

North Eastern Electricity Supply Company of Odisha
Limited

SECTION –IV (A)

TECHINICAL SPECIFICATIONS

OF

DISTRIBUTION TRANSFORMER

TENDER NOTICE NO- NESCO/DESI/21/11366

DATE: 23.08.2013

GROUP-A

DISTRIBUTION TRANSFORMER:

PART-I

**11/0.433 KV, 63 KVA, 100 KVA ALUMINIUM WOUND
DISTRIBUTION TRANSFORMERS (3 STAR RATED);**

TECHNICAL SPECIFICATION
DISTRIBUTION TRANSFORMER
PART-I

GENERAL

1. SCOPE

- 1.1 The specification covers the design, engineering, manufacture, stage inspection, testing, pre-delivery inspection, supply, delivery, loading, unloading and performance requirements of 11/0.433 KV non-sealed type aluminum wound BEE specified 3 Star Distribution Transformers for outdoor use in the networks of NESCO. The Transformers shall be double wound, three phase, CRGO M3 Grade (0.23mm) or better, oil immersed with ONAN cooling with Oil filled up to maximum permissible level. The ratings required under this specification are **63KVA, 100 KVA with Aluminum windings.**
- 1.2 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 bid opening. Compliance shall be demonstrated by submitting with the bid, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./ State Govt. or their undertakings.
- 1.3 The scope of supply should also include the provision of type test **Purchaser reserves the right to waive type tests as indicated in the section 1.2 on Quality Assurance, Inspection and Testing in this specification.**
- 1.4 The 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 Purchaser shall have the power to reject any work or material, which, in his judgment, is not in full accordance therewith.

2. CODES & STANDARDS

- 2.1 Except where modified by this specification, the Transformers shall be designed, manufactured and tested in accordance with the latest editions of the following standards. The Bidder may propose alternative standards, provided it is demonstrated that they give a degree of quality and performance equivalent to or better than the referenced standards. Whether to accept or reject any alternative standard shall be adjudged by the Purchaser. The Bidder shall furnish a copy of the alternative standard proposed along with the bid. If the alternative standard is in a language other than English, an English translation shall be submitted with the standard. In the case of conflict the order of precedence shall be 1) IEC or ISO Standards, 2) Indian Standards, 3) other alternative standards.

IEC/ISO	Indian Standard	Subject
IEC 71		Insulation Coordination
IEC 76	IS 2026	Power transformer
	IS 1180	Outdoor Three Phase Distribution Transformers up to 100KVA, 11/ 0.4 KV, Non- Sealed Type.
IEC 137	IS 2099	Bushing for Alternating Voltages above 1000Volt.
IEC 156		Method of determining Electric Strength of Insulating Oils.

IEC 296	IS 335	Specification for Mineral Insulating Oils for Transformer and Switchgear.
	IS 6792	Method of determination of electric strength of insulating oils.
IEC 354	IS 6600	Loading Guide for oil immersed Transformers
	IS 4257	Dimensions for clamping arrangement for bushings
	IS 7421	Specification for Low Voltage bushings
	IS 3347	Specification for Outdoor bushings
IEC 554	IS 9335	Specification for Insulating craft Papers
	IS 1567	Specification for Insulating Press Board
	IS 6162	Paper covered aluminium conductor
	IS 5561	Electrical Power Connector
	IS 6103	Testing of specific resistance of electrical insulating liquids
	IS 6262	Method of test for power factor and dielectric constant of electrical insulating liquids
	IS 10028	Installation and maintenance of transformers

This list is not to be considered exhaustive and reference to a particular standard or recommendation in this specification does not relieve the Supplier of the necessity of providing the goods complying with other relevant standards or recommendations.

3. SERVICE CONDITIONS

The service conditions shall be as follows:

maximum altitude above sea level	1,000m
maximum ambient air temperature	50° C
maximum daily average ambient air temperature	40° C
minimum ambient air temperature	-5° C
maximum temperature attainable by an object exposed to the sun	60 ° C
maximum yearly weighted average ambient temperature	32° C
maximum relative humidity	100%
average number of thunderstorm days per annum (isokeraunic level)	70
average number of rainy days per annum	120
average annual rainfall	1500 mm
maximum wind pressure	260Kg / m ²

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.

4. SYSTEM CONDITIONS:

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

- Frequency 50Hz ± 5%

- Nominal System Voltage 11KV System 11KV
LV System 433/250V

- Maximum System Voltage 11KV System 12 KV
LV System 476 V

- ◆ Minimum LV voltage (NEC) 392 V

- ◆ Nominal short circuit apparent power of the system 11 KV System 500 MVA (IS: 2026)

- ◆ Insulation levels :
1.2/50 μ sec impulse withstand 11 KV System 95 KV peak (As Per
BEE, Clause No.10)

- ◆ Power frequency one minute withstand (wet and dry) 11 KV System 28 KV (rms)

- ◆ Neutral earthing arrangements : LV System 3 KV (rms)
LV System Solidly earthed

5. TECHNICAL SPECIFIC TECHNICAL REQUIREMENTS

1	Rated KVA (ONAN rating)	63 KVA, 100KVA 11/0.433 KV
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 Channels.
7	Rated voltage	
	a) High voltage winding	11 KV
	b) Low voltage winding	0.433 KV
8	Highest continuous system voltage	
	a) Maximum system voltage ratio (HV / LV)	12 KV / 0.476 KV
	b) Rated voltage ratio (HV / LV)	11 KV / 0.433 KV
9	No. of windings	Two winding Transformers (3 Star Rated)
10	Type of cooling	ONAN (Oil natural / Air natural)
11	KVA Rating corresponding to ONAN cooling system	100%
12	Method of connection:	
	HV:	Delta
	LV:	Star
13	Connection symbol	Dyn 11
14	System earthing	Neutral of LV side to be solidly earthed.
15	Percentage impedance voltage on normal tap and KVA base at 75 ⁰ C corresponding to HV/ LV rating and applicable tolerances :	<u>% Impedance</u> + <u>Tolerance %</u> 4.5 + 10%
		(No negative tolerance will be allowed)
16	Intended regular cyclic overloading of windings	As per IEC –76-1, Clause 4.2
17	a) Anticipated unbalanced loading	Around 10%
	b) Anticipated continuous loading of windings (HV / LV)	110 % of rated current
19	Neutral terminal to be brought out	On LV side only
20	Over Voltage operating capability and duration	112.5 % of rated voltage (continuous)
21	Maximum Flux Density in any part of the core and yoke at rated KVA, rated voltage i.e 11 KV / 0.433 KV and system frequency of 50 HZ	1.5 Tesla
22	Insulation levels for windings :-	

a)	1.2 / 50 microsecond wave shape Impulse withstand (KVP)	HV: 95	LV: N.A.
b)	Power frequency voltage withstand (KV-rms)	HV: 28	LV: 03
23	Type of winding insulation		
a)	HV winding	Uniform	
b)	LV winding	Uniform	
24	Withstand time for three phase short circuit	2 Seconds	
25	Noise level at rated voltage and frequency	As per NEMA Publication No. TR-1.	
26	Permissible Temperature Rise over ambient temperature of 50 ⁰ C		
a)	Of top oil measured by thermometer.	35 ⁰ C	
b)	Of winding measured by resistance.	40 ⁰ C	
27	Minimum HV clearances in air (mm) :-		
a)	Phase to Phase	280	
b)	Phase to ground	140	
28	Bushings & Terminals		
a)	HV winding line end	12 KV oil filled porcelain communicating type of bushings (Antifog type)	
b)	LV winding	0.4 KV porcelain type of bushing (Antifog type)	
29	Insulation level of bushing	<u>HV</u>	<u>LV</u>
a)	Lightning Impulse withstand (KVP)	95	Not applicable
b)	1 Minute Power Frequency withstand voltage (KV –rms)	28	3
c)	Creepage distance (mm) (minimum)	25 mm/ KV	
30	Material of HV & LV Conductor	EC grade Aluminum	
31	Maximum current density for HV and LV winding for rated current	1.6 Amp/ mm ² .	
32	Polarisation index i.e. ratio of megger values at 600 sec. to 60 sec for HV to earth, L.V to earth and HV to LV.	Shall be greater than or equal to 1.5, but less than or equal to '5'.	
33	Core Assembly	Boltless type	
34	Transformer rating		
		Max. Losses at 50% load (Watts)	Max. Losses at 100 % load(Watts)
a)	63 KVA	380	1250
b)	100 KVA	520	1800

