil	One Number
b)	Winding	One Number

34. **Losses:** The losses shall not exceed the value given below

MVA Rating	No-load losses (Fixed loss)	Load losses at 75°C	Percentage impedance voltage on normal tap and
3.15	3	16	7.15
5	4	23	7.15
6.3	4.6	36	7.15
8	5.5	40	8.35
10	7	50	8.35
12.5	7.5	65	10

2.1. MARSHALLING BOX

A metal enclosed, weather, vermin and dust proof marshalling box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch etc. shall be provided with each transformer to accommodate temperature indicators, terminal blocks etc. It shall have degree of protection of IP 55 or better as per IS: 2147 (Refer Clause 3.12).

2.2. CAPITALIZATION OF LOSSES AND LIQUIDATED DAMAGES

Capitalisation of losses will be as per Annexure B which is attached herewith. No (+)ve tolerance shall be allowed at any point of time, on the quoted losses after the award. In case, the losses during type testing, routine testing etc are found above the quoted lossses, the award shall stand cancelled. In such a case, the CPG money shall also be forfeited.

2.3. PERFORMANCE

i) Transformer shall be capable of withstanding for two seconds without damage to any external short circuit, with the short circuit MVA available at the terminals.

ii) The maximum flux density in any part of the core and yoke at rated Voltage and frequency shall be such that the flux density with +12.5% combined voltage and frequency variation from rated voltage and frequency shall not exceed 1.9Tesla.

iii) Transformer shall under exceptional circumstances due to sudden disconnection of the load, be capable of operating at the voltage approximately 25% above normal rated voltage for a period of not exceeding one minute and 40% above normal for a period of 5 seconds.

iv) The transformer may be operated continuously without danger on any particular tapping at the rated MVA± 1.25% of the voltage corresponding to the tapping.

v) The thermal ability to withstand short circuit shall be demonstrated by calculation.

vi) Transformer shall be capable of withstanding thermal and mechanical stress caused by any symmetrical and asymmetrical faults on any winding.

2.4. DRAWINGS/ DOCUMENTS INCORPORATING THE FOLLOWING PARTICULARS SHALL BE SUBMITTED WITH THE BID

a) General outline drawing showing shipping dimensions and overall dimensions, net weights and shipping weights, quality of insulating oil, spacing of wheels in either direction of motion, location of coolers, marshalling box and tap changers etc.

b) Assembly drawings of core, windings etc. and weights of main components / parts.

c) Height of center line on HV and LV connectors of transformers from the rail top level.

d) Dimensions of the largest part to be transported.

e) GA drawings / details of various types of bushing

f) Tap changing and Name Plate diagram

g) Type test certificates of similar transformers.

h) Illustrative & descriptive literature of the Transformer.

i) Maintenance and Operating Instructions.

2.5. MISCELLANEOUS

i) Padlocks along with duplicate keys as asked for various valves, marshalling box etc. shall be supplied by the contractor, wherever locking arrangement is provided.
ii) Foundation bolts for wheel locking devices of Transformer shall be supplied by the Contractor.

2.6. DELIVERY

The full quantity of the equipments shall be delivered as per the delivery schedule appended to this specification.

2.7. SCHEDULES

All Schedules annexed to the specification shall be duly filled by the bidder separately.

2.8. ALTITUDE FACTOR

If the equipment is to be installed in the hilly area, necessary correction factors as given in the Indian Standard for oil temperature rise, insulation level etc. shall be applied to the Standard Technical Parameters given above.

2.9. NAME PLATE

Transformer rating plate shall contain the information as given in clause 15 of IS-2026 (part-I). The details on rating plate shall be finalized during the detailed engineering. Further, each transformer shall have inscription of Employer‟s name. The name plate shall also include (i) The short circuit rating , (ii) Measured no load current and no load losses at rated voltage and rated frequency, (iii) measured load losses at 75° C (normal tap only), (iv) D.C resistance of each winding at 75° C.

3. SERVICE CONDITIONS:

The service conditions shall be as follows: (To be confirmed by PIA as per locality of project)		
	Plain area	**Hilly area**
Maximum altitude above sea level	1000m	5000m
Maximum ambient air temperature	50° C	50° C
Maximum daily average ambient air temperature	35° C	40° C
Minimum ambient air temperature	-5° C	-30° C
Maximum temperature attainable by an object exposed to the sun	60°C	60°C
Maximum yearly weighted average ambient temperature	32° C	32° C
Maximum relative humidity	100%	100%
Average number of thunderstorm days per annum (isokeraunic level)	70	70
Average number of rainy days per annum	120	120
Average annual rainfall	1500 mm	1500 mm
Maximum wind pressure	260Kg/m^2	260Kg/m^2

* HP, J&K, Uttrakhand, Sikkim, Assam, Meghalaya, Manipur, Nagaland, Tripura and Mizoram will be considered as Hilly Area.
Environmentally, the region where the equipment will be installed includes coastal areas, subject to high relative humidity, which can give rise to condensation. Onshore winds will frequently be salt laden. On occasions, the combination of salt and condensation may create pollution conditions for outdoor insulators. Therefore, outdoor material and equipment shall be Designed and protected for use in exposed, heavily polluted, salty, corrosive, tropical and humid coastal atmosphere.

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4. SYSTEM CONDITIONS

The equipment shall be suitable for installation in supply systems of the following characteristics.

Frequency		50 Hz± 5%
Nominal system voltages		33 KV
		11 KV
Maximum system voltages	33KV System	36.3 KV
	11 KV System	12 KV
Nominal short circuit level (Basing on apparent power)		
	33KV System	31.5KA
	11 KV System	13.1KA
Insulation levels : 1.2/50 μ sec impulse withstand voltage		
	33KV System	170KV (peak)
	11 KV System	75 KV (peak)
Power frequency one minute withstand (wet and dry) voltage		
	33KV System	70KV (rms)
	11 KV System	28KV (rms)
Neutral earthing arrangements	11 KV System	Solidly earthed

5. CODES & STANDARDS

5.1. (i) The design, material, fabrication, manufacture, inspection, testing before dispatch and performance of power transformers at site shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice. Nothing in this specification shall be construed to relieve the contractor of this responsibility.

5.2. The equipment and materials covered by this specification shall conform to the latest applicable provision of the following standards.

IS:5	Colour for ready mixed paints
IS:325	Three Phase Induction Motors
IS:335	New insulating oil for transformers, switch gears
IS:1271	Classification of insulating materials for electrical machinery and apparatus in relation to their stability in services
IS:2026(Part I to IV)	Power Transformer
IS:2071	Method of high voltage testing
IS:2099	High voltage porcelain bushings
IS:2147	Degree of protection
IS:2705	Current Transformers
IS:3202	Code of practice for climate proofing of electrical equipment
IS:3347	Dimensions for porcelain Transformer Bushings
IS:3637	Gas operated relays
IS:3639	Fittings and accessories for power Transformers
IS:5561	Electric Power Connectors
IS:6600/BS:CP‟10:0	Guide for loading of oil immersed Transformers
IS:10028	Code of practice for selection, installation and maintenance of transformers, Part I. II and III
C.B.I.P. Publication	Manual on Transformers

If the standard is not quoted for any item, it shall be presumed that the latest version of Indian Standard shall be applicable to that item.

The equipment complying other internationally accepted standards, may also be considered if they ensure performance superior to the Indian Standards.

5.3 DRAWINGS

a) The contractor shall furnish, within fifteen days after issuing of Letter of Award. Six copies each of the following drawings/documents incorporating the transformer rating for approval.

(i) Detailed overall general arrangement drawing showing front and side elevations and plan of the transformer and all accessories including radiators and external features with details of dimensions, spacing of wheels in either direction of motion, net weights

and shipping weights, crane lift for un-tanking, size of lugs and eyes, bushing lifting dimensions, clearances between HV and L.V terminals and ground, quantity of insulating oil etc.

(ii) Assembly drawings of core and winging and weights of main components / parts
(iii) Foundation plan showing loading on each wheel land jacking points with respect to centre line of transformer.
(iv) GA drawings details of bushing and terminal connectors.
(v) Name plate drawing with terminal marking and connection diagrams.
(vi) Wheel locking arrangement drawing.
(vii) Transportation dimensions drawings.
(viii) Magnetization characteristic curves of PS class neutral and phase side current transformers, if applicable.
(ix) Interconnection diagrams.
(x) Over fluxing withstand time characteristic of transformer.
(xi) GA drawing of marshalling box.
(xii) Control scheme/wiring diagram of marshalling box.
(xiii) Technical leaflets of major components and fittings.
(xiv) As built drawings of schematics, wiring diagram etc.
(xv) Setting of oil temperature indicator, winding temperature indicator.
(xvi) Completed technical data sheets.
(xvii) Details including write-up of tap changing gear.
(xviii) HV & LV bushing.
(xix) Bushing Assembly.
(xx) Bi-metallic connector suitable for connection to 100 mm2 up to 232 mm2 AAAC Conductor.
(xxi) GA of LV cable Box.
(xxii) Radiator type assembly.

b) All drawings, documents, technical data sheets and test certificates, results calculations shall be furnished.

5.4 Any approval given to the detailed drawings by the Employer‟s shall not relieve the contractor of the responsibility for correctness of the drawing and in the manufacture of the equipment. The approval given by the employer shall be general with overall responsibility with contractor.

6. GENERAL CONSTRUCTIONAL FEATURES

6.1. All material used shall be of best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting up of undue stresses which may impair suitability of the various parts for the work which they have to perform.

6.2. Similar parts particularly removable ones shall be interchangeable.

6.3. Pipes and pipe fittings, screws, studs, nuts and bolts used for external connections shall be as per the relevant standards. Steel bolts and nuts exposed to atmosphere shall be galvanized.

6.4. Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washer or locknuts.

6.5. Exposed parts shall not have pockets where water can collect.

6.6. Internal design of transformer shall ensure that air is not trapped in any location.

6.7. Material in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or cadmium plated

6.8. Labels, indelibly marked, shall be provided for all identifiable accessories like Relays, switches current transformers etc. All label plates shall be of in corrodible material.

6.9. All internal connections and fastenings shall be capable of operating under overloads and over-excitation, allowed as per specified stands without injury.

6.10. Transformer and accessories shall be designed to facilitate proper operation, inspection, maintenance and repairs.

6.11. No patching, plugging, shimming or other such means of overcoming defects, discrepancies or errors will be accepted.

6.12. Schematic Drawing of the wiring, including external cables shall be put under the prospane sheet on the inside door of the transformer marshalling box.

6.13. Painting

6.13.1. All paints shall be applied in accordance with the paint manufacturer‟s recommendations. Particular attention shall be paid to the following:

a) Proper storage to avoid exposure as well as extremes of temperature.

b) Surface preparation prior to painting.

c) Mixing and thinning

d) Application of paints and the recommended limit on time intervals between coats.

e) Shelf life for storage.

6.13.1.1. All paints, when applied in normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

6.13.1.2. All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to the manufacturer‟s recommendations. However, wherever airless spray is not possible, conventional spray be used with prior approval of Employer.

