SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF 11kV / 415 V, 1600kVA TRANSFORMER

GENERAL SCOPE

Supply, installation, testing and commissioning of 1600 KVA, 11kV / 433V, 3Phase, 50Hz, outdoor type copper wound, plinth/floor mounted, Delta / Star connected (Dyn11), ONAN type of cooling, core type distribution transformer with OFF CIRCUIT tap changing switch with locking arrangement which is operated externally with permissible voltage variation of +5% to -10% @ 2.5% per tap and suitable for operation in an ambient temperature up to 50 °C.

The transformers shall be completely assembled and tests at the factory in accordance with relevant IS shall be conducted on each of the transformer.

The transformer shall conform to the various requirements as furnished in the following list of annexures. Necessary test certificates are to be furnished for confirming the technical requirements. Technical data shall be duly filled in the format “Guaranteed technical particulars”.

The makes of Transformer shall be one among the following only

Schneider, PETE-Hammond, Voltamp, Bharat Bijlee, Indo Tech, ECE Industries Ltd, Indian Transformers (ITL), Essenar, KEL, Kavika

List of Annexures:

ANNEXURE – I : DETAILED SPECIFICATIONS/GUIDELINES
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ANNEXURE I
DETAILED SPECIFICATIONS / GUIDE LINES

1. SCOPE

This specification is to cover the requirement of design, manufacturing, supply, installation, testing and commissioning of transformer with fittings and accessories for trouble free operation.

2. STANDARDS

The transformer and its accessories specified herein shall confirm to the relevant Indian standards with latest amendments.

IS: 1180 Part-I Outdoor Type Oil Immersed Distribution Transformers upto and including 2500kVA, 33kV Transformer.
IS: 3024 Grain oriented electrical steel sheets and strips
IS: 5 Colour for ready mixed paints
IS: 191 Specification for Copper
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 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 Guide for loading of oil immersed Transformers
IS: 10028 Code of practice for selection, installation and maintenance of transformers, Part I. II and III
3. DESIGN AND CONSTRUCTION

3.1 General Specification

The transformer shall conform to the IS: 1180 part I with latest amendments in all respects like insulation levels, temperature rise, impedance voltage and losses in general shall meet as specified in various annexures attached herewith. Temperature rise shall not exceed 55° over ambient in the winding & 50° C in oil as per IS 355. The transformer shall be designed for continuous operation and to operate satisfactorily in parallel with similar units.

The exterior surfaces of transformer shall be given a primary coat of zinc chromate-cum-red oxide anti corrosive paint and two finishing coats of durable weather/oil resisting enamel paint of shade no.632 conforming to IS: 5. However powder coating after seven tank process treatment for all the metal surfaces is preferred.

3.2 Core

1. Transformer core shall be made with low loss, non-ageing, high permeability prime grade, CRGO silicon steel only with M4 Grade or better, perfectly insulated and clamped to minimize noise and vibrations. The maximum flux density in any part of the cores and yoke at normal voltage and frequency shall not be more than 1.5 Tesla.

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

3. 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.

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

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

6. The core clamping structure shall be designed to minimize eddy current loss. The framework and clamping arrangements shall be securely earthed and rigidly clamped to ensure adequate mechanical strength.

7. 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.

8. 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.

9. 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.

10. Documents like invoice copy of the core purchased by the vendor from the above manufacturers or from their accredited marketing organisations, Mill’s test certificate and other relevant documents to substantiate the above points pertaining to the transformer core are to be furnished to the CLIP members during inspection of the transformer.

3.3 Winding

1. Coils shall be made of continuous smooth high grade 99.9% pure electrolytic copper conductor, shaped and braced to provide for expansion and contraction due to temperature changes.
2. Materials used in the insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil and shall not soften or otherwise affected under the operating conditions.
3. The insulation of winding shall be designed to withstand voltage stress arising from surge. The HV & LV winding should be able withstand thermal and mechanical stress in the event of short circuit.
4. 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.