6. TYPE OF TRANSFORMER

6.1 The Transformers(3Star rated) shall be of core type construction, double wound, three phase, oil immersed, 11/0.433KV, 50 Hz with natural oil and air cooling (ONAN) to be used as step down Transformers(3 Star Rated) for out door use. The design of the tank, fittings, bushings, etc shall be such that it will not be necessary to keep the transformer energised to prevent deterioration as the Transformers may be held in reserve, outdoors, for many years.

7. **PERFORMANCE, CAPACITY AND SHORT CIRCUIT RATINGS**

7.1 The following ratings are covered under this specification

- 63 KVA, 11/0.433 KV, Aluminum wound
- 100KVA, 11/0.433 KV, Aluminum wound

7.2 The transformer shall be capable of supplying a continuous load equal to its KVA rating, under the following conditions :

- ◆ continuous steady load;
- ◆ design at maximum ambient air temperature of 50⁰C;
- ◆ 40⁰ C average winding temperature rise and 35⁰C top oil temperature rise for conventional breathing Transformers(3 Star Rated)

7.3 The transformer may be overloaded during emergency up to 150% of its continuous rating in accordance with IEC Publication 354 or IS: 6600. Bushings and other current-carrying parts shall also be designed for this condition.

7.4 The 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 of either winding with rated voltage on the other winding. If short circuit tests have been carried out on the particular design of transformer offered, the test results shall be supplied with the bid.

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

7.6 The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits, as specified in IEC 76-5 or IS: 2026: Ability to withstand short circuits.

7.7 The maximum flux density in any part of the core and yoke at rated KVA, Voltage and frequency shall not exceed 1.5 Tesla

8. VOLTAGE RATIO

8.1 The Transformers(Star Rated) shall have the following ratio :-

- ◆ the nominal voltage ratio shall be 11,000/ 433 V for 63 KVA, 100KVA, 11/0.4KV Transformers(3Star Rated)
- ◆ Tolerance on the voltage ratio shall be $\pm 0.5\%$.

8.2 The bidder shall state in the technical schedule, the percentage regulation at full load, power factor 1.0 and at full load, power factor 0.8 lagging.

Transformers(3 Star Rated) shall be suitable for parallel operation with each other.

9. PERCENTAGE IMPEDANCE

9.1 The Percentage of Impedance at 75° C shall be 4.5 % for 63 KVA & 100KVA Transformers . No negative tolerance on percentage Impedance is allowed.

10 LOSSES

The load losses shall not exceed the values given

below:-

	Transformer rating	3 star rated	
		Max. Losses at 50% load (Watts)	Max. Losses at 100 % load(Watts)
a)	63 KVA	380	1250
b)	100 KVA	520	1800

10.1 The above losses are maximum allowable at rated voltage and rated frequency permitted at 75° C for 11/0.433 KV transformers and there should not be any positive tolerance.

10.2 The offered transformer(s) should have been type-tested at CPRI/ NABL Accredited laboratory. The bid shall be accompanied with type-test reports (short circuit test and Impulse test) conducted at Central Power Research Institute / NABL Accredited laboratory for the offered Transformers(Star Rated) within five years from date of tender. The short circuit test report(s) must contain the measured no load loss and load loss, determined by CPRI/ NABL Accredited laboratory.

In case of any doubts, NESCO reserves the right to verify the original type test reports of CPRI/ NABL Accredited laboratory or ask the supplier to conduct the type tests at CPRI/ NABL Accredited laboratory at his (supplier's) cost for re-confirmation of the test results particularly no load losses, load

losses and percentage impedance.

10.3 If the bidder quotes lower values of losses than the CPRI's measured losses, he has to prove the same by conducting the Impulse & short Circuit tests at CPRI/ NABL Accredited laboratory along with measurement of no load losses and load losses at his own cost in presence of Purchaser's authorized representative without any financial liability to Purchaser.

10.4 However, if the loss figures will exceed the stipulated values as per specification, the transformer(s) shall be out rightly rejected.

11. VECTOR GROUP

11.1 The Transformers(3 Star Rated) shall be connected delta-star, in accordance with vector group reference Dyn11 of IEC - 76/ IS - 2026.

11.2 The LV neutral shall be brought out to a terminal bushing, which shall be identical to the phase bushings in all respects.

12. LOSSES

12.1 Transformers(3 Star Star Rated) would be out rightly rejected if losses exceed the values indicated at clause-10 above.

13. FLUX DENSITY

The flux density at rated voltage & rated frequency shall not exceed. 1.5 Tesla. The transformer must be capable of operating at 10% over voltage and at frequency of 48.5 Hz without saturation.

14. INSULATION LEVELS

The insulation levels as defined in IEC 76-C/ IS: 2026 Insulation levels and dielectric test shall apply as per Table 2:

Table 2 : Transformer insulation level

	HV Winding	LV Winding
Basic Impulse voltage Level (KV peak) (1.2/50 micro. sec.wave)	95	Not Applicable
Power Frequency voltage withstand level, Wet and Dry (KV)	28	3

Bushings and terminals shall be adequate for the winding insulation tests and shall flash over externally before puncture or internal failure can occur.

15. NOISE LEVEL

The average noise level of the Transformers shall not exceed 51db up to 100 KVA and 55 db rating from 101 – 300 KVA. The measurement shall be carried out in accordance with IEC 551 at a distance of 300mm from the envelope of the

16. RADIO INFLUENCE VOLTAGE

The maximum radio influence voltage shall be 250 μ V, measured as specified in IEC 437.

17 CORE AND WINDINGS

17.1 Core

17.1.1 Stage level inspection for core construction shall be carried out by the owner.

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

17.1.3 The core shall be constructed from high grade, non-ageing, **Cold Rolled Grain Oriented (CRGO) silicon steel of M3 Grade (0.23mm) or HIB grade laminations only.** No other core materials shall be entertained. Bidders are requested to note that

only **PRIME CORE M3 Grade (0.23mm) materials HIB grade** are to be used. In no case, second grade core material is to be used. The purchaser at his discretion, may select samples from the core laminations and get the same tested in CPRI/ NABL Accredited laboratory to prove the quality of the core material.