6.13.1.3. The supplier shall, prior to painting protect nameplates, lettering gauges, sight glasses, light fittings and similar such items.

6.13.2 **Cleaning and Surface Preparation**

6.13.2.1 After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.

6.13.2.2 Steel surfaces shall be prepared by Sand/Shot blast cleaning or Chemical cleaning by Seven tank process including Phosphate to the appropriate quality.

6.13.2.3 The pressure and Volume of the compressed air supply for the blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination prior to any painting. 6.13.2.4 Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale and shall only be used where blast cleaning is impractical.

6.13.3 Protective Coating As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anticorrosion protection.

6.13.4 **Paint Material**

Followings are the type of paints that may be suitably used for the items to be painted at shop and supply of matching paint to site:

i) Heat resistant paint (Hot oil proof) for inside surface.

ii) For external surfaces one coat of Thermo Setting Paint or 2 coats of Zinc chromate/ Zinc Phosphate followed by 2 coats of POLYURETHANE . The color of the finishing coats shall be dark admiral grey conforming to No.632 or IS 5:1961.

6.13.5 **Painting Procedure**

6.13.5.1 All painting shall be carried out in conformity with both specifications and with the paint manufacture‟s recommendations. All paints in any one particular system. Whether shop or site applied, shall originate from one paint manufacturer.

6.13.5.2 Particular attention shall be paid to the manufacture‟s instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller, conventional or airless spray and shall be applied under the manufacturer’s recommended conditions. Minimum and maximum time intervals between coats shall be closely followed.

6.13.5.3 All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is warm.

6.13.5.4 Where the quality of film is impaired by excess film thickness,(wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coatings and apply another. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25% . In all instances, where two or more coats of the same paints are specifies, such coatings may or may not be of contrasting colors.

6.13.5.5 Paint applied to items that are not be painted, shall be removed at supplier's expense, leaving the surface clean, un-stained and undamaged.

6.13.6 **Damages to Paints Work**

6.13.6.1 Any damage occurring to any part of the painting scheme shall be made good to the same standard of corrosion protection and appearance as that originally employed.

6.13.6.2 Any damaged paint work shall be made as follows:

a) The damaged area, together with an area extending 25mm around its boundary, shall be

cleaned down to bare metal.

b) A priming coat shall immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the originally damaged.

6.13.6.3 The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before & after priming.

6.13.7 **Dry Film Thickness**

6.13.7.1 To the maximum extent practicable, the coats shall be applied as a continuous film of uniform thickness and free of pores. Over-spray, skips, runs, sags and drips should be avoided. The different coats may or may not be same color.

6.13.7.2 Each coat of paint shall allowed to hardened before the next is applied as per manufacture‟s recommendations.

6.13.7.3 Particular attention must be paid to full film thickness at edges.

6.13.7.4 The requirement for the dry film thickness (DFT) of paint and the material to be used shall be as given below:

Sl. No.	Paint Type	Are to be painted	No. Of Coatir	Total Dry Film
1.	Liquid Paint			
	a) Zinc Chromate(Primaer)	Out side	02	45 micron
	b) POLYURETHANE	Out side	02	45 micron

7.1 DETAILED DESCRIPTION

7.2 Tank

7.2.1 The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the shall be of welded construction.

7.2.2 Tank shall be designed to permit lifting by crane or jacks of the complete transformer assembly filed with oil. Suitable lugs and bossed shall be provided for this purpose.

7.2.3 All breams, flanges, lifting lugs, braces and permanent parts attached to the tank shall be welded and where practicable, they shall be double welded.

7.2.4 The main tank body of the transformer, excluding tap changing compartments and radiators, shall be capable of withstanding pressure of 760mm of Hg.

7.2.5 Inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided on the tank cover. The inspection hole(s) shall be of sufficient size to afford easy access to the lower ends of the bushings, terminals etc.

7.2.6 Gaskets of nitrile rubber or equivalent shall be used to ensure perfect oil tightness. All gaskets shall be closed design (without open ends) and shall be of one piece only. Rubber gaskets used for flange type connections of the various oil compartments, shall be laid in grooves or in groove-

equivalent sections on bolt sides of the gasket, throughout their total length. Care shall be taken to secure uniformly distributed mechanical strength over the gaskets and retains throughout the total length. Gaskets of neoprene and / or any kind of impregnated / bonded core or cork only which can easily be damaged by over-pressing are not acceptable. Use of hemp as gasket material is also not acceptable.

7.2.7 Suitable guides shall be provided for positioning the various parts during assemble or dismantling. Adequate space shall be provided between the cores and windings and the bottom of the tank for collection of any sediment.

7.3 Tank Cover

The transformer top shall be provided with a detachable tank cover with bolted flanged gasket joint. Lifting lugs shall be provided for removing the cover. The surface of the cover shall be suitable sloped so that it does not retain rain water.

7.4 UNDER CARRIAGE

7.4.1 The transformer tank filled with oil shall be supported on steel structure with detachable plain rollers. Suitable channels for movement of roller with transformer shall be space accordingly, rollers wheels shall be provided with suitable rollers bearings, which will resist rust and corrosion and shall be equipped with fittings for lubrication.

7.5 CORE

7.5.1 Each lamination shall be insulated such that it will not deteriorate due to mechanical pressure and the action of hot transformer oil.

7.5.2 The core shall be constructed either from high grade, non-aging Cold Rolled Grain Oriented (CRGO) silicon steel laminations conforming to HIB grade with lamination thickness not more than 0.23mm to 0.27mm or better(Quoted grade and type shall be used). The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall not be more than 1.69 Tesla. The Bidder shall provide saturation curve of the core material, proposed to be used. Laminations of different grade(s)_and different thickness (s) are not allowed to be used in any manner or under any circumstances.

CRGO steel for core shall be purchased only from the approved vendors, list of which is available at http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf

7.5.3 The bidder should offer the core for inspection starting from the destination port to enable Employer for deputing inspecting officers for detail verification as given below and approval by the Employer during the manufacturing stage. Bidder‟s call notice for the purpose should be accompanied with the following documents as applicable as a proof towards use of prime core material: The core coils, if found suitable, are to be sealed with proper seals which shall be opened in presence of the inspecting officers during core- cutting at the manufacturer‟s or it‟s sub-vendor‟s premises as per approved design drawing.

a) Purchase Order No. & Date.
b) Invoice of the supplier
c) Mills test certificate
d) Packing list
e) Bill of lading
f) Bill of entry certificate to customs

Core material shall be directly procured either from the manufacturer or through their accredited marketing organization of repute, but not through any agent.
Please refer to **"Check-list for Inspection of Prime quality CRGO for Transformers"** attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

7.5.4 The laminations shall be free of all burrs and sharp projections. Each sheet shall have an insulting coating resistant to the action of hot oil.

7.5.5 The insulation structure for the core to bolts and core to clamp plates, shall be such as to withstand 2000 V DC voltage for one minute.

7.5.6 The completed core and coil shall be so assembled that the axis and the plane of the outer surface of the core assemble shall not deviate from the vertical plane by more than 25mm.

7.5.7 All steel sections used for supporting the core shall be thoroughly shot or sand blasted, after cutting, drilling and welding.

7.5.8 The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.

7.5.9 The core clamping structure shall be designed to minimize eddy current loss.

7.5.10 The framework and clamping arrangements shall be securely earthed.

7.5.11 The core shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength.

7.5.12 Oil ducts shall be provided, where necessary, to ensure adequate cooling inside the core. The welding structure and major insulation shall not obstruct the free flow of oil through such ducts.

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

framework 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.

7.5.14 The construction is to be of boltless core type. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The core and coil assemble shall be so fixed in the tank that shifting will not occur during transport or short circuits.

7.5.15 The temperature gradient between core & surrounding oil shall be maintained less than 20 deg. Centigrade. The manufacturer shall demonstrate this either through test (procurement to be mutually agreed) or by calculation.

7.6 INTERNAL EARTHING

7.6.1 All internal metal parts of the transformer, with the exception of individual laminations and their individual clamping plates shall be earthed.

7.6.2 The top clamping structure shall be connected to the tank by a copper strap. The bottom clamping structure shall be earthed by one or more the following methods:

a) By connection through vertical tie-rods to the top structure.
b) By direct metal to metal contact with the tank base.
c) By a connection to the structure on the same side of the core as the main earth connection to the tank.

7.6.3 The magnetic circuit shall be connected to the clamping structure at one point only and this shall be brought out of the top cover of the transformer tank through a suitably rated insulator. A disconnecting link shall be provided on transformer tank to facilitate disconnections from ground for IR measurement purpose.

7.6.4 Coil clamping rings of metal at earth potential shall be connected to the adjacent core clamping structure on the same side as the main earth connections.

7.7 WINDING

7.7.1 Winding shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service. 7.6.2 All low voltage windings for use in the circular coil concentric winding shall be wound on a performed insulating cylinder for mechanical protection of the winding in handling and placing around the core.

7.7.2 Winding shall not contain sharp bends which might damage the insulation or produce high dielectric stresses. No strip conductor wound on edge shall have width exceeding six times the thickness.

The conductors shall be of electrolytic grade copper free from scales and burrs. The conductor

insulation shall be made from high-density (at least 0.75 gm/cc) paper having high mechanical strength. The barrier insulation including spacers shall be made from high- density pre-compressed pressboard (1.1 gm/cc minimum for load bearing and 1 to 1.3 gm/cc minimum for non-load bearing) to minimize dimensional changes.

7.7.3 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 the otherwise affected under the operating conditions.

7.7.4 Winding and connections shall be braced to withstand shocks during transport or short circuit.

7.7.5 Permanent current carrying joints in the windings and leads shall be welded or brazed. Clamping bolts for current carrying parts inside oil shall be made of oil resistant material which shall not be affected by acidity in the oil steel bolts, if used, shall be suitably treated.

7.7.6 Terminals of all windings shall be brought out of the tank through bushings for external connections.

7.6.6.1 The completed core and coil assemble shall be dried in vacuum at not more than 0.5mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum over or in the transformer tank.

7.6.6.2 The winding shall be so designed that all coil assembles of identical voltage ratings shall be interchangeable and field repairs to the winding can be made readily without special equipment. The coils shall have high dielectric strength.

7.6.6.3 Coils shall be made of continuous smooth high grade electrolytic copper conductor, shaped and braced to provide for expansion and contraction due to temperature changes.

7.6.6.4 Adequate barriers shall be provided between coils and core and between high and low voltage coil. End turn shall have additional protection against abnormal line disturbances.

7.6.6.5 The insulation of winding shall be designed to withstand voltage stress arising from surge in transmission lines due to atmospheric or transient conditions caused by switching etc.

7.6.6.6 Tapping shall not be brought out from inside the coil or from intermediate turns and shall be so arranged as to preserve as far as possible magnetic balance of transformer at all voltage ratios.

7.6.6.7 Magnitude of impulse surges transferred from HV to LV windings by electromagnetic induction and capacitance coupling shall be limited to BILL of LV winding.