3.4 Transformer Oil

1. Insulating oil for first filling shall be supplied with the transformers at no extra cost along with oil test certificates. Adequate extra oil required for top up during commissioning shall also be arranged by the vendor.
2. Transformer oil shall be as per IS-335:1993. It shall be “PCB free and polycyclic Aromatic Hydrocarbons free mineral oil”.
3. Material Safety Data Sheets (MSDS) and other relevant documents pertaining to the transformer oil shall be furnished to the CLIP members during inspection.
3.5 OCTC

1. The transformer shall be provided with Off Circuit Tap Changer (OCTC) on HV side, immersed in oil, which is also suitably insulated.
2. The OCTC shall have 7 distinct tap positions including ‘0’ position with voltage variations from +5% to (-)10% in steps of 2.5% for variation of HV with clear markings of the tap position embossed on the tap changer switch.
3. The OCTC shall have locking provision so as to avoid inadvertent operation.
4. OCTC arrangement shall be either by means of links or by an externally operated switch with mechanical locking device and a position indicator. Arrangement for pad locking shall be provided.

3.6 Transformer Tank

1. The Transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and the cover shall be of welded construction.
2. Since the transformer is meant for outdoor duty, necessary care shall be taken for surface treatment and painting as per any of the following methods:
   a. The exterior surfaces shall be grit blasted and shall be finished with powder coating of enamel light grey paint of shade no: 631, IS: 5. If the process requires necessary primer shall also be applied prior to painting. The final finish shall be durable and weather / oil resistant.
   b. The exterior surfaces shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather-resistant nature, preferably of distinct colour from the prime and finish coats. The final coat shall be of a flossy, oil and weather resisting non-fading paint of specified shade. (Enamel Light Grey of Shade No 631,IS:5 )
3. The interior of the tank shall be cleaned by shot blasting and painting with two coats of heat resistant and oil insoluble paint.
4. Steel bolts and nuts exposed to the atmosphere shall be galvanised. The tank cover shall be suitably sloped so that it does not retain rain water. The material used for gaskets shall be cork neoprene or approved equivalent. All bolts / nuts / washers exposed to atmosphere shall be as follows:
   a. Size 12mm or below : Stainless Steel
   b. Above 12mm: Steel with suitable finish like electrogalvanised with passivation or hot dip galvanized.
5. Gaskets wherever used shall conform to Type III as per IS 1149/ Type C as per IS 4253 (Part 2).
6. Plain transformer tank shall be capable of withstanding a pressure of 80kPa and a vacuum of 500mm of mercury as per IS 1180(Part I):2014.

3.7 Conservator Tank

1. 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.
2. The conservator tank shall be bolted into position so that it can be removed for cleaning purposes.
3. Magnetic Oil level gauge shall be mounted on the conservator tank with low level electrically insulated alarm contact.
4. The silica gel breather shall be so positioned that it can be seen clearly by an operator standing on the ground.

3.8 Marshalling Box

1. Sheet steel, weather, vermin and dust proof marshalling box of 2mm thick 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.
2. Marshalling box shall have the following minimum accessories

   Top oil temperature indicator – 150 mm with alarm and trip contact ... 1 No.
   Winding temperature indicator with alarm & trip contacts ... 1 No.
   Terminal block ... 1 No.
   Sight glass, door and locking arrangements ... 1 Set
3. Interconnecting cables between the marshalling box and remote panels shall be in the scope of the Department.
4. The marshalling box shall be tank mounted, outdoor, weather-proof, sheet-steel (2 mm thick) enclosed, with hinged door having padlocking facility and painted with the same colour as the transformer (Enamel Light Grey of Shade No 631,IS:5).
5. All doors, covers and plates shall be fitted with neoprene gaskets. The door shall have glazed cut out to monitor the gauge readings from the outside.
6. Top surface of the box shall be sloped and the bottom shall be at least 600 mm from floor level and provided with gland plate and cable glands as required.
7. Wiring inside the marshalling box shall be with stranded, copper conductors of sizes not smaller than 1.5 sq.mm for control circuits and not less than 2.5 sq.mm for power circuits.