- 17.1.4 For the above purpose, the supplier shall have to offer every batch of core laminations received from his Sub-Vendor along with Invoice of the sub-vendor, Mills test certificate, packing list, Bill of landing, Bill of entry certificate to customs etc. towards proof of prime core materials for verification by the Purchaser's representative without any cost to the Purchaser. Besides, the contractor must mention in his bid about the type of CRGO / Amorphous laminations to be utilized for the offered Transformers(Star Rated) along with a copy of the specific core loss curve at different flux densities.
- 17.1.5 Core materials should be directly procured either from the manufacturer or through their accredited marketing organization of repute, but not through any agent.
The core and winding shall be capable of withstanding shocks during transport, installation and service. Provision shall be made to prevent movement of the core and windings relative to the tank during these conditions and also during short circuits.
- 17.1.6 The design shall avoid the presence of pockets which would prevent the complete emptying of the tank through the drain valve. The core material offered in the tender to be checked for its correctness before core coil assembly. For this, the tendered must ask for core and coil inspection before its tanking.
- 17.1.7 The laminations shall be free of all burrs and sharp projections. Each sheet shall have an insulating coating resistant to the action of hot oil.
- 17.1.8 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.
- 17.1.9 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.
- 17.1.10 All steel sections used for supporting the core shall be thoroughly shot or sand blasted, after cutting, drilling and welding.
- 17.1.11 The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.
- 17.1.12 The core clamping structure shall be designed to minimize eddy current loss.
- 17.1.13 The framework and clamping arrangements shall be securely earthed.

- 17.1.14 The core shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength.
- 17.1.15 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.
- 17.1.16 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.
- 17.1.17 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 assembly shall be so fixed in the tank that shifting will not occur during transport or short circuits.

17.2 INTERNAL EARTHING

- 17.2.1 All internal metal parts of the transformer, with the exception of individual laminations and their individual clamping plates shall be earthed.
- 17.2.2 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.
- 17.2.3 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.
- 17.2.4 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.

17.3 Windings

- 17.3.1 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.
- 17.3.2 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.

- 17.3.3 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.
- 17.3.4 The winding insulation shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse. It shall be non catalytic and chemically inert in hot transformer oil during normal service.
- 17.3.5 The stacks of windings are to receive adequate shrinkage treatment.
- 17.3.6 The windings and connections are to be braced to withstand shocks during transport, switching, short circuit or other transient conditions.
- 17.3.7 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.
- 17.3.8 Terminals of all windings shall be brought out of the tank through bushings for external connections.
- 17.3.9 The windings shall be uniformly insulated and the L.V neutral points shall be insulated for full voltage.
- 17.3.10 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.
- 17.3.11 The winding shall be so designed that all coil assemblies 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.
- 17.3.12 Coils shall be made of continuous smooth high grade electrolytic copper or aluminium conductor, shaped and braced to provide for expansion and contraction due to temperature changes.
- 17.3.13 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.
- 17.3.14 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

- 17.3.15 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.
- 17.3.16 Magnitude of impulse surges transferred from HV to LV windings by electro magnetic induction and capacitance coupling shall be limited to BIL of LV winding.
- 17.3.17 The winding conductor shall be of Aluminum. The current density shall not exceed 1.6 Amp/ mm² for aluminium at normal full load current.

18. BUSHINGS AND TERMINATIONS

18.1 Bushings

- 18.1.1 Bushings shall be of the outdoor type and easily replaceable. Cemented in types will not be accepted. They shall be sufficiently robust to withstand normal transport and erection hazards and shall confirm to IEC 137 /IS 3347 and 2099.
- 18.1.2 All bushings shall have a minimum creepage distance of 25 mm /KV and shall have a continuous rating of 200% of the transformer rating. The protected creepage distance shall not be less than 50% of the total.

The following minimum 11 KV clearance shall be provided:

	External (Air) for 11 KV
Phase to phase	255 mm
Phase to earth	140 mm

- 18.1.3 The 11 KV bushings of Transformers(Star Rated) shall be provided with a bi-metallic terminal connector or suitable device to receive 34,55,80,100 mm² AAAC or ACSR conductor directly without any bi-metallic action. The dia of HT bushing stud should not be less than 12.5 mm.

18.1.4

The secondary bushings of Transformers(3 Star Rated) shall be fitted with non ferrous threaded terminals of dia not less than 20 mm. With the exception of brass the terminals shall be protected from atmospheric deterioration by suitable tinning or by some other approved coating.

18.1.5 The terminals are to be supplied with one 16mm bolt, one conic spring washer, one matching flat washer, one nut and one lock nut for each hole in the terminal plate.

18.2 Bushing Labels

18.2.1 The HV bushings shall be labeled 1U,1 V and 1W and the LV bushing 2u, 2v, 2w and 2n. Marking letters shall be at least 12 mm high. The means of marking shall be

- ◆ engraved metal plate; or
- ◆ etched anodized aluminum.

Phase identification by adhesive stickers shall not be acceptable.

18.2.2 If labeling is to be carried out on the tank, it is preferred that one plate be used rather than individual markings for each phase, in order to prevent incorrect phase markings. Labels shall conform to the requirements of the section on labels in this specification.

18.3 Earthing Terminals

All Transformers(Star Rated) shall be provided with two earthing terminals conforming to relevant Standards and M12 ISO metric bolt and nut which shall be non ferrous. It shall include a spring washer and lock washer.

18.4 LIGHTNING ARRESTORS

9 KV, 5KA metal oxide lightning arresters of reputed make conforming to IS-3070 Part-III, one number per phase shall be provided.(Under the HV bushing with GI earth strip 25x4 mm connected to the body of the transformer with robust clamping arrangement). Lightning arrestors with polymer insulators in conformance with relevant IEC can also be used.

19 TANK FABRICATION

19.1 All transformer sizes, the tank shall be of bolted type construction in accordance with IS 1180 (Part 2).

- The tank shall be at atmospheric pressure at an internal temperature of 10⁰C.
- The tank shall be designed for an internal pressure of 100Kg/ m² at 50⁰ C ambient conditions. It shall be capable of withstanding an unlimited number of 24 hours cyclic variations of internal pressure from atmospheric to this value.
- The tendered shall state the top oil temperature at which the tank internal pressure shall reach the value of 100 kN/ m² and the value of steady load which will result in this top oil temperature with an ambient temperature of 45⁰ C.

- Adequate space shall be provided at the bottom of the tank for collection of sediments.

19.2 Transformer tanks of all types shall be designed so that the completed transformer can be lifted and transported without permanent deformation or oil leakage. Stiffeners provided on all the four side walls for rigidity should be so designed that there is no accumulation of water.

19.3 The Tank shall be of rectangular shape with round edges fabricated from tested quality mild steel plates with minimum thickness of **3.15** mm. for the side walls while top cover and the bottom plate of the tank shall have a minimum thickness of **5** mm. The transformer tank and the top cover shall be designed in such a manner as to leave no external pockets in which water can log, or any internal pocket where air/ gas can accumulate.

Edge of Top cover should be bend downwards so as to avoid water through cover plate gasket. The width of the bend plate shall be 25mm minimum.

19.4 All sealing washers / gaskets shall be made of oil and heat resistant neoprene rubber or neoprene bonded cork seals suitable for temperature as stipulated in this specification. Surfaces at gasketed joints shall be such that an even face is presented to gasket, thereby eliminating the necessity for the gasket to take up surface irregularities.

19.5 All pipes, radiators, stiffeners or corrugations which are welded to the tank wall shall be welded externally and shall be double welded wherever possible. All welds shall be stress relieved.

19.6 The transformer tank shall be complete with all accessories, lifting lugs etc. and shall be designed to allow the complete transformer filled with oil to be lifted by crane or jacks without risk of any damage and can be transported by Rail/ Road without straining any joints and without causing any leakage of oil.

19.7 The height of the tank shall be such that minimum vertical clearance up to the top cover plate of 80mm is achieved from the top of the yoke.