7.7 INSULATING OIL

7.7.1 The insulating oil for the transformer shall be of EHV grade, generally conforming to IS: 335. No inhibitors shall be used in the oil.

7.7.2 The quantity of oil required for the first filling of the transformer and its full specification shall be stated in the bid. transformer shall supplied complete with all fittings, accessories and new transformer oil required for first filling plus 10% extra oil. The extra quantity of oil shall be supplied in non-returnable drums along with the oil required for the radiator banks.

7.7.3 The design and materials used in the construction of the transformer shall be such as to reduce the risk of the development of acidity in the oil.

7.7.4 The oil parameters shall be as per Table-1 of IS 335.

7.8 VALVES

i) Valves shall be of forged carbon steel upto 50mm size and of gun mental or of cast iron bodies with gun metal fittings for sizes above 50mm. They shall be of full way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.

Each valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be furnished with pipe plugs for protection. Padlocks with duplicate keys shall be supplied along with the valves.

ii) All valves except screwed valves shall be provided with flanges having machined faced drilled to suit the applicable requirements, Oil tight blanking plates shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required the contractor shall supply the same.

iii) Each transformer shall be provided with following valves on the tank:

a) Drain valve so located as to completely drain the tank & to be provided with locking arrangement.
b) Two filter valves on diagonally opposite corners of 50mm size & to be provided with locking arrangement.
c) Oil sampling valves not less than 8mm at top and bottom of main tank & to be provided with locking arrangement.
d) One 15mm air release plug.
e) Valves between radiators and tank. Drain and filter valves shall be suitable for applying vacuum as specified in the specifications.

7.9 ACCESSORIES

7.9.1 Bushing

i) All porcelain used in bushings shall be homogeneous, non-porous, uniformly glazed to brown colour and free from blisters, burns and other defects.

ii) Stress due to expansion and contraction in any part of the bushing shall not lead to deterioration.

iii) Bushing shall be designed and tested to comply with the applicable standards.

iv) Bushing rated for 400A and above shall have non-ferrous flanges and hardware.

v) Fittings made of steel or malleable iron shall be galvanized

vi) Bushing shall be so located on the transformers that full flashover strength will be utilized.

Minimum clearances as required for the BIL shall be realized between live parts and live parts to earthed structures.

vii) All applicable routine and type tests certificates of the bushings shall be furnished for approval.

viii) Bushing shall be supplied with bi-metallic terminal connector/ clamp/ washers suitable for fixing to bushing terminal and the Employers specified conductors. The connector/clamp shall be rated to carry the bushing rated current without exceeding a temperature rise of 550 Co ver an ambient of 500 C. The connector/clamp shall be designed to be corona free at the maximum rated line to ground voltage.

ix) Bushing of identical voltage rating shall be interchangeable.

x) The insulation class of high voltage neutral bushing shall be properly coordinated with the insulation class of the neutral of the low voltage winding.

xi) Each bushing shall be so coordinated with the transformer insulation that all flashover will occur outside the tank.

xii) The extended bushing bus bars shall be used for termination of 11 KV cables. LV busing shall be housed in completely sealed metallic enclosure.

xiii) Sheet steel, weather, vermin and dust proof cable box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch, water- tight hinged and padlocked door of a suitable construction shall be provided with each transformer to accommodate 11 KV cables etc. The box shall have slopping roof and the interior and exterior painting shall be in accordance with the specification. Padlock along with duplicate keys shall be supplied for marshaling box. The degree of protection shall be IP-55 or better. To prevent internal condensation, a metal clad heater with thermostat shall be provided. The heater shall be controlled by a MCB of suitable rating mounted in the box. The ventilation louvers, suitably padded with felt, shall also be provided. The louvers shall be provided with suitable felt pads to prevent ingress of dust. All incoming cables shall enter the kiosk from the bottom and minimum 4mm thick, non-magnetic, gland plate shall not be less than 600 mm from the base of the box. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench – **for those transformers which are used in partly indoor substation**, If required as per BOQ, a cable box for LV bushings shall be provided.

7.9.2 Protection & Measuring Devices

i) Oil Conservator Tank

a) The Conservator tank shall have adequate capacity between highest and lowest visible levels to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment.

b) The conservator tank shall be bolted into position so that it can be remove for cleaning purposes.

c) The conservator shall be fitted with magnetic oil level gauge with low level electrically insulated alarm contact.

d) Plain conservator fitted with silica gel breather.

ii) Pressure Relief Device.

The pressure relief device provided shall be of sufficient size for rapid release of any pressure that may be generated in the tank and which may result in damage of the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure of transformer tank. It shall be mounted direct on the tank. A pair of electrically insulated contract shall be provided for alarm and tripping.

iii) Buchholz Relay

A double float type Buchholz relay shall be provided. Any gas evolved in the transformer shall collect in this relay. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation. A copper tube shall be connected from the gas collector to a valve located about 1200 mm above ground level to facilitate sampling with the transformer in service. The device shall be provided with two electrically independent potential free contracts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.

iv) Temperature Indicator

a) Oil Temperature Indicator (OTI)

The transformers shall be provided with a micro switch contact type thermometer with 150 mm dial for top oil temperature indication. The thermometer shall have adjustable, electrically independent potential free alarm and trip contacts. Maximum reading pointer and resetting device shall be mounted in the local control panel. A temperature sensing element suitably located in a pocket on top oil shall be furnished. This shall be connected to the OTI by means of capillary tubing. Accuracy class of OTI shall be ± 1% or better. One No electrical contact capable of operating at 5 A ac at 230 volt supply.

b) Winding Temperature indicator (WTI)

A device for measuring the hot spot temperature of the winding shall be provided. It shall comprise the following.

i) Temperature sensing element.
ii) Image Coil.
iii) Micro switch contacts.
iv) Auxiliary CTS, If required to match the image coil, shall be furnished and mounted in the local control panel.
v) 150mm dial local indicating instrument with maximum reading pointer mounted in local panel and with adjustable electrically independent ungrounded contacts, besides that required for control of cooling equipment, one for high winding temperature alarm and on for trip.
vi) Two number electrical contact each capable of operating at 5 A ac at 230 Volt supply.

7.9.3 Oil Preservation Equipment

7.9.3.1 **Oil Sealing**

The oil preservation shall be diaphragm type oil sealing in conservator to prevent oxidation and contamination of oil due to contact with atmospheric moisture.

The conservator shall be fitted with a dehydrating filter breather. It shall be so designed that.

i) Passage of air is through a dust filter & Silica gel.

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

iii) Moisture absorption indicated by a change in colour of the crystals of the silica gel can be easily observed from a distance.

iv) Breather is mounted not more than 1400 mm above rail top level.

7.10 MARSHALLING BOX

i) Sheet steel, weather, vermin and dust proof marshaling box fitted with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch, water- tight hinged and padlocked door of a suitable construction shall be provided with each transformer to accommodate temperature indicators, terminal blocks etc. The box shall have slopping roof and the interior and exterior painting shall be in accordance with the specification. Padlock along with duplicate keys shall be supplied for marshaling box. The degree of protection shall be IP-55 or better.

ii) The schematic diagram of the circuitry inside the marshaling box be prepared and fixed inside the door under a propone sheet.

iii) The marshaling box shall accommodate the following equipment:

a) Temperature indicators.

b) Space for accommodating Control & Protection equipment in future for the cooling fan (for ONAF type cooling, may be provided in future).

c) Terminal blocks and gland plates for incoming and outgoing cables.

All the above equipment except c) shall be mounted on panels and back of panel wiring shall be used for inter-connection. The temperature indicators shall be so mounted that the dials are not more than 1600 mm from the ground level and the door (s) of the compartment(s) shall be provided with glazed window of adequate size. The transformer shall be erected on a plinth which shall be 2.5 feet above ground level.

iv) To prevent internal condensation, a metal clad heater with thermostat shall be provided. The heater shall be controlled by a MCB of suitable rating mounted in the box. The ventilation louvers, suitably padded with felt, shall also be provided. The louvers shall be provided with suitable felt pads to prevent ingress of dust.

v) All incoming cables shall enter the kiosk from the bottom and the gland plate shall not be less than 450 mm from the base of the box. The gland plate and associated compartment shall be sealed in suitable manner to prevent the ingress of moisture from the cable trench.

7.11 TAPCHANGER

7.11.1 ON-LOAD TAP-CHANGERS

i) The3.15/5/6.3/8/10/12.5 MVA transformers shall be provided with On-load Taps. Specification of OLTC is attached herewith as Annexure.

ii) The Transformer with off-load tap changing gear shall have taps ranging from +5% to -15% in 9 equal steps of 2.5% each for Off Load Tap.

iii) 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 locking arrangement along with tap position indication, thus enabling the switch to be locked in position

7.12 FITTINGS AND ACCESSORIES

The following fittings and accessories shall be provided on the transformers:

i) Conservator with isolating valves, oil filling hole with cap and drain valve. The conservator vessel shall be filled with constant oil pressure diaphragm oil sealing system.

ii) Magnetic type oil level gauge (150 mm dia) with low oil level alarm contacts.

iii) Prismatic/ toughened glass oil level gauge.

iv) Silica gel breather with oil seal and connecting pipe complete with first fill of activated silica gel or Alumina mounted at a level of 1300 mm above ground level.

v) A double float type Buchholz relay with isolating valve. Bleeding pipe and a testing cock, the test cock shall be suitable for a flexible (pipe connection for checking its operation). A 5mm dia. Copper pipe shall be connected from the relay test cock to a valve located at a suitable height above ground level to facilitate sampling of gas with the transformer in service. Interconnection between gas collection box and relay shall also be provided. The device shall be provided with two electrically independent ungrounded contacts, one for alarm on gas accumulation and the other for tripping on sudden oil surge. These contacts shall be wired upto transformer marshaling box. The relay shall be provided with shut off valve on the conservator side as well as on the tank side.

vi) Pressure relief devices (including pressure relief valve) and necessary air equalizer connection between this and the conservator with necessary alarm and trip contacts.

vii) Air release plugs in the top cover.

viii) Inspection cover, access holes with bolted covers for access to inner ends of bushing etc.

ix) Winding temperature (hot spot) indicating device for local mounting complete in all respects. Winding temperature indicator shall have two set of contacts to operate at different settings :

a) To provide winding temperature high alarm

b) To provide temperature too high trip

x) Dial thermometer with pocket for oil temperature indicator with one set of alarm and one set of trip contacts and maximum reading pointer.

xi) Lifting eyes or lugs for the top cover, core and coils and for the complete transformer.

xii) Jacking pads

xiii) Haulage lugs.

xiv) Protected type mercury / alcohol in glass thermometer and a pocket to house the same.

xv) Top and bottom filter valves on diagonally opposite ends with pad locking arrangement on both valves.

xvi) Top and bottom sampling valves.

xvii) Drain valve with pad locking arrangement

xviii) Rating and connection diagram plate.

xix) Two numbers tank earthing terminals with associated nuts and bolts for connections to Employer‟s grounding strip.

xx) Marshaling Box (MB)

xxi) Shut off valve on both sides of flexible pipe connections between radiator bank and transformer tank.

xxii) Cooling Accessories :

a) Requisite number of radiators provided with :-

- One shut off valve on top
- One shut off valve at bottom
- Air release device on top
- Drain and sampling device at bottom
- Lifting lugs.

b) Air release device and oil drain plug on oil pipe connectors:

xxiii) Terminal marking plates for Current Transformer and Main Transformer

xxiv) On/Off Load Tap changer as per BOQ

xxv) Oil Preservation Equipment

xxvi) Oil Temperature indicator

xxvii) Transformer shall be supplied with all control cable, WTI & OTI, sensing cable, glands, lugs etc (complete control).