3.9 List of fittings and accessories

The list of fittings and accessories are to be fitted in Transformers are mentioned below,

1. Lifting Lugs : Necessary lifting lugs shall be provided to lift the transformer without disturbing the connection.
2. Swivel type rollers: 4 Nos, bi-directional rollers shall be fitted on cross channel at the bottom of the transformer so as to facilitate the movement of transformer in both the directions.

3. Oil-level indicator with minimum marking.

4. Air release valve: An air release valve shall be provided on the top of the tank cover to facilitate the release of the entrapped air while filling of oil.

5. Breather: Sufficient capacity of indicating de-hydrating silica gel breather shall be provided.

6. Drain cum oil filter valve: At the bottom of the transformer, drain cum oil filter valve with plug shall be provided.

7. Radiator cutoff valves for all radiators.

8. Earthing terminals: Two separate earthing terminals shall be provided on both sides of the tank for earthing.

9. Diagram and rating plate: The transformer shall be fitted with a diagram and rating plate indicating the details of the transformer connection diagram, vector group etc.

10. Terminal marking plate.

11. Stem type dial thermometer of range 0 – 150 deg.c.

12. Explosion Vent: The transformer shall be fitted with an explosion vent of suitable size.

13. The transformer shall be provided with first filling of oil. The transformer oil shall conform to IS 335/1983 with latest amendment.

14. Top Filter Valve with plug.

15. Buchholz relay with two sets of contacts for alarm and trip condition. The relay operation shall be suitable for 24V DC.

16. Magnetic oil level gauge

17. Jacking lugs

18. Inspection cover
19. HV cable box and terminals shall be suitable for providing end termination of 1 runs of 3C x 120 sq.mm heat shrinkable Raychem kit.

20. LV terminal box suitable for Bus duct arrangement with neutral brought out.
ANNEXURE II

LIST OF TESTS TO BE CONDUCTED AT FACTORY/WORKS OF SUPPLIER

The following tests shall be conducted as per IS - 1180 Part-1 at the manufacturer's premises / factory in the presence of Department Engineers before dispatching and the tests certificates shall be furnished.

1. Measurement of winding resistance
2. Measurement of Voltage Ratio and check of voltage vector relationship
3. Measurement of Impedance voltage / short circuit impedance
4. Measurement of Load losses
5. Measurement of No load losses and no load current
6. Measurement of Insulation resistance
7. Measurement of Induced over voltage withstand test
8. Measurement of Separate source voltage withstand test
9. Magnetic balance test
10. Pressure Test
11. Oil leakage Test
12. Temperature rise test

NOTE:

1. The supplier shall give advance intimation about the readiness of the transformers offered for inspection to the Department.
2. The tests at factory will be inspected by our Department's CLIP inspection team (generally consisting of 2 Engineers).
3. All necessary instruments, meters, etc, tools and plants required for conducting the tests shall be arranged by the supplier. The meters shall have valid calibrated dates.
4. The test certificates shall be furnished including graph/plot etc, in respect of temperature rise test, shall be furnished in triplicate to the inspection team.
5. Factory in house test certificate for the transformers shall also be furnished.
6. Batch test certificate for the raw material has to be furnished during inspection.
ANNEXURE III

INSTALLATION, TESTING AND COMMISSIONING OF TRANSFORMER

i) SITE INSPECTION: On receipt of the transformer, the same shall be inspected at site to ascertain that there is no damage to any of the components and accessories of the transformer. Installation and maintenance manual shall be supplied by the manufacturer.

ii) INSTALLATION: The transformer shall be integrated with all its accessories and installed as per the guidelines of manufacturer's installation manual. The installation includes first filling of oil by the manufacturer. The installation shall also conform to the relevant IS and IE rules. Civil works do not form part of the scope of installation. The plinth construction and embedment of channels will be carried out by Department. Providing neutral and body earthing system is in the scope of Department. The supplier shall ensure that the earth strips are properly connected to the respective terminals. However the details / drawing required for embedment of channels / rails in plinth or foundation shall be furnished during detailed Engineering by the supplier. Necessary locking arrangement for wheels shall be ensured. The breather shall be filled with oil and silica gel of 6mm mesh size. Necessary provision has to be available on LV side for executing the bus duct installation and mating with the transformer.

iii) TESTING AND COMMISSIONING: The following tests shall be conducted on the transformer prior to its commissioning.