19.8 The tank shall further be capable of withstanding a pressure of 0.8 kg/sq.cm(g) and a vacuum of 0.7 kg/sq.cm(g) without any deformation.

PRESSURE RELIEF DEVICE

20

Transformers shall be fitted with a pressure relief device in the form of explosion vent.

The tendered shall state the pressure at which it is designed to operate.

21 OIL LEVEL GAUGE

A suitable oil level gauge (Normal Oil Level Gauge Indicator) shall be fitted on the Transformers and so located that it can be easily read from ground level. The gauge fitted with the conservator shall be graduated for temperatures of -5°C , 30°C and $+98^{\circ}\text{C}$.

22 CONSERVATORS AND BREATHERS

All the Transformers shall be provided with a conservator tank.

22.1 The conservator tank shall be so designed and located as to eliminate any trapping of air in the transformer or pipe work. It shall be inclined at an angle of about 5 degrees to the horizontal towards the drain plug and the pipe connecting the main tank to the conservator should project about 20 mm above the bottom of the conservator so as to create a sump for the collection of impurities. Minimum oil level corresponding to -5°C shall be well above the sump level.

22.2 All Transformers shall be fitted with a silica gel breather of weatherproof design at a convenient height with oil seal at the bottom, draw in plug and filling holes with covers to isolate the silica gel from the atmosphere. The breather pipe should be connected at top of the conservator tank with two bends at right angles. The cover of the main tank and bushings turrets shall be provided with air release plug to enable the trapped air to be released.

23 FITTINGS AND ACCESSORIES

23.1 The following standard fittings and accessories shall be provided :

- ◆ Rating, diagram and terminal marking plate.
- ◆ Two earthing terminals.
- ◆ Lifting lugs/ platform lugs.
- ◆ Pressure relief device or explosion vent.
- ◆ Silica gel breather.
- ◆ Normal Oil Level Gauge Indicator for all Transformers indicating three position(3) of oil - minimum.- 5°C , 30°C and 98°C .
- ◆ Top filter valve with locking arrangement.
- ◆ Bottom filter valve with locking arrangement duly welded with a separate plug
- ◆ Air release plugs at transformer top cover, bushing turrets etc.
- ◆ Set of Radiators.
- ◆ Conservator Tank

Bi-metallic terminals on the bushings for connection with over head ACSR/ AAAC conductor. The Specification and brief details of the salient features of these terminals should be stated.

25 TRANSFORMER OIL

The Transformers shall be supplied complete with first filling of transformer oil up to maximum permissible level. The quantity of oil required for the first filling of the transformer and its full specification shall be stated in the bid. The complete first filling shall be of new oil free from inhibitors and additives up to maximum permissible level for the supplied Transformer. The bidder shall quote the price of transformer including the cost of Transformer Oil required for initial filling.

The insulating oil for the transformer shall be of EHV grade, generally conforming to IEC: 296/ BS: 148/ REC: 39/ 1993 or latest version of IS: 335/ 1983 whichever is more stringent. No inhibitors shall be used in the oil. The dielectric strength of the oil shall not be less than 60 KV at 2.5 mm. gap when tested in accordance with IS: 6792/ 1972. If an anti-oxidant inhibitor is recommended, its use shall be subject to the purchaser's approval.

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.

The contractor shall warrant that oil furnished is in accordance with the following specifications.

S.No	Characteristic	Requirement	Method of Test
01	Appearance	The oil shall be clear & transparent & free from suspended matter or sediment	A representative sample of oil shall be examined in a 100 mm thick layer at ambient temp.
02	Density at 20 ⁰ C	0.89 g/cm ³ Max.	IS:1448
03	Kinematic Viscosity at 27 deg. C Max	27 CST	IS:1448
04	Interfacial tension at 27deg.C Min.	0.03 N/m	IS:6104
05	Flash Point	136 ⁰ C	IS:1448
06	Pour Point Max.	-6 ⁰ C	IS:1448
07	Naturalization Value (Total Acidity) Max.	0.03 mg KOH/gm	IS:335
08	Electric strength Breakdown (voltage) Min.	72.5 KV	IS:6792
09	Dielectric dissipation factor tan delta at 90 ⁰ C	0.03 Max	IS:6262

10	Min specific resistance (resistively) at 90 deg.C	35X10 ¹² ohm cm (min.)	IS:6103
11	Oxidation stability		
12	Neutralization value after oxidation	0.40mg KOH/g	
13	Total sludge after oxidation	0.10% by weight max.	
14	Presence of oxidation Inhibitor	The oil shall not contain anti-oxidant Additives.	IS:335
15	Water content Max:	Less than 25ppm	IS:2362

26 RATING AND CONNECTION PLATE

Each transformer shall be provided with a rating plate of weatherproof material showing the following items indelibly marked :

- ◆ Type of transformer
- ◆ Standard to which it is manufactured (preferably IEC 76)
- ◆ Manufacturer's name
- ◆ Transformer serial number
- ◆ Year of manufacture
- ◆ Rated frequency in Hz (50)
- ◆ Rated voltages in KV (11/0.433)
- ◆ Number of phases (3)
- ◆ Rated power in KVA
- ◆ Type of cooling (ONAN)
- ◆ Rated currents in A
- ◆ Vector group symbol (Dyn11)
- ◆ 1.2/50µs wave impulse voltage withstand level in KVp
- ◆ Power frequency withstand voltage in KV
- ◆ Impedance voltage at rated current and frequency in percentage at 75⁰ C at normal tap
- ◆ Measured load loss in KW at rated current and at 75⁰ C at normal tap
- ◆ Measured no-load loss in KW at rated voltage and rated frequency
- ◆ Continuous ambient temperature at which ratings apply in ⁰C

- ◆ Top oil and winding temperature rise at rated load in °C
- ◆ Winding connection diagram
- ◆ Total weight in kg with complete oil filled.
- ◆ Total weight of the transformer without oil
- ◆ Volume of oil in litres.
- ◆ Weight of core and windings in kg; and
- ◆ Name of the purchaser
- ◆ NESCO, DESI

The rating plate shall conform to the requirements of the section of Labels in this specification.

27. BASE MOUNTING ARRANGEMENT

The under base of all Transformers up to 200KVA capacity shall be provided with two 75x40 mm channels, 460 mm long with holes of 14 mm dia at a centre to centre distance of 420 mm to make them suitable for fixing on a platform or plinth.

27 (a) PUNCHINGS: Non-erasable Punching and embossing of Volume of oil in litres, name of the Purchaser- NESCO, Odisha, Name of the Supplier – M/s -
-----, Year of Manufacture, Guarantee Period (i.e. 2 years from the date of installation)and Sl. No. of each transformer is to be made on top core channel, top cover, side walls and name plates of Transformers.

27 (b) STAR LEVEL: In addition to above, the supplied Distribution Transformers must contain Star Level with style and information provided by the Bureau of Energy Efficiency (B.E.E), Ministry of Power, Government of India.

28. PAINTING

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

- 28.2
- 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.

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

28.3.1 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 purchaser.

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

28.4 Cleaning and Surface Preparation

28.4.1 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.

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

28.4.3 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.

28.4.4 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.

28.5 Protective Coating

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

28.6 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 followed by 2 coats of P.U (Poly-urethane) paint. The color of the finishing coats shall be dark admiral gray. 'DESI' to be written on the body of the conservator tank with white paint having total letter size 2"x8".

28.7 Painting Procedure

28.7.1 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.

28.7.2 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.

28.7.3 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.

28.7.4 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.

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

28.8 Damages to Paints Work

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.

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.

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

28.9 Dry Film Thickness

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.