Note :

1. The fittings listed above are indicative and any other fittings which are generally required for satisfactory operation of the transformer are deemed to be included in the quoted price of the transformer.

2. The contacts of various devices required for alarm and trip shall be potential free and shall be adequately rated for continuous, making and breaking current duties as specified.

7.13 CONTROL CONNECTIONS AND INSTRUMENT AND WIRING TERMINAL BOARD AND FUSES

i) Normally no fuses shall be used anywhere instead of fuses MCB‟s (both in AC & DC circuits) shall be used. Only in cases where a MCB cannot replace a fuse due to system requirements, a HRC fuse can be accepted.

ii) All wiring connections, terminal boards, fuses MCB‟s and links shall be suitable for tropical atmosphere. Any wiring liable to be in contact with oil shall have oil resisting insulation and the bare ends of stranded wire shall be sweated together to prevent seepage of oil along the wire.

iii) Panel connections shall be neatly and squarely fixed to the panel. All instruments and panel wiring shall be run in PVC or non-rusting metal cleats of the compression type. All wiring to a panel shall be taken from suitable terminal boards.

iv) Where conduits are used, the runs shall be laid with suitable falls, and the lowest parts of the run shall be external to the boxes. All conduit runs shall be adequately drained and ventilated. Conduits shall not be run at or below ground level.

v) When 400 volt connections are taken through junction boxes or marshaling boxes, they shall be adequately screened and 400 volts Danger Notice must be affixed to the outside of the junction boxes or marshaling box. Proper colour code for Red, Yellow, Blue wires shall be followed.

vi) All box wiring shall be in accordance with relevant ISS. All wiring shall be of stranded copper (48 strands) of 1100 Volt grade and size not less than 2.5 sq.mm

vii) All wires on panels and all multi-core cables shall have ferrules, for easy identifications, which bear the same number at both ends, as indicated in the relevant drawing.

viii) At those points of interconnection between the wiring carried out by separate contractors, where a change of number cannot be avoided double ferrules shall be provided on each wire. The change of numbering shall be shown on the appropriate diagram of the equipment.

ix) The same ferrule number shall not be used on wires in different circuits on the same panels.

x) Ferrules shall be of white insulating material and shall be provided with glossy finish to prevent the adhesion of dirt. They shall be clearly and durably marked in black and shall not be affected by dampness or oil.

xi) Stranded wires shall be terminated with tinned Ross Courtney terminals, claw washers or crimped tubular lugs. Separate washers shall be suited to the size of the wire terminated. Wiring shall, in general, be accommodated on the sides of the box and the wires for each circuit shall be separately grouped. Back of panel wiring shall be arranged so that access to the connecting items of relays and other apparatus is not impeded.

xii) All circuits in which the voltage exceeds 125 volts, shall be kept physically separated from the remaining wiring. The function of each circuit shall be marked on the associated terminal boards.

xiii) Where apparatus is mounted on panels, all metal cases shall be separately earthed by means of

stranded (48 No.) copper wire of strip having a cross section of not less than 2 sq. mm where strip is used, the joints shall be sweated. The copper wire shall have green coloured insulation for earth connections.

xiv) All wiring diagram for control and relay panel shall preferably be drawn as viewed from the back and shall show the terminal boards arranged as in services.

xv) Terminal block rows should be spaced adequately not less than 100 mm apart to permit convenient access to external cables and terminations.

xvi) Terminal blocks shall be placed with respect to the cable gland (at a minimum distance of 200 mm) as to permit satisfactory arrangement of multicore cable tails .

xvii) Terminal blocks shall have pairs of terminals for incoming and outgoing wires. Insulating barriers shall be provided between adjacent connections. The height of the barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals. The terminals shall be adequately protected with insulating dust proof covers. No live metal shall be exposed at the back of the terminal boards. CT terminals shall have shorting facilities. The terminals for CTs should have provision to insert banana plugs and with isolating links.

xviii) All interconnecting wiring, as per the final approved scheme between accessories of transformer and marshaling box is included in the scope of this specification and shall be done by the Transformer supplier.

xix) The schematic diagram shall be drawn and fixed under a transparent prospane sheet on the inner side of the marshaling box cover.

xx) To avoid condensation in the Marshaling Box, a space heater shall be provided with an MCB and thermostat.

xxi) Suitable MV, CFL light shall be provided in the Marshaling Box for lightning purpose.

7.14 RADIO INTERFERENCE AND NOISE LEVEL

Transformers shall be designed with particular care to suppress at least the third and fifth harmonic voltages so as to minimize interference with communication circuits. Transformer noise level when energized at normal voltage and frequency shall be as per NEMA stipulations.

8 INSPECTION AND TESTING

(i) The Contractor shall carry out a comprehensive inspection and testing programme during manufacture of the transformer. This is, however, not intended to form a comprehensive programme as it is contractor‟s responsibility to draw up and carry out such a programme duly approved by the Employer.

(ii) Transformer of each rating will be as per pre-type tested design.

(iii) The pre-shipment checks shall also be carried out by the contractor.

(iv) The requirements on site tests are as listed in the specifications.

(v) Certified test report and oscillograms shall be furnished to the Employer Consultants for evaluation as per the schedule of distribution of documents. The Contractor shall also evaluate the test results and rectify the defects in the equipment based on his and the Employers evaluations of the tests without any extra charges to the Employer. Manufacturer‟s Test Certificates in respect of all associated auxiliary and ancillary equipment shall be furnished.

(vi) The bidder shall state in his proposal the testing facilities available at his works. In case full testing facilities are not available, the bidder shall state the method proposed to be adopted so as to ascertain the transformer characteristics corresponding to full capacity.

8.1 INSPECTION

Transformers not manufactured as per Type- Tested design shall be rejected.

i) **Tank and Conservator**

a) Inspection of major weld.

b) Crack detection of major strength weld seams by dye penetration test. and further dimensional check.

c) Leakage test of the conservator.

ii) **Core**

a) Sample testing of core materials for checking specific loss, properties, magnetization characteristics and thickness.

b) Check on the quality of varnish if used on the stampings.

c) Check on the amount of burrs.

d) Visual and dimensional check during assembly stage.

e) Check on completed core for measurement of iron loss, determination of maximum flux density.

f) Visual and dimensional checks for straightness and roundness of core, thickness of limbs and suitability of clamps.

g) High voltage DC test (2 KV for one minute) between core and clamps.

Please refer to **“Check-list for Inspection of Prime quality CRGO for Transformers”** attached at Annexure-A. It is mandatory to follow the procedure given in this Annexure.

iii) Insulating Material

a) Sample Check for physical properties of materials.

b) Check for dielectric strength

c) Check for the reaction of hot oil on insulating materials.

iv) Winding

a) Sample check on winding conductor for mechanical and electrical conductivity.

b) Visual and dimensional checks on conductor for scratches, dent mark etc.

c) Sample check on insulating paper for PH value, electric strength.

d) Check for the bonding of the insulating paper with conductor.

e) Check and ensure that physical condition of all materials taken for windings is satisfactory and free of dust.

f) Check for absence of short circuit between parallel strands.

v) Checks Before Drying Process

a) Check condition of insulation on the conductor and between the windings.

b) Check insulation distance between high voltage connections, between high voltage connection cables and earth and other live parts.

c) Check insulating distances between low voltage connections and earth and other parts.

d) Insulating test for core earthing.

vi) Check During Drying Process

a) Measurement and recording of temperature and drying time during vacuum treatment.

b) Check for completeness of drying

vii) Assembled Transformer

a) Check completed transformer against approved outline drawing, provision for all fittings, finish level etc.

b) Jacking test on the assembled Transformer.

viii) Oil All standard tests in accordance with IS: 335 shall be carried out on Transformer oil sample before filling in the transformer.

ix) Test Report for bought out items The contractor shall submit the test reports for all bought out / sub contracted items for approval.

a) Buchholz relay

b) Sudden pressure rise relay on Main Tank

c) Winding temperature indicators (for TX capacity 5 MVA)

d) Oil temperature indicators

e) Bushings

f) Bushing current transformers in neutral (If Provided)

g) Marshaling box

h) On/Off Load Tap changer as per BOQ

i) Any other item required to complete the works.

j) Porcelain, bushings, bushing current transformers, wherever provided, winding

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coolers, control devices, insulating oil and other associated equipment shall be tested by the contractor in accordance with relevant IS . If such requirement is purchased by the contractor on a sub-contract, he shall have them tested to comply with these requirements.

8.2 FACTORY TESTS

i) All standards routine tests in accordance IS: 2026 with dielectric tests corresponding as per latest amendments to IS: 2026 shall be carried out.

ii) All auxiliary equipment shall be tested as per the relevant IS. Test certificates shall be submitted for bought out items.

iii) High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.

iv) Following additional routine tests shall also be carried out on each transformer:

a) Magnetic Circuit Test Each core shall be tested for 1 minute at 2000 Volt AC

b) Oil leakage test on transformer

8.2.1 Type Test

8.2.1.1 The measurements and tests should be carried out in accordance with the standard specified in each case as indicated in the following table if the same tests were not conducted earlier at CPRI or any NABL accredited Laboratory on the transformers of the offered design without any cost implication on employer.

Table 6: Transformer type tests

Type Test Standard	
Temperature Rise Test	IEC 76/IS 2026/IS6600
Impulse Volt age Withstand Test, including Full Waves and Chopped Waves as listed below	IEC 76/IS 2026
Noise Level Measurement	IEC 551

In accordance with IEC 76-3 the following sequence of impulses should have been/ should be applied;

- One full wave at 50% BIL;
- One full wave at 100% BIL;
- One chopped wave at 50% BIL
- Two chopped waves at 100% BIL and
- Two full waves at 100% BIL.

8.2.1.2 If the type test report(s) submitted by the bidder do not fulfill the criteria, as stipulated in this technical specification/ Bidder‟s offer, the relevant type test(s) has/ have to be

conducted by the Bidder at his own cost in CPRI/ NABL accredited laboratory in the presence of employers representative(s) without any financial liability to employer in the event of order placed on him.