1. Insulation resistance of winding between individual phases and earth on both HV and LV sides and also between HV and LV windings.
2. Voltage ratio test at all tap positions
3. Polarity test
4. Magnetic balance test
5. Operation of buchholz relay
6. Checking control wiring including simulation of actuation of contacts up to marshalling box.
7. Di-electric strength of transformer oil

After commissioning of the transformer, the LV side voltage shall be measured at different tap positions. The transformer shall be kept energised on No load for 24 hours and shall be ascertained that there is no undue temperature rise or no abnormality noticed before loading the transformer.

Note: Providing necessary technicians support / unskilled manpower for carrying out above works at site shall be the responsibility of the supplier. Material handling equipment support will be arranged by Department only based on then availability (at free of cost).
ANNEXURE IV

GUARANTEE AND TEST CERTIFICATES OF TRANSFORMER

The transformers shall be guaranteed for a period of minimum 12 months from the date of commissioning or 18 months from the date of supply whichever is earlier. The supplier shall repair / replace the damaged equipment without any extra cost during the guarantee period.

The test certificates for the following shall be submitted in Hard copies along with the supply

1. Certificates of Tests carried out under Annexure-II at Factory before dispatch of the transformers.
2. Type test certificates if the type test is carried out at Factory or Type test certificates of similar transformers.
3. Factory in house test certificate for the test carried out during assembling of core, winding, vacuum impregnation etc.
4. Test Certificates for all accessories and fittings fitted along with the transformer and other brought-out items.

In addition to this, Operation and Maintenance manual of Transformer shall be submitted in Triplicate copies.
# ANNEXURE V
**GUARANTEED TECHNICAL PARTICULARS TO BE FURNISHED BY THE TENDERER**

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Technical Particulars</th>
<th>As per Indent</th>
<th>To be furnished by the party</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Name of Manufacturer (List of Makes given under General Scope)</td>
<td>To be mentioned</td>
<td></td>
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<tr>
<td>2</td>
<td>Service</td>
<td>Outdoor type with off Circuit tap changer</td>
<td></td>
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<td>3</td>
<td>Rated KVA</td>
<td>1600 KVA</td>
<td></td>
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<tr>
<td>4</td>
<td>Rated voltage of HV</td>
<td>11 KV</td>
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<td>5</td>
<td>Rated voltage of LV</td>
<td>433 Volts</td>
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<td>6</td>
<td>Rated Frequency</td>
<td>50 HZ</td>
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<td>7</td>
<td>No. of Phases</td>
<td>Three</td>
<td></td>
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<td>8</td>
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<td>50 deg. C</td>
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<td>8</td>
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<td>50 deg. C</td>
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<td>9</td>
<td>Temp. rise by resistance of windings</td>
<td>55 deg. C</td>
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<td>10</td>
<td>Type of cooling</td>
<td>ONAN</td>
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<td>11</td>
<td>Type of connection</td>
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<td></td>
<td>i. High voltage side</td>
<td>Delta</td>
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<td>ii. Low voltage side</td>
<td>Star</td>
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<td>iii. Vector group reference</td>
<td>Dyn11</td>
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<td>Tap changer type</td>
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<td>Tap settings at HV side apart from normal tap</td>
<td>+5% to -10% @ 2.5% per tap</td>
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<td>% Impedance at 75°C, rated current &amp; Frequency % (subject to IS tol)</td>
<td>6.25 %</td>
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<td>Total losses @ 50% Load at rated voltage &amp; frequency kW (Max)</td>
<td>4.5kW</td>
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<td>16</td>
<td>Total losses @ 