Each coat of paint shall be allowed to harden before the next is applied as per manufacture's recommendations. Particular attention must be paid to full film thickness at edges.

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	Area to be painted	No of Coats	Total Dry film thickness(Min)
1.	Liquid paint			
	a) Zinc Chromate (Primer)	Out side	01	30 micron
	b) P.U. Paint (Finish Coat)	Out side	02	45 each
	c) Hot Oil paint	inside	01	35/10 micron

The colour of the finishing coat shall be Dark Admiral Gray .

29 SEALING GASKETS

All sealing washers / gaskets shall be made of oil and heat-resistant Nitrile/ Neoprene rubber/ synthetic rubber bonded cork type RC-70C gaskets. Gaskets made of natural rubber or cork sheet are not permissible.

30 SUPPRESSION OF HARMONICS

The transformer shall be designed with attention to the suppression of harmonic voltage, especially the third and fifth.

**TESTING, INSPECTION AND OTHER TECHNICAL
SPECIFICATION FOR
DISTRIBUTION TRANSFORMER**

31 TESTS

31.1 Routine Tests

Routine tests shall be carried out on all Transformers (Star Rated) and the tests shall be conducted in accordance with relevant National/ International Standards. No sampling is allowed. In addition, tank tests in accordance with IS: 1180 shall be carried out.

The following routine measurements and tests shall be carried out in presence of Purchaser's authorized representative(s):

- a) Measurement of winding resistance.
- b) Voltage ratio measurement and check of polarity and vector group. Bushing positions shall have permanent markings at this stage of production;
- c) measurement of impedance voltages/ short circuit impedance at rated current and frequency
- d) measurement of load loss at full load and 75⁰C;
- e) measurement of neutral unbalance current;
- f) Temperature rise test on one transformer of each rating and measurement of hot resistance.
- g) measurement of no-load loss and no-load currents at full, 50%, 75%, 90%, 110%, 112.5% and 120% of rated voltages;
- h) induced over voltage withstand test at 22KV for 60 sec on the HV windings;
- i) power frequency voltage withstand tests on HV and LV windings;
- j) magnetic balance test
- k) Polarization Index test P.I. value shall be not less than 1.5. P.I. = IR at 600 sec / IR at 60 sec.
- l) oil leakage test : The criterion of leakage shall be discoloration by oil of whitewash applied externally to suspected parts at an oil temperature of 90⁰C or other method, as approved by the Purchaser;
- m) Pressure test on transformer tank on one unit for each rating.

Bushings and oil shall be subject to the following routine tests. n)
bushing routine test: in accordance with IEC 137/IS 3347;

- o) Oil dielectric and moisture content test: conforming to IEC 156 or IS 335.

Routine test certificates shall include in addition to the test results, the purchaser's order number, the transformer serial number, outline drawing number and transformer KVA rating.

Any other applicable tests shall be conducted at the discretion of the Purchaser without any extra cost to Purchaser.

31.2 Type Tests

31.2.1 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(Star Rated) of the offered design.

Table 6: Transformer type tests

Type Test	Standard
Temperature Rise Test	IEC76/IS 2026/IS6600
Impulse Voltage Withstand Test,	IEC 76/IS 2026
Short Circuit Test	IEC 76 / IS 2026

31.2.3 Even if the Type test report(s) confirm(s) the Purchaser's specification, the Purchaser at his discretion may ask the Supplier to repeat any or all specified type tests at CPRI/ NABL accredited laboratory on sample(s), selected at random by the purchaser's representative(s) out of the offered quantity. The type test(s) are to be test-witnessed by the Purchaser's representative(s). For such type of repetition of type tests, the Bidder may quote Type

Test Charges in the enclosed Price Schedule or conduct the tests free of cost.

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

31.3 CHALLENGE TESTING:

The manufacturer can also request challenge testing for any test based on the specification and measurement of no load losses, load losses & impedance at 75⁰C. The challenger would request for testing with testing fees. The challenge test fees are proposed to be at least three times the cost of testing. This is likely to deter unnecessary challenges. The challenger would have the opportunity to select the sample from the store and any such challenge should be made within the guarantee period. The party challenged, challenger and the utility could witness the challenge testing.

The challenge testing would cover the following tests:

1. Measurement of magnetizing current & No Load losses at rated voltage & frequency.
2. Load Losses at more than 50% loading to determine the Full Load losses & percentage impedance at 75⁰C and neutral unbalance current.
3. Temperature Rise Test.

The challenge test could be conducted at NABL Laboratory like ERDA and CPRI. If the values are within the limits the product gets confirmed else not confirmed. No positive tolerances in losses are permitted. If the product is not confirmed the manufacturer would pay the challenge fee and the challenger would get the fee refunded. However as a redressal system the challenged would be allowed to ask for fresh testing of two or more samples from the store and the same be tested in NABL Laboratory or CPRI in presence of the party challenged, challenger and the utility.

If any one of the above two samples does not confirm the test, then the product is said to have failed the test. In such cases the manufacturer will be declared as unsuccessful manufacturer for the said product with wide publicity and would not be allowed to compete in tenders of the purchaser for a period of at least three years and heavy penalty would be imposed.

31.4 TEST VOLTAGE

Transformers shall be capable of withstanding the Power frequency and Impulse test voltage as described below:

Nominal system voltage	Highest System voltage	Impulse Test voltage	Power frequency test voltage
433 V (rms)			3 KV (rms)
11 KV (rms)	12 KV (rms)	95 KV (Peak)	28 KV (rms)

32 COMPLIANCE WITH SPECIFICATION

The Transformers(3 Star Rated) shall comply in all respects with the requirements of this specification. However, any minor departure from the provisions of the specification shall be disclosed at the time of tendering in the Non Compliance Schedule as in Annexure-3, Section- V of this document.

33 COMPLIANCE WITH REGULATIONS

All the equipment shall comply in all respects with the Indian Regulations and acts in force.

The equipment and connections shall be designed and arranged to minimize the risk of fire and any damage which might be caused in the event of fire.

34 INSPECTION AND TESTING

- 34.1 The Purchaser shall have free entry at all times, while work on the contract is being performed, to all parts of the manufacturer's works which concern the processing of the equipment ordered. The manufacturer shall afford the Purchaser without charge, all reasonable facilities to assure that the equipment being furnished is in accordance with this specification. After approval of Drawings by the Purchaser, the manufacturer shall start manufacturing . The supplier shall offer the core, windings and tanks of each transformer for inspection by the purchaser's representative(s). During stage inspection, all the measurements like diameter, window height, limb 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 HV and LV windings, length, breadth, height and thickness of plates of transformer tanks, the quality of fittings and accessories will be taken.

The Inspection Report for the Tests conducted by our Authorized Inspectors in presence of the manufacturer's representative, for inspection with suggested modifications, if any shall be submitted to the undersigned for approval.

Supplier can offer for final inspection of the Transformer subject to clearance of the stage inspection report by the Purchaser.

34.2 The equipment shall successfully pass all the type tests and routine tests mentioned in the above Clauses and those listed in the most recent edition of the standards given in Clause 2, of this specification.

34.3 The Purchaser reserves the right to reject an item of equipment if the test results do not comply with the values specified or with the data given in the technical data schedule

34.4 Routine tests shall be carried out by the Supplier at no extra charge at their works. Adequate facility with calibrated testing equipment must be provided by the manufacturer free of cost to carry out the tests. Type test certificates must be furnished along with the tender for reference of the Purchaser.