8.2.1.3 The offered transformer must be manufactured as per type tested design. A copy of type test certificate must be submitted by manufacturer to Engineer/Employer. Transformers offered without type tested however design shall not be accepted. In case manufacturer agrees for type testing of transformers, testing shall be conducted on manufacturer‟s cost. No claim shall be acceptable towards type testing. The transformers shall be accepted only on acceptance of type testing results by employer.

8.2.1.4 The supplier shall furnish calculations in accordance with IS: 2026 to demonstrate the Thermal ability of the transformers to withstand Short Circuit forces.

8.2.1(A) Special Test

The short circuit test shall be a mandatory test for each design shall be supplied by the manufacturer and no exception shall be allowed. The test shall be conducted as per latest standard tabled below:

Short Circuit Test	IEC 76 / IS 2026

8.2.2 STAGE INSPECTION

The supplier shall offer the core, windings and tank of each transformer for inspection by the Employers representative(s). During stage Inspection, all the measurements like diameter, window height, leg Centre, stack width, stack thickness, thickness of laminations etc. for core assembly, conductor size, Insulation thickness, I.D., O.D, winding height, major and minor insulations for both H.V and L.V windings, length, breadth, height and thickness of plates of Transformer tank, the quality of fittings and accessories will be taken / determined. The supplier can offer for final inspection of the transformers subject to clearance of the stage Inspection report by the Employer.

8.2.3 Routine Tests

Transformer routine tests shall include tests stated in latest issue of IS: 2026 (Part –1). These tests shall also include but shall not be limited to the following:

(i) Measurement of winding DC resistance.
(ii) Voltage ratio on each tapping and check of voltage vector relationship.
(iii) Impedance voltage at all tappings.
(iv) Magnetic circuit test as per relevant ISS or CBIP manual or latest standard being followed.
(v) Measurement of Load losses at normal tap and extreme taps.
(vi) No load losses and no load current at rated voltage and rated frequency, also at 25% to 120 % of rated voltage in steps.
(vii) Absorption index i.e insulation resistance for 15 seconds and 60 seconds (R 60/ R 15) and polarization index i.e Insulation Resistance for 10 minutes and one minute (R 10 mt / R 1 mt).
(viii) Induced over voltage withstand test.
(ix) Separate source voltage withstand test.
(x) Tan delta measurement and capacitance of each winding to earth (with all other windings earthed) & between all windings connected together to earth.

(xi) Measurement of zero sequence impedance
(xii) Tests on On/Off Load Tap changer as per BOQ (fully assembled on transformer) as per IS 2026
(xiii) Auxiliary circuit tests
(xiv) Oil BDV tests
(xv) Measurement of neutral unbalance current which shall not exceed 2% of the full rated current of the transformer.
(xvi) Magnetic balance test
(xvii) Leakage test.

Six (6) set of certified test reports and oscillographs shall be submitted for evaluation prior to dispatch of the equipment. The contractor shall also evaluate the test results and shall correct any defect indicated by his and Employers evaluation of the tests without charge to the Employer.

8.4 **TANK TESTS**

a) **Oil leakage Test :**

The tank and oil filled compartments shall be tested for oil tightness completely filled with air or oil of viscosity not greater than that of insulating oil conforming to IS : 335 at the ambient temperature and applying a pressure equal to the normal pressure plus 35 KN/ m2 measured at the base of the tank. The pressure shall be maintained for a period of not less than 12 hours of oil and one hour for air and during that time no leak shall occur.

b) **Pressure Test**

Where required by the Employer, one transformer tank of each size together with its radiator, conservator vessel and other fittings shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 KN / m2 whichever is lower, measured at the base of the tank and maintained for one hour.

c) **Vacuum Test**

One transformer tank of each size shall be subjected to the vacuum pressure of 60 mm of mercury. The tanks designed for full vacuum shall be tested at an internal pressure of 3.33 KN/m2 (25 mm of mercury) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the value specified in C.B.I.P. Manual on Transformers (Revised 1999) without affecting the performance of the transformer.

8.5 **PRE-SHIPMENT CHECK AT MANUFACTURERS WORKS**

i) Check for proper packing and preservation of accessories like radiators, bushings, explosions vent, dehydrating breather, rollers, buchholz relay, control cubicle connecting pipes and conservator etc.

ii) Check for proper provision of bracing to arrest the movement of core and winding assembly inside the tank.

iii) Gas tightness test to conform tightness.

8.6 **INSPECTION AND TESTING AT SITE**

On receipt of transformer at site, shall be performed detailed inspection covering areas

right from the receipt of material up to commissioning stage. An indicative program of inspection as envisaged by the Engineer is given below.

8.6.1 **Receipt and Storage Checks**

i) Check and record conditions of each package visible parts of the transformers etc for any damage.
ii) Check and record the gas pressure in the transformer tank as well as in the gas cylinder.
iii) Visual check of core and coils before filling up with oil and also check condition of core and winding in general.

8.6.2 **Installation Checks**

i) Inspection and performance testing of accessories like tap changers etc.
ii) Check choking of the tubes of radiators
iii) Test on oil samples taken from main tank top and bottom and cooling system. Samples should be taken only after the oil has been allowed to settle for 24 hours.
iv) Check the whole assembly for tightness, general appearance etc.
v) Oil leakage tests.

8.6.3 **Pre-Commissioning Tests**

After the transformer is installed, the following pre-commissioning tests and checks shall be done before putting the transformer in service.

i) Megger Test

ii) Phase relationship test (Vector group test)

iii) Buchholz relay alarm & surge operation test (Physical)

iv) Ratio test on all taps

v) Low oil level (in conservator) alarm

vi) Temperature Indicators (Physical)

vii) Marshaling kiosk (Physical)

8.6.4 **The following additional checks shall be made :**

i) All oil valves are incorrect position closed or opened as required

ii) All air pocket are cleared.

iii) Thermometer pockets are filled with oil

iv) Oil is at correct level in the bushing, conservator, diverter switch & tank etc.

v) Earthing connections are made.

vi) Bushing arcing horn is set correctly and gap distance is recorded.

vii) C T polarity and ratio is correct.

8.7 **PERFORMANCE**

The performance of the transformer shall be measured on the following aspects.

i) The transformer shall be capable of being operated without danger on any tapping at the rated KVA with voltage variations and ± 10% corresponding to the voltage of the tapping

ii) Radio interference and Noise Level

iii) The transformer shall be designed with particular attention to the suppression of third and fifth harmonics so as to minimize interference with communication circuits.

8.8 **FAULT CONDITIONS**

a) The transformer shall be capable of withstanding for two(2) seconds without damages any external short circuit to earth

b) Transformer shall be capable of withstanding thermal and mechanical stresses conveyed by symmetrical or asymmetrical faults on any winding. This shall be demonstrated through calculation as per IS : 2026.

c) Transformer shall accept, without injurious heating, combined voltage and frequency fluctuation which produce the 125% over fluxing condition for one minute and 140% for 5 seconds.

8.9 **WITNESSING OF TESTS AND EXCESSIVE LOSSES**

i) The Employer reserves the right to reject the Transformer if losses exceed the maximum specified as per Clause No 2. SPECIFIC TECHNICAL REQUIREMENTS (STANDARD CONDITIONS), item-35of this specification or if temperature rise of oil and winding exceed the values specified at item -26 of the above clause.

9 LIQUIDATED DAMAGES FOR EXCESSIVE LOSSES

There is no positive tolerance on the guaranteed losses offered by the bidder. However, the transformer(s) shall be rejected out rightly, if any of the losses i.e. no load loss or load loss or both exceed (s) the guaranteed maximum permissible loss figures quoted by the bidder in the Technical Data Schedule with the bid.

10 **SPARE PARTS**

In case the manufacturer goes out of production of spare parts, then he shall make available the drawings of spare parts and specification of materials at no extra cost to the Employer to fabricate or procure spare parts from other sources.

Mandatory Spare Parts

The suppliers shall provide the following mandatory spare s for each of Transformer supplied

1. H.V. & L.V. Bushing & Studs –Each 2 Nos
2. Bimetallic connector for H.V & L.V. Bushings – Each 2 sets

10.1 **INSTRUCTION MANUAL**

Eight sets of the instruction manuals shall be supplied at least four (4) weeks before the

actual dispatch of equipment. The manuals shall be in bound volumes and shall contain all the drawings and information required for erection, operation and maintenance of the transformer. The manuals shall include amongst other, the following particular:

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

b) Detailed dimensions, assembly and description of all auxiliaries.

c) Detailed views of the core and winding assembly, winding connections and tapings tap changer construction etc. These drawings are required for carrying out overhauling operation at site.

d) Salient technical particulars of the transformer.

e) Copies of all final approved drawings.

f) Detailed O&M instructions with periodical check lists and Performa etc.

10.2 COMPLETENESS OF EQUIPMENT

All fittings and accessories, which may not be specifically mentioned in the specification but which are necessary for the satisfactory operation of the transformer, shall be deemed to be included in the specification and shall be furnished by the supplier without extra charges. The equipment shall be complete in all details whether such details are mentioned in the specification or not, without any financial liability to the Employer under any circumstances.

11.0 COMMISSIONING

The utility will give a 10 days‟ notice to the supplier of transformer before commissioning. The manufacturer will depute his representative to supervise the commissioning. In case, the manufacturer fails to depute his representative, the utility will go ahead with the commissioning and under these circumstances, it would be deemed that commissioning is done as per recommendations of manufacturer.

12.0 GUARANTEE

The manufacturers of the transformer shall provide a guarantee of 60 months from the date of receipt of transformer at the stores of the Utility. In case the transformer fails within the guarantee period, the supplier will depute his representative within 15 days from date of intimation by the utility for joint inspection. In case, the failure is due to the reasons attributed to supplier, the transformer will be replaced/repaired by the supplier within 2 months from the date of joint inspection.

13.0 Addition/ Modification in Technical specification to suit WBSEDCL specific requirement

The Addition / Modification in technical specification required to suit WBSEDCL specific requirement are noted in the **Annexure – specific requirements and Additional Accessories.** The Addition/Modifications noted there are to be considered in the technical specification.

Annexure-B

Methodology for computing total owning cost for Power Transformer			
TOC = IC + (A xWi) + (B xWc) ; Losses in KW			
Where,			
TOC	=	Total Owning Cost	
IC	=	Initial cost including taxes of transformer as quoted by the manufacturer	
A factor	=	Cost of no load losses in Rs/KW	(A = 334447)
B factor	=	Cost of load losses in Rs/KW	(B = 151616)
Wi	=	No load losses quoted by the manufacturer in KW	
Wc	=	Load losses quoted by the manufacturer in KW	

ON LOAD TAP CHANGER FOR 33/11KV POWER TRANSFORMER

The tapping range of On Load Tap Changer shall be +5% to -15% in steps of 1.25% each. The no of taps shall be 17.The On Load Tap Changer shall be supplied with RTCC panel and AVR (Automatic Voltage Regulating Relay)
The Continuous current rating of the tap changer shall be based on connected winding rating and shall have liberal and ample margin. Lower rated tap changers connected in parallel are not acceptable.
The on-load tap changing equipment shall have the provision for mechanical and electrical control from a local position and electrical control from a remote position. For local mechanical operation, the operating handle shall be brought outside the tank for operation from floor level with provision to lock the handle in each tap position. Remote electrical operation shall have an AUTO-MANUAL selection at the remote location. When selected AUTO, the tap changing gear shall maintain steady voltage within practical limit on the transformers secondary bus from which the reference shall not respond to transient variation of voltage due to grid disturbance and system fault.