34.5 The Purchaser will witness all required tests. In order to facilitate this, the Supplier shall give the Purchaser a minimum of two weeks notice as mentioned in clause-7(ii) of General Terms and Condition of Contract (GTCC) that the materials are ready for testing. If the Purchaser does not indicate his intention to participate in the testing, the manufacturer may proceed with the tests only after receipt of written confirmation to this effect from the Purchaser and shall furnish the results thereof to the Purchaser consequent upon such testing.

34.6 Full details of the proposed methods of testing, including connection diagrams, shall be submitted to the Purchaser by the Supplier for approval, at least one month before testing.

All costs in connection with the testing, including any necessary re-testing, shall be borne by the Supplier who shall provide the Purchaser with all the test facilities which the latter may require, free of charge. The Purchaser shall have the right to select the samples for test and shall also have the right to assure that the testing apparatus is duly calibrated and correct. Measuring apparatus for routine tests shall be calibrated at the expense of the Supplier at an approved laboratory and shall be approved by the Purchaser.

34.7 The supplier shall submit to the Purchaser five signed copies of the test certificates, giving the results of the tests as required. No materials shall be dispatched until the test certificates have been received by the Purchaser and the Supplier has been informed that they are acceptable.

The test certificates must show the actual values obtained from the tests, in the units used in this specification, and not merely confirm that the requirements have been met.

In the case of components for which specific type tests or routine tests are not given in this specification or in the quoted standards in Clause 2, of this specification, The Supplier shall include a list of the tests normally required for these components. All materials used in the Contract shall withstand and shall be certified to have satisfactorily passed such tests.

34.8 The Purchaser at his discretion may re-confirm the Routine Test Results, particularly no load losses, load losses and percentage impedance in his own laboratory or laboratory of his choice.

No inspection or lack of inspection or passing by the Purchaser's Representative of equipment or materials whether supplied by the Supplier or sub-supplier, shall relieve the Supplier from his liability to complete the contract works in accordance with the contract or exonerate him from any of his guarantees.

However in case of future discrepancy, if any, after acceptance of equipments, observed at any stage during guarantee period, the matter may be referred to Bureau of Energy Efficiency (B.E.E) for random testing of equipments supplied. In such cases the observation of B.E.E shall be binding to both parties.

35 GUARANTEE

The supplier shall guarantee the following:

- ◆ Quality and strength of materials used;
- ◆ Satisfactory operation during the guarantee period of **two years (24 months)** from the date of commissioning, or 30 months from the date of acceptance of the equipment by the Purchaser following delivery, whichever is earlier;
- ◆ Performance figures as supplied by the tendered in the schedule of guaranteed particulars;
- ◆ The offered surface treatment shall protect the treated metal from corrosion for a period of not less than five years from the date of delivery.

36 PACKING AND SHIPPING

36.1 Packing

The equipment and any supporting structures are to be transported adequately sealed against water ingress. All accessories and spares shall be packed and securely clamped against movement in robust, wooden, non returnable packing cases to ensure safe transit in rough terrain, cross country road conditions and in heavy rains from the manufacturer's works to the work sites/ earmarked destinations.

36.1.1 All accessories shall be carefully packed so that they are fully protected during transport and handling operations and in storage. Internal surfaces of loose accessories shall be sealed by means of gaskets and blanking off plates. All parts liable to rust shall receive an anti-rusting coat and shall be suitably protected. It shall be the responsibility of the Supplier to make good any damage caused through insufficient packing.

Each packing case shall be indelibly marked, on two adjacent sides and on the top, with the following:

- ◆ Individual serial number;
- ◆ Purchaser's name;
- ◆ Contract number;
- ◆ Destination;
- ◆ A colour coded marking to indicate destination;
- ◆ Supplier's name;
- ◆ Name and address of supplier's agent in Odisha;
- ◆ Description and numbers of contents;
- ◆ Manufacturer's name;
- ◆ Country of origin;
- ◆ Case measurements;
- ◆ Gross and net weight in kilograms: and
- ◆ All necessary slinging and stacking instructions.

36.1.2 Each crate or container shall be marked clearly on the outside of the case to show TOP and BOTTOM positions with appropriate signs to indicate where the mass is bearing and the correct positions for slings. All component parts which are separately transported shall have permanent identification marks to facilitate correct matching and assembly at site. Welded parts shall be marked before welding. Six copies of each packing list shall be sent to the Purchaser prior to dispatching the equipment.

36.2 Transportation

The Supplier shall be responsible for the transport of all plant and equipment supplied by them and for the transport of all goods to the various specified destinations including all road clearance, offloading, warehousing and insurance.

The Supplier shall inform himself fully as to all relevant transport facilities and requirements and loading gauges and ensure that the equipment as packed for transport conform to these limitations. The Supplier shall also be responsible for verifying the access facilities specified.

The Supplier shall be responsible for the transportation of all loads associated with the contract works and shall take all reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute loads so that the risk of damage shall be avoided. The Supplier shall immediately report to the Purchaser any claims made against the Supplier arising out of alleged damage to a highway or bridge.

All transport accessories, such as riding lugs, jacking pads or blanking off plates shall become the property of the Purchaser.

All items of equipment shall be securely clamped against movement to ensure safe transit from the manufacturer's facilities to the specified destinations.

The Supplier shall advise the storage requirements for any plant and equipment that may be delivered to the Purchaser's stores. The Supplier shall be required to accept responsibility for the advice given in so far as these arrangements may have a bearing on the behavior of the equipment in subsequent service.

37 Hazardous substances

The Supplier shall submit safety data sheets for all hazardous substances used with the equipment. The Supplier shall give an assurance that there are no other substances classified as hazardous in the equipment supplied. No oil shall be supplied or used at any stage of manufacture or test without a certificate acceptable to the Purchaser that it has a PCB content of less than 2 mg/ kg. The Supplier shall accept responsibility for the disposal of such hazardous substances, should any be found.

The Supplier shall also be responsible for any injuries resulting from hazardous substances due to non compliance with these requirements.

38 SUBMITTALS

38.1 Submittals required with the bid

The following shall be required with each copy of the bid :

- Completed technical data schedule;
- Descriptive literature giving full technical details of equipment offered;
- Outline dimensions drawing for each major component, general arrangement drawing showing component layout and general schematic diagram;
- Type test certificates (short circuit withstand test and impulse test) of the offered Transformers(3 Star Rated) conducted at CPRI/ or any NABL Accredited laboratory without which tender will be out rightly rejected.
- Sample routine test reports;

Detailed reference list of customers already using equipment offered along with performance certificates of such equipment, during the last 3 (three) years with particular emphasis on units of similar design and rating;

- Details of manufacturer's quality assurance standards and programme and ISO 9000 series or equivalent national certification;
- Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted;
- List of recommended spare parts and consumable items for five year of operation with prices and spare parts catalogue with price list for future requirements.

38.2 Submittals required after contract award

38.2.1 Programme

Five copies of the programme for production and testing

38.2.2 Technical Particulars

Within 30 days of contract award five bound folders with records of the technical particulars relating to the equipment. Each folder shall contain the following information:

- ◆ General description of the equipment and all components, including brochures;
- ◆ Technical data schedule, with approved revision;
- ◆ Calculations to substantiate choice of electrical, structural, mechanical component size/ ratings;
- ◆ Detailed dimension drawing for all components, general arrangement drawing showing detailed component layout and detailed schematic and wiring drawings for all components; along with core-coil assembly drawings, showing details of core such as grade, thickness, window height, leg centre, diameter, step width, step thickness and details of windings such as I.D., O.D , thickness , Conductor size, No. of turns, major and minor insulations, winding height etc.
- ◆ Detailed loading drawing to enable the Purchaser to design and construct foundations for the transformer;

- ◆ Statement drawing attention to all exposed points in the equipment at which copper / aluminum or aluminum alloy parts are in contact with or in close proximity to other metals and stating clearly what protection is employed to prevent corrosion at each point;
- ◆ Detailed installation and commissioning instructions;

At the final hold point for Purchaser approval prior to delivery of the equipment the following shall be submitted ;

- ◆ Inspection and test reports carried out in the manufacturer's works;
- ◆ Operation and maintenance instructions as well as trouble shooting charts.

38.2.3 Operation and Maintenance Instructions

A copy of installation and commissioning instructions and of the operation and maintenance instructions and trouble shooting charts shall be supplied with each transformer.

38.3 Drawings

38.3.1 Within 15 days of award of contract, the Supplier shall submit 4 complete sets of drawings as detailed below describing equipment in details. These drawings would be duly approved by the Purchaser after due securitization and approval will be communicated within 15 days of receipt of these drawings. After the drawings are approved and communicated to the supplier, he would supply ten complete sets of final drawings.

38.3.2 All detail drawings submitted for approval shall be to scale not less than 1:20. All important dimensions shall be given and the material of which each part is to be constructed shall be indicated on the drawings. All documents and drawings shall be submitted in accordance with the provisions of this specification and shall become the property of the Purchaser.

- 38.3.3 All drawings and calculations, submitted to the Purchaser, shall be on international standard size paper, either A0, A1, A2, A3 or A4. All such drawings and calculations shall be provided with a contract title block, which shall include the name of the Purchaser and shall be assigned an unique project drawing number; the contract title block and project numbering system shall be agreed with the Purchaser.
- 38.3.4 Script sizes and thickness of scripts and lines be selected so that if reduced by two stages the alphanumeric characters and lines are still perfectly legible so as to facilitate microfilming.
- 38.3.5 For presentation of design drawings and circuit documents IEC Publication 617 or equivalent standards for graphical symbols are to be followed. The drawing approval will be communicated within 15 days from the receipt of drawings from the Bidder and for any delay in furnishing the drawings, if delivery period will be delayed, no extension of delivery time will be granted due to this.
- 38.3.6 The following drawings for each item are to be submitted as part of this Contract.
- a. Out line dimensional drawings of Transformers(3 Star Rated) and accessories
 - b. Assembly drawings and weights of main component parts.
 - c. Transportation drawings showing dimensions and weights of each package.
 - d. Drawings giving the weights for foundations each .
 - e. Drawing showing details such as clamping arrangements of core, core assembly showing oil duct section of HT and LT coils with conductor size showing insulation arrangements of windings and their reinforcement to withstand short circuit stresses, in side tank dimensions showing core assembly. Details of core and windings, as enumerated at Cl. No. 33.2.2 of this part of Specification shall be indicated in the above drawings.
 - f. Schematic diagram showing the flow of oil in the cooling system as well as each limb and winding. Longitudinal and cross- sectional views showing the duct sizes, cooling pipe etc. for transformer/ heat exchanger, drawn to scale shall be furnished.
 - g. Large Scale drawings of high and low tension winding of the Transformers(3 Star Rated) showing the nature and arrangements of insulation and terminal connection.
 - h. Name plate drawing showing details as per Cl. 23 of Part-2 of Technical Specification.
 - i. Test Reports

39 FASTENERS

- 39.1 All bolts, studs, screw threads, pipe threads, bolt heads and nuts shall comply with the appropriate Indian Standards for metric threads, or the technical equivalent.

- 39.2 Bolts or studs shall not be less than 6 mm in diameter except when used for small wiring terminals. All nuts and pins shall be adequately locked.
- 39.3 Wherever possible, bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.
- 39.4 All ferrous bolts, nuts and washers placed in outdoor positions shall be of anti-corrosive materials except high tensile steel bolts and spring washers which shall be electro-galvanized to service condition stated elsewhere in the Specification. Appropriate precautions shall be taken to prevent electrolytic action between dissimilar metals where bolts are used on external horizontal surfaces and where water can collect, methods of preventing the ingress of moisture to the threads shall be provided. Each bolt or stud shall project at least one thread but not more than three threads through the nut, except when otherwise approved for terminal board studs or relay stems. If bolts nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided. The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members. Taper washers shall be provided where necessary. Protective washers of suitable material shall be provided front and back on the securing screws.

40. LABELS

- 40.1 All apparatus shall be clearly labelled indicating, where necessary, its purpose and service positions. The material of all labels and plates, their dimensions, legend and the method of printing shall be subject to approval of the Purchaser. The surfaces of all labels and plates shall have a mat or satin finish to avoid dazzle from reflected light. Colours shall be permanent and free from fading. Labels mounted on black surfaces shall have white lettering. Danger plates shall have white lettering on a red background. All labels and plates for outdoor use shall be of in-corrodible material. Where the use of enameled iron plates is approved, the whole surface including the back and edges, shall be properly covered and resistant to corrosion. They shall be engraved in English. Name plates shall be white with black engraved lettering and shall carry all the applicable information specified in the applicable items of the Standards. No scratching, corrections or changes will be allowed on name plates.
- 40.2 Name plates shall be provided of white background with black engraved lettering carrying all the applicable information specified in the standards and other details as required by the Purchaser. The name plate inscription and the size and lettering shall be submitted to the Purchaser for approval.

General Manager (P&C)
NESCO, Balasore, ODISHA

PROFORMA FOR STAGE INSPECTION OF DISTRIBUTION TRANSFORMERS

Sl No	Particulars	As Offered	As Observed	Deviati Rema
1	Name of the Manufacture & Address			
2	Service			
3	Type			
4	Rating			
	Rated output			
	Rated voltage HV			
	Rated voltage LV			
	No load Voltage ratio			
	No of Phase			
	Frequency			
5	Tank			
	Length			
	Breadth			
	Height			
a.	Sheet Thickness			
	Side			
	Top			
	Bottom			
	Size & no. of Stiffenner			
6	Core Details			
	No of Steps			
	Dimension of steps			
	in mm	Width(L) Thickness(K)	Width(L) Thickness(K)	
	Step No.			
	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	Core dia x window x Limb centre			
	Cross section area (gross)			

	Cross section area (Net)			
	Grade of lamination			
	Thickness of Lamination			
	Weight of Lamination			
	weight of Limb			
	weight of Yoke			
	Total Wt . Of Core			
7	HV Coil Construction			
	Type of winding			
	Size of Bare conductor			
	Size of covered conductor			
	Cross sectional area of conductor			
	Conductor Covering			
	Current density			
	No. of Coils/Phase			
	Internal Diameter			
	External Diameter			
	No of Turns/Phase			
	Axial length of each coil			
	Weight of insulated Cond. in one lag			
8	LV Coil Construction			
	Type of winding			
	Size of Bare conductor			
	Size of covered conductor			
	Cross sectional area of conductor			
	Conductor Covering			
	Current density			
	No. of Coils/Phase			
	Internal Diameter			
	External Diameter			
	No of Turns/Phase			
	Axial length including packing			
	Inter layer insulation			
	Weight of insulated Cond. in one lag			
9	Insulation Details			
	HV to Yoke			
	LV to Yoke			
	Inter Coil spacers between HV Section			
	Channel Separator			
	Bottom Foot Channel Insulation			
	Inter Phase Barrier			
	Cylinder between Core to LV			
	Cylinder between LV to HV			