The required voltage relay shall not be sensitive to frequency variation and shall be suitable for sensing voltage from the secondary of potential transformers mounted on the 66KV, 33KV, or 11KV bus.
The tap changer shall be provided with over-current protection in order to prevent the tap- change operation during a short circuit, which would to greatly stress the contacts of the diverter switch. The function of protection shall be arranged as follows;

(i) Whenever over current occurs, the control circuit for commanding OLTC motor operation shall be blocked by the normally close contracts of the over current relays.

(ii) If during tap change over current occurs, the OLTC motor circuit shall be blocked through the mechanical cam switch, which is close from the very beginning to the very end of every tap change operation and to the normally open contacts of the over current relays. The stop action of the motor shall be made through the motor brake contactor.

The design of the tap changing equipment shall be such that the mechanism will not stop in any intermediate position; however, if the mechanism through faulty operation does stop in an intermediate position, the full load must be carried by the transformer without injury to the equipment. The mechanical position indicator shall be equipped in the motor drive cubicle. The motor shall be designed to be of step control. In any case the operation shall be of step by step. The **voltage regulating relay** shall be supplied together with the timer and under voltage relay. The signal order from the voltage regulating relay to execute the tap changer operation, when the regulating voltage is out of the voltage regulating level shall be designed to be delayed by the adjustable timer. If the control voltage abnormally falls, the movement of the tap changer shall be locked by the contact of the under voltage relay, even if the contacts of the voltage regulating relay are working.

The control circuit of the transformer shall be completely designed and provisions shall be made for parallel operation with another transformer.

The following accessories, control and selector switches and other necessary accessories shall be furnished.

Remote tap changer control board

(Placed in the control room)

- Voltmeter
- "AUTO-MANUAL" control switch
- "RAISE-LOWER" control switch
- Tap position indicator
- Tap changer operation program indicator.

Transformer Tap Changer driving mechanism control cubicle

- "REMOTE-LOCAL-TEST" selector switch
- "AUTOMATIC-MANUAL" control switch
- "RAISE-LOWER" control switch
- Tap position indicator
- Tap changer operation program indicator
- Voltmeter
- Tap change operation counter
- Means for manual operation when power supply is lost

Annexure - A

Check-list for Inspection of Prime quality CRGO for Transformers

During inspection of PRIME CRGO, the following points needs to be checked by the Transformer manufacturer.

Utilitity"s inspector shall verify all these points during inspection:-

i) **In case PRIME CRGO cutting is at works of Transformer Manufacturer:**

Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/Authorised Agency

Manufacturer"s test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below

Certificate of Origin

BIS Certification

Format for Reconciliation/Traceability records

Packing List No./date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate No./date

Serial No.	Deatails of Package/Job	Drawing Reference	Quantity Invoved	Commulative Quantity Consumed	Balance Stock

(i)1 Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer‟s Identification Slip on PRIME CRGO Coils

Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).

Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.

ISI logo sticker on packed mother coil and ISI logo in Material TC.

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

3 Inspection of PRIME CRGO laminations: Transformer manufacturer will maintain records for traceability of laminations to prime CRGO coils and burr/bow on laminations shall be measured. Utility can review these records on surveillance basis.

4 Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/ rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in A.2.2 above.

Above tests shall be witnessed by Utility. In case testing facilities are not available at Manufacturer‟s work, the sample(s) sealed by Utility to be sent to approved labs for testing.

Inspection Clearance Report would be issued after this inspection

(i) In case PRIME CRGO cutting is at Sub-vendor of Transformer Manufacturer:

Review of documents:

Purchase Order (unpriced) to PRIME CRGO supplier/ Authorised Agency

Purchase Order (unpriced) to Core Cutter

Manufacturer test certificate

Invoice of the Supplier

Packing List

Bill of Lading

Bill of Entry Certificate by Customs Deptt.

Reconciliation Statement as per format below

Certificate of origin

BIS Certification

Format for Traceability records as below:-

Packing List No./date /Quantity of PRIME CRGO received

Name of Manufacturer

Manufacturer test certificate No./date

Serial No.	Name of Customer	Deatails of Package/Job	Drawing Reference	Quantity Invoved	Commulative Quantity Consumed	Balance Stock	Dispatch details

(ii) 1 Inspection of PRIME CRGO Coils:

PRIME CRGO-Manufacturer‟s Identification Slip on PRIME CRGO Coils

Visual Inspection of PRIME CRGO Coils offered as per packing list (for verification of coil details as per Test certificate & healthiness of packaging).

Unique numbering inside of each sample of PRIME CRGO coil and verification of records to be maintained in the register for consumption of CRGO coil.

ISI logo sticker on packed mother coil and ISI logo in Material TC.

2.2. During inspection of PRIME CRGO, surveillance testing of sample shall be carried out for Stacking Factor, Permeability, Specific watt loss at 1.5 Tesla and/or 1.7 Tesla, thickness depending on the grade of PRIME CRGO and aging test etc. applicable as per relevant IS/ IEC standard, Tech. Spec., MQP and Transformer manufacturer plant standard.

Inspection Clearance Report would be issued after this inspection

3 Inspection of PRIME CRGO laminations**:**

Transformer manufacturer representative will inspect laminations and issue their internal Inspection Clearance Report. Inspection will comprise of review of traceability to prime CRGO coils, visual Inspection of PRIME CRGO laminations and record of burr/bow. After clearance given by transformer manufacturer, Utility will issue an Inspection Clearance Report after record review. If so desired by Utility, their representative may also join transformer manufacturer representative during this inspection.

Inspection Clearance Report would be issued after this inspection

vi) Inspection at the time of core building:

Visual Inspection of PRIME CRGO laminations. In case of suspected mix-up/rusting/decoloration, samples may be taken for testing on surveillance basis for tests mentioned in B.2.2.

Inspection Clearance Report would be issued after this inspection

NOTE :-

a) Transformer Manufacturer to ensure that PRIME CRGO is procured from POWERGRID approved vendors and CRGO manufacturer should have valid BIS Certificate for respective offered Grade.

14.1 Transformer Manufacturer should also involve themselves for ensuring the quality of CRGO laminations at their Core Cutter‟s works. They should visit the works of their Core cutter and carry out necessary checks.

a) General

If a surveillance sample is drawn and sent to TPL (if testing facility not available with the manufacturer), the Transformer manufacturer can continue manufacturing at their own risk and cost pending TPL test report on PRIME CRGO sample drawn. Decision for acceptance of PRIME CRGO shall be based upon report of the sample drawn.

These checks shall be read in-conjunction with approved Quality Plan, specification as a whole and conditions of contract.

	Sampling Plan (PRIME CRGO)
33 / 11 kV	-1st transformer and subsequently at random 10% of Transformers (min. 1) offered for inspection.
DTs and other ratings	-1st transformer and subsequently at random 2% of Transformers (min. 1) offered for inspection.
	NOTE:- One sample for each lot of CRGO shall be drawn on surveillance basis.

CRGO has to be procured only from POWERGRID approved vendors. List of such vendors is available at the following website. Since the list is dynamic in nature, the site may be checked from time to time to see the list of approved vendors. http://apps.powergridindia.com/ims/ComponentList/Power-former%20upto%20420%20kV-CM%20List.pdf

Annexure – specific requirements and Additional Accessories
The Bidders are requested to follow the following Addition/ Modification in Technical specification to suit WBSEDCL specific requirement

A. Clause no. 17 a) regarding Tap Changer:

Both the 6.30 & 10.0 MVA PTR shall have On Load Tap Changer(OLTC) with SCADA compatible Remote Tap change control panel having the following specification:

On Load Tap Changer applicable for 10 MVA and 6.3MVA transformer including RTCC panel.

This shall be designed suitable for local manual as well as local electrical operation and Remote electrical operation including SCADA operation with provision of master follower scheme for parallel operation. 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.

On Load Tap Changer

(1) The on load tap changer shall include the following –

(a) 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.

(b) Motor driven mechanism.

(c) Control and protection devices.

(d) Local/Remote tap changer position indicator.

(e) Manual/Electrical operating device.

(f) Voltage tapping range on H.V. side will be (+5%) to (-15%) in steps of 1.25%.

(2) **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 ($0.49\ kg/cm^2$.) with trip float arrangement shall be provided for OLTC compartment.

c) The tap changer shall be capable of permitting parallel operation with either existing or future transformers of the same type as Master or Follower.

d) 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.

e) The control scheme for the tap changer shall be provided for independent control of the tap changers when the transformers are in independent service. In addition, provision shall be made so that under parallel operation the tap changer will give alarm and visual indication for becoming out of step. Visual indication during the operation of motor shall also be incorporated. The control scheme of the tap changer of the existing transformer to run in parallel will be furnished to the successful bidders, if required. The tap change control must ensure step by step operation under all operating conditions.

Necessary interlock blocking independent control when the units are in parallel shall be provided.

f) Under parallel operation, as may occur if the contactor controlling one tap changer sticks, the arrangement must be such as to switch off supply to the motor so that an out of step condition is limited to one tap difference between the units. Details of out of step

protection provided for the taps shall be furnished in the bid.

g) 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 400 volts, 50 cycle external power supply.

3. Remote Tap Changer Control Panel

A) 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 WBSEDCL's Control Room for remote operation.

i) Raise and Lower Push Button Switch

ii) Remote tap position indicator and other required devices. 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).

iii) An indication lamp showing tap changing in a progress

iv)Master, Follower and Independent selecting switch and other accessories required for complete operation of tap changer.

v) Name plate of each component

vi)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.

vii)Provision for SCADA operation(Please see enclosed Annexure-X)

viii)An under voltage relay shall be incorporated to monitor the 110 Volt AC control circuit voltage circuit supply Similarly audible and visual indication shall be provided in RTCC panel.

The OLTC should have been Type Tested.

B. Clause no. 28 regarding Cable End Box on LV side: The clause may be modified as follows:
Both the HV and LV sides shall have bare end bushing as per specification.

C. Clause no. 5.3 regarding submission of Drawing: The following shall be included:
The detailed drawing and control circuit wring diagram for OLTC and SCADA compatible RTCC panel and their interconnection wiring diagram is also to be submitted. The drawing for LV side cable End box is not required to be submitted.

D. Clauses no. 7.9.2. and 7.9.3.1 regarding conservator and oil sealing of conservator:
The following shall be included:

Conservator vessels: 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 outer coating resistant to transformer oil & inner 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 of capacity to meet the requirement of expansion of the total cold oil volume in the Transformer & cooling equipment and it should be such that the oil level will always be visible through the plain oil level gauge.