	Oil duct between LV to Cylinder			
	Oil duct between Cylinder to HV			
	Type of Blocks between HV Sections			
	No. of Blocks/Circle			
10	Details of Internal Clearance			
	Internal clearance between inner walls of the Tank and outside surface of HV			
	a) on Length Side			
	b) on Breadth Side			
	Radial Clearance between LV and HV			
	Phase to Phase Clearance between HV limb			
	Clearance between Top of Yoke & inside of Tank Cover			
	Radial Clearance between Core to LV			
	Horizontal spacer between HV Sections			
	End Clearance between HV to Yoke			
	End Clearance between LV to Yoke			
11	Particulars of HV Bushing Particulars of LV Bushing			
	Name of the Manufacture & Address			
	Type/KV/A/ISS			
	Creepage Distance			
12	Transformer Oil			
	Make			
	Electrical Characteristics			
	Qty. Of Oil for first filling			
	Qty of Oil proposed be soaked by Insulation			
	Facilities available with the Bidder to carry out acceptance test on Oil for BDV, ten Delta, Resistivity,Acidity as per IS-335			
13	Weights			
	Weight of core			
	Weight of Aluminium			
	Weight of Complete active part			
	Weight of Tank and fittings			
	Weight of Oil			
	Complete Weight of Transformer			
14	Overall Dimension of Transformer			
	Length			
	Breadth			
	Height			
15	Material And Size of Core clamping Device			

	Core Channels			
	Tie Rod			
	Core Studs			
	Bottom Foot Support			
16	Terminal arrangement			
	LV (Size & Material)			
	HV (Size & Material)			
17	Size of Conservator			
	Dia.			
	Length			
	Volume			
	Whether one end is with bolted cover or not			
18	Core earthing Materials			
19	Size and material Tapping leads			
	Delta and Line leads			
20	Location of Thermometer pocket			
	Length of Thermometer pocket			
	Pipe diameter of thermometer pocket			
21	Radiators Details			
	Type			
	No of radiators/Trf.			
	Width of each fin			
	No. of Fins per radiator			
	Centre distance of header pipe			
	Diameter of Header pipe			

Inspecting Officer of Company
Date of Inspection

Firm Representative

Tender Notice NO. NESCO/DEPOSIT/21 Date: 23.08.13

GUARANTEED TECHNICAL PARTICULARS FOR 63 KVA ,100 KVA 11/0.4KV, 3-PHASE STAR RATED DISTRIBUTION TRANSFORMERS

(To be furnished by the
Manufacturer)

Sl. No	Description	As Specified		Bidder's Offer transformer wise
		63 KVA	100 KVA	
	Capacity of Transformer	63 KVA	100 KVA	
1	Make			
2	Name of the Manufacturer			
3	Place of Manufacture			
3 (a)	Type of B.E.E Specified Star Level to be fixed near Name Plate.	3 Star	3 Star	
4	Voltage Ratio	11000/433V	11000/433V	
5	Rating in KVA	63	100	
6	Core Material used and Grade:	CRGO and M3 or Better	CRGO and M3 or Better	
	a) Flux density	1.5 Tesla (Max.)	1.5 Tesla (Max.)	
	b) Over fluxing without saturation (Curve to be furnished by the Manufacturer in support of his claim)			
7	Maximum temperature rise of:			
	a) windings by resistance method	40°C over an ambient of 50°C		
	b) Oil by thermometer	35°C over an ambient of 50°C		
8	Magnetizing (no-load) current at:			
	a) 90% Voltage			

	b) 100% Voltage	3% (Max.)	3% (Max.)	
	c) 112.5% Voltage	6% (Max.)	6% (Max.)	
9	Core loss in watts:			
	a) Normal voltage			
	b) Maximum voltage			
10	Resistance of windings at 20°C (with 5% tolerance)			
	a) HV Winding (ohms)			
	b) LV Winding (ohms)			
11	Full load losses (watts) at 75°C			
12	Total losses at 100% load at 75°C	1250W(Max.)	1800W(Max.)	
13	Total losses at 50% load at 75°C	380W(Max.)	520W(Max.)	
14	Current density used for : (Amp./ Sq mm)			
	a) HV Winding	1.6(Max.)	1.6(Max.)	
	b) LV Winding	1.6(Max.)	1.6(Max.)	
15	Clearances : (mm)			
	a) Core and LV			
	b) LV and HV			
	c) HV Phase to Phase			
	d) End insulation clearance to earth			
	e) Any point of winding to tank			
16	Efficiency at 75°C:			
	a) Unity P. F. and			
	b) 0.8 P.F			
	1) 125% load			

	2) 100% load			
	3) 75% load			
	4) 50% load			
	5) 25% load			
17	Regulation at:			
	a) Unity P.F.			
	b) 0.8 P.F. at 75 ⁰ C			
18	% Impedance at 75 ⁰ C	4.5+10%(No negative tolerance)	4.5+10%(No negative tolerance)	
19	Separate Source Voltage withstand Test:			
	(I) HV 28kV/50 HZ for 1 minute	yes		
	(ii) LV 3kV/50 HZ for 1 minute	yes		
20	Induced Over Voltage withstand Test (Double Voltage and Double frequency for 1 minute)	22KV for HV winding by applying 0.866 KV on LV at 100 Hz for the duration of 1 minute.		
21	Impulse test	HV-95KV peak, LV- NA		
22	Mass of : (kg)			
	a) Core lamination (minimum)			
	b) Windings (minimum)			
	c) Tank and fittings			
	d) Oil			
	e) Oil quantity (minimum) (litre)			
	f) Total weight			
23	Oil Data:			
	1. Quantity for first filling (minimum) (litre)			

	2. Grade of oil used			
	3. Maker's name			
	4. BDV at the time of filling (kV)			
24	Transformer:			
	1) Overall length x breadth x height (mmx mmx mm)			
	2) Tank length x breadth x height			
	3) Thickness of plates for			
	a) Side plate (min)	3.15mm		
	b) Top and bottom plate (min)	5 mm		
	4) Conservator Dimensions.			
25	Radiation			
	1) Heat dissipation by tank walls excluding top and bottom			
	2) Heat dissipation by cooling tube.			
	3) Diameter and thickness of cooling tube.			
	4) Whether calculation sheet for selecting cooling area to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise is enclosed.			
26	Inter layer insulation provided in design for:			
	1) Top and bottom layer	Epoxy Dotted Kraft Paper		
	2) In between all layer	Epoxy Dotted Kraft Paper		

	3) Details of end insulation.	Press Board		
	4) Whether wedges are provided at 50% turns of the HV coil			
27	Insulation materials provided			
	a) For conductors			
	(1) HV	DPC		
	(2) LV	DPC		
	b) For Core	Carlite		
28	Material and Size of the wire used.			
	1) HV Dia			
	2) LV			
	a) Strip size			
	b) No. of Conductors in parallel			
	c) Total area of cross section (sq mm)			
29	Whether the name plate gives all particulars as required in Tender	yes		
30	Particulars of bushings HV/LV			
	1) Maker's name			
	2) Type IS-3347/ IS-2099/ IS- 7421			
	3) Rating as per IS			
	4) Dry power frequency voltage withstand test	HV-28KV, LV-3KV		
	5) Wet power frequency voltage withstand test	HV-28KV, LV-3KV		

Note:

The following shall be specifically confirmed:

- 1) Whether the offer conforms to the limits of impedance mentioned in the specification.
- 2) Whether the offer conforms to the limits of temperature rise mentioned in the specification.
- 3) Whether the transformer offered is already type tested for the design & test reports enclosed
- 4) Whether the losses of the Transformers (Star Rated) offered are within the limits specified.

Signature of the Bidder with Seal