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 Annexure-Y (Sheet1/2) for filling of oil manually at site. One oil filling instruction plate is also to be provided in the conservator tank as per Annexure-Y (Sheet2/2).

i) OIL GAUGES : One Magnetic type oil gauge shall be provided. The oil level at 30 Deg. C. shall be marked on the gauge along wit 1/4th Level, max & Min. level. A plain oil level gauge of prismatic type is also to be provided on the opposite side of the conservator, on which MOG is provided with marking as per ISS.

ii)CONNECTION : The oil connection from the transformer tank to the conservator vessel shall be arranged at a raising angle of 4 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.

iii)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 moisture absorption indicated by a change in colour of the tinted crystals can be easily observed from the distance.
iii) All breathers shall be mounted at approximately 1400 mm above ground level and shall be connected to the air cell of the conservator through pipe for the purpose of breathing during contraction or expansion of the air cell.
iv) A suitable metallic cover should be provided on the pipe on which breather is provided at a location just above the breather so that it can protect rain water from falling directly onto the breather. The same arrangement shall be made fin case of breather associated with OLTC tank conservator.

E. Clause no. 7.9(iv): Regarding OTI & WTI:

The OTI and WTI shall have the following feature:

The OTI & WTI shall be provided with repeater for remote indication of those temperatures at the RTCC panel.

The winding temperature indicator with two electrical contacts for alarm & trip purposes and with repeater for remote indication 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 00C to 1500C. The angular displacement of thermometer should be 270 Deg. The signalling contact of WTI
& OTI shall be set to operate at the following temperature:

The tripping contacts of indicator shall be adjustable to close the winding temperature indicator between 60 Deg.C and 120 Deg.C. The alarm contacts of indicator shall be adjustable to close between 50 deg.C & 100 Deg.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 and the resistance value should be of value ≤ 25 watts. The winding C.T ratio for 6.30MVA shall be 330/5A

and for 10.00 MVA it shall be 525/5A.

F. Clause no. 7.3 : Regarding tank top 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 changing ratio or testing the earth connection. Each inspection opening shall be of adequate 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 be provided on tank cover to house the bushings. The top of turrets of both HV & LV bushings should be connected through pipes with main tank Buchholz Relay pipe to drive out trapped air. Turret top of LV side should have bolted cover on which C.T. is provided and turret pipe should have suitable sections so that top covers of the bolted bushing turrets can be removed in order to have access to the CTs as and when required, inside them and the bushing CTs should be so positioned that it can be attended/replaced by removing the top cover of bushing turret and box cover for WTI CT secondary terminals and secondary terminals of other C.Ts.

G. In addition phase and neutral bushing C.T.s are to be provided in LV sides for both 6.3 & 10 MVA PTR

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 in the bushing turret of r, y & b phases and neutral of LV side of both 6.30 & 10.0 MVA power transformer.

CT Particulars		For 6.3 MVA Transformer	For 10 MVA Transformer
i) Type	:	Suitable for installation in L.V.side of Power Transformer for REF protection	Suitable for installation in L.V.side of Power Transformer for REF protection
ii) Ratio	:	400/1A at all phases and Neutral side	600/1A at all phases and Neutral
iii) Accuracy Class	:	PS.	PS.
iv) Knee Point Voltage Vk	:	Vk > 250 volt	Vk > 250 volt
v) RCT at 75 Deg. C at Lower & Higher Taps.	:	RCT <4 Ohm at 75 Deg.C	RCT <4 Ohm at 75 Deg.C
vi) Magnetising Current at knee point voltage	:	< 30 mA at VK	< 30 mA at VK
vii)Additional winding for testing of the C.T.	:	Not required.	Not required.

H. Clause no. 7.4 regarding under carriage:

The following shall be includeded:

AXIS AND WHEELS :

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

Transformer rating in MVA	Type
6.3	Flanged wheel suitable for use on a 1435 mm guage track.
10	Flanged wheel 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.

I. Clause no. 7.9.2(ii) regarding Pressure release device: The following shall be added:

The operating pressure of the Pressure Relief Device shall be 0.49 Kg/cm^2.

J. Clause no. 2.2 & Clause no. 9: Regarding liquidated damages for losses beyond quoted loss figures:
The part of clause no. 9 related to liquidated damage shall prevail.

K. Clause nos. 8.2.1 & 8.2.1A: Regarding Type & special Test:

Those Tests if carried out as per specification before 5(Five) years from the date of opening of bid will not be accepted.

L. Clause no. 8.2.3: Regarding Routine Test:

Temperature rise Test shall have to be conducted on one no Tr. of each type against the order as per relevant ISS.
The Transformer Turns ratio of the transformers will be measured at all tap positions. The %Error at other tap positions shall be same as those specified for normal and minimum Tap positions as per relevant ISS.

M. Clause no. 1.2 regarding Core:

The core construction of the core shall be of conventional stack core type.

N. Clause no. 7.12 regarding fitting & Accessories:

The following accessories are to be provided in the 6.30 & 10 MVA Power Transformer if they are not covered in the Fittings & Accessories as per clause no. :

	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 & conservator 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 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.	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 & 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.	Bushing C.T.s as specified and suitable for installation in all phases including Neutral of L.V. side of both Power Transformer for both 6.3 MVA and 10 MVA Power Transformer. Suitable C.T as specified for Winding Temperature Indicator in the blue phase of LV side for both 6.3 MVA and 10 MVA Power Transformer.
28.	Rating plate, as per I.S.S.
29.	Diagram Plate.
30.	Property label.
31.	Oil filling instruction plate shall be provided at i) conservator body, ii) tank body along with rating and
32.	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.

Note: The Oil Temperature indicator, Winding Temperature Indicator of the Transformer and Digital Tap position Indicator of the SCADA compatible RTCC panel are to be tested & calibrated from Distribution Testing Department. Those tested & Calibrated OTI, WTI & TPI are to be supplied along with the Transformer & RTCC Panel.

SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS :

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

GUARANTEED TECHNICAL PARTICULARS			
Sl.No.	Particulars		
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	:	
	(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 6.3 & 10 MVA 33/11KV TR.	:	

GUARANTEED TECHNICAL PARTICULARS

	Tap Number	Voltage ratio in KV/KV		Tap Number	Voltage ratio in KV/KV
	1.			10.	
	2.			11.	
	3.			12.	
	4.			13.	
	5.			14.	
	6.			15.	
	7.			16.	
	8.			17.	
	9.				

12.	(i) Temperature rise under normal operating 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 (in 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	:	

GUARANTEED TECHNICAL PARTICULARS			
17.	Load loss in KW at 75 Deg. C. at Rated output and frequency	:	
	(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 ¾ full load (i) at unity power factor	:	
	(ii) at 0.8 power factor lagging	:	
	(c) at 1/2 full load (i) at unity power factor	:	
	(ii) at 0.8 power factor lagging	:	
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.		

GUARANTEED TECHNICAL PARTICULARS			
	(a) at Lowest tap	:	
	(b) at principal tap	:	
	© at highest tap	:	
24.	Withstand time without injury for three phase 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 100% rated voltage at 50 Hz (in lines/sq.cm	:	
	b) at 110% 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.)	:	
	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 &	:	

GUARANTEED TECHNICAL PARTICULARS				
	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	:		
	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 1	At lowest tapping 2	At highest tapping 3
(a)	High voltage (Amp.per sq.cm)			
(b)	Low voltage (Amp.per sq.mm)			

iv)	Insulating material used for	
	(a) High voltage winding	:
	(b) Low voltage winding	:
v)	Insulting material used between	:
	(a) High voltage and low voltage	:

GUARANTEED TECHNICAL PARTICULARS						
	winding					
	(b) Low voltage winding and core	:				
vi)	Whether adjustable coil clamps are pro0vided 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	:				
viii)	Type of Radial Coil Supports	:				
	(a) H.V. winding	:				
	(b) L.V. winding	:				
ix)	Current in the winding at rated MVA		At principal tapping	At lowest tapping	AT highest tapping	
	(i) Low voltage (in Amps)					
	(ii) High voltage (in Amps)					
33	Insulation withstand Test voltages	:	H.V.	L.V.		
	i) Lightning Impulse withstand test voltage (KV Peak)	:				
	(ii) Power frequency withstand test voltage (in KV rms for 1 min)	:				
	(iii) Induced over voltage withstand test voltage (in KV rms)	:				
34	Voltage per turn (KV per turn)	:				
35	Ampere turn	:				
36	Number of turns	:	At principal tapping	At lowest tapping	AT highest tapping	
	(i) Low Voltage	:				
	(ii) High Voltage	:				
37.	Details of Tapchanger	:				
	i) Number of steps	:				
	ii) Number of Plus taps	:				
	iii) Number of minus taps	:				

GUARANTEED TECHNICAL PARTICULARS						
	iv) Position of taps on HV	:				
	v) Type of tap changing arrangement	:				
38.	Bushing :		High voltage		Low voltage	
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	:				
	2)Wet	:				
v)	Creepage distance					
	a) Total (in mm)	:				
	b) Protected (in mm)	:				
vi)	Minimum height of the bushing	:				
39.	Minimum clearance (in mm)	:				
			In Oil		In Air	
			Between 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	:				
	iv) Knee Point Voltage	:				
	v) RCT at 75 Deg.C					

GUARANTEED TECHNICAL PARTICULARS			
	vi) Magnetising Current at Knee Point Voltage	:	
	viii) Additional winding particulars of testing on the C.T.	:	:
	viii) Short Time Rating	:	
	ix) Reference Standard	:	
41	Approximate weight of Transformer (in Kgs)	:	
	i) Core with clamping	:	
	ii) Coil with insulation	:	
	iii) Core and winding	:	
42.	Tank and fitting with accessories	:	
	v) Untanking weight	:	
	vi) Oil required for first filling	:	
	vii) Total weight with Core, Winding, Oil Fittings	:	
43.	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) Track gauge required for the	:	Axis

GUARANTEED TECHNICAL PARTICULARS				
	wheels			
			Transverse	Longitudinal
	Dimension of base channel (in mm x mm)			
	vi) Type of Pressure relief device / Explosion Vent and pressure at which it operates	:		
44.	Conservator			
	i) Total volume (in Litres)	:		
	ii) Volume between the highest and Lowest visible oil level (in litres)	:		
45.	Oil Quality			
	i) Applicable standard	:		
	ii) Total quantity of oil (in Litres)	:		
46.	Radiator	:		
	i) Number of Radiator Bank	:		
	ii) Number of tubes/fins in each radiator Bank	:		
	iii) Thickness of tubes/fins (in mm)	:		
	iv) Overall dimensions (in mm)	:		
	a) Length b) Breadth c) Height	: : :		
	v) Type of mounting	:		
	ix) Vacuum withstand capability	:		
47	Gas And Oil Actuated Relay	:		
	i) Make	:		
	ii) Type	:		

GUARANTEED TECHNICAL PARTICULARS				
	iii) Number of float contacts	:		
48	Temperature Indicators		Oil Temperature Indicator	Winding Temperature Indicator
i)	Make	:		
ii)	Type	:		
iii)	Permissible setting ranges for alarm and trip	:		
iv)	Number of contacts	:		
v)	Current rating of each contact	:		
49.	Approximate overall Dimensions (in mm)	:		
	a) Length	:		
	b) Breadth	:		
	c) Height	:		
	d) Minimum height of bottom most protion of bushing from bottom of base channel	:		
50.	Minimum clearance height for lifting tank cover (in mm)	:		
51.	Make of OLTC			
52.	Whether OLTC is Type tested			
53.	whether OLTC is in line with the specification			
54.	Make of RTCC			
	whether RTCC is in line with the specification			
55.	Type of Core Construction(Stack/Others)			
56.	Whether agreeable to carry out Type Tests, in line with specification at your Cost ?			
57.	Whether all particulars as specified above are furnished?			

SIGNATURE OF THE TENDERER
WITH COMPANY'S SEAL

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ANNEXURE-X (Sheet 1/2)

Provision for SCADA operation

The following features are to be added in RTCC & DM (where necessary) for interfacing SCADA signal as per enclosed schematic drawing (Annexure - B) :-

1) Seperate Terminal Block (X1 as in the drg.) is to be provided for SCADA operation. (i.e. SCADA Terminal Block (STB)).
2) OLTC Control Supply, 110 V AC is to be wired to STB (A1 in the drg.).
3) OLTC 3 – phase main supply for motor MCB in DM is to be of 3- pole / 4 – pole type with at least 1 (one) no. ' NC ' auxiliary contact. The auxiliary contact is to be wired to STB for OLTC motor supply fail indication (A2 in the drg.)
4) ' NC ' contact of Under Voltage (U/V) Relay is to be wired to STB for OLTC Control Supply fail indication (A3 in the drg.).
5) One 110 V AC relay / contractor actuated by contacts of raise & lower contractors is to be provided for Tap-changer-in-progress indication to SCADA end . ' NO ' contact of the relay is to be wired to STB (A4 in the drg.)
6) One Two - position (Sub- stn. / SCADA) stay put **lockable type** Selector Switch having 4 nos. ' NO ' and 4 nos. ' NC ' auxiliary contacts in each position is to be provided in the remote path of Local / Remote switch . Sub-stn. position of the said selector switch should mean operation of Tap – changer from sub-stn. control room (Remote) and in SCADA position it is operation of Tap - changer from SCADA end. Necessary wiring from the Sub-stn / SCADA selector switch are to be terminated to STB both for operation of Tap – changer as well as indication (A5 in the drg.) of the selected position.
7) ' NO ' contact of OSR / TDR is to be wired to STB for tap- changer out – of – step indication (A6 in the drg.) .
8) 3 nos. wires are to be wired up from remote Tap Position Indicating device at DM to STB to facilitate Tap position indicatioin to SCADA end (A7 in the drg.).

Sufficient space closed to SCADA Terminal Block (STB) in RTCC panel should be available for mounting 2 nos. D.C. Contractor used for receiving command for for tap changing operation from SCADA control centre . SCADA Terminal Block should be provided with sufficient spare terminals (Ten nos. or more).

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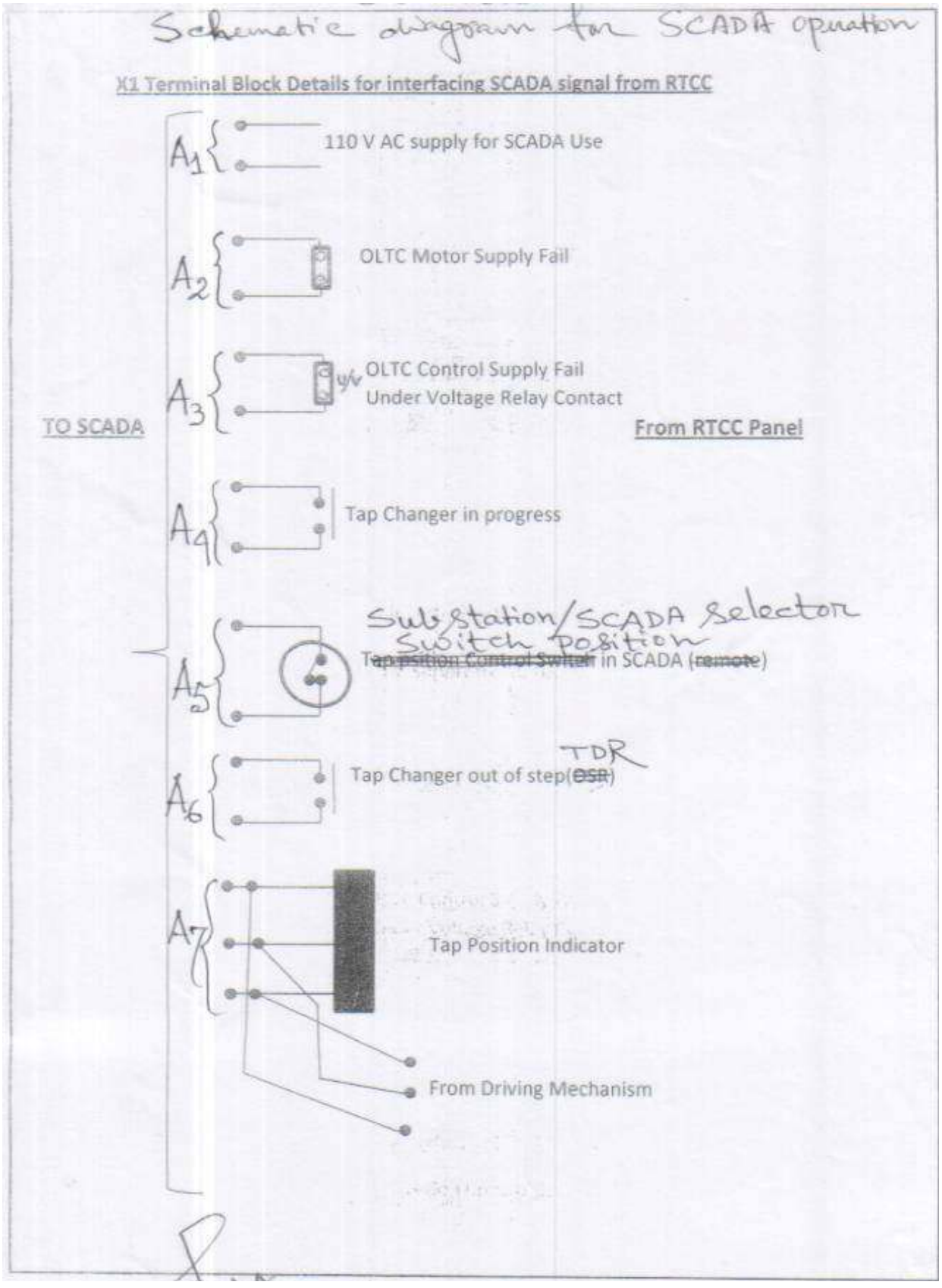
ANNEXURE-X (Sheet 2/2)



ANNEXURE-Y (Sheet 1/2)

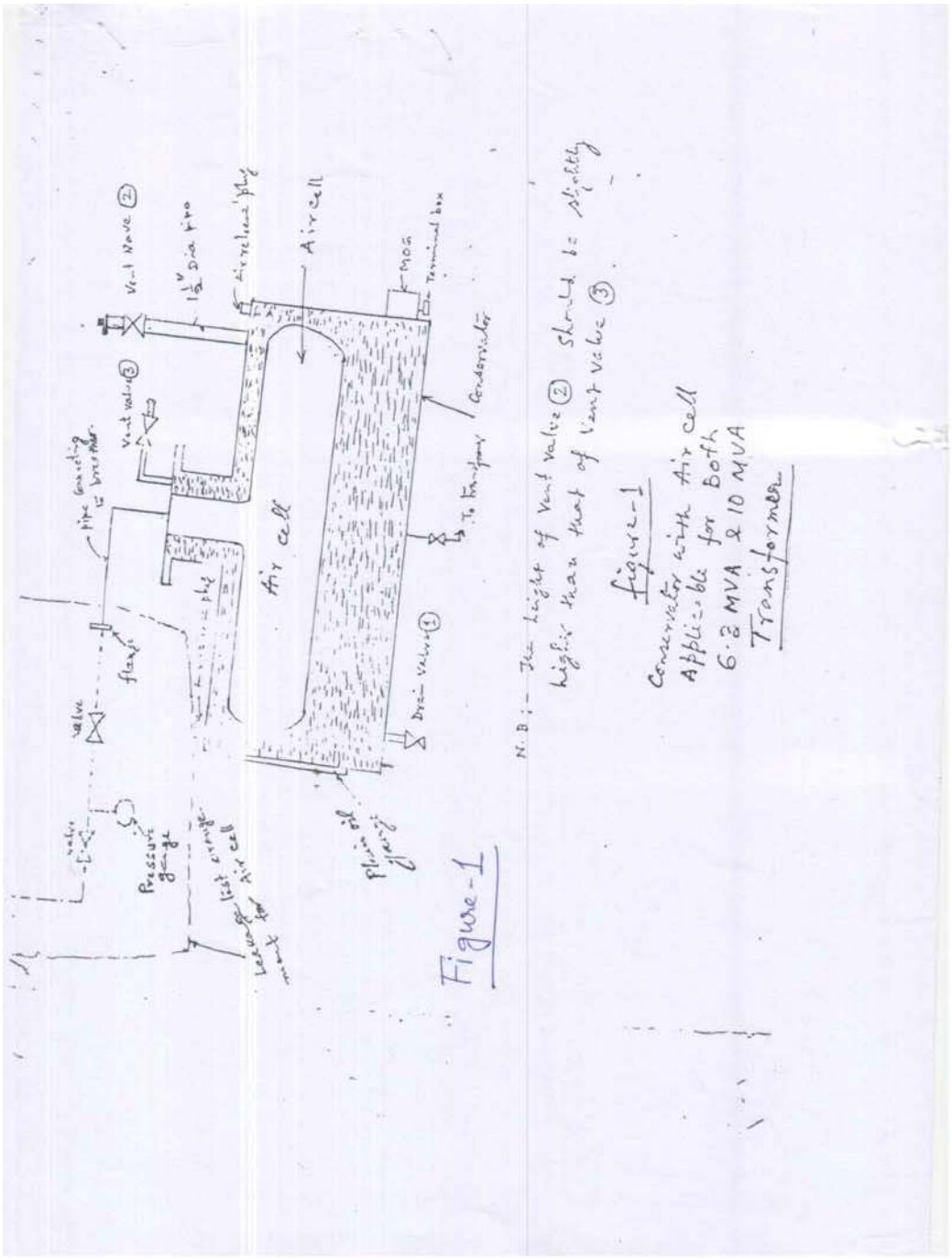


Figure-1

Figure-1

Conservator with Air cell
Applicable for Both
6.2 MVA & 10 MVA
Transformer

ANNEXURE-Y (Sheet 2/2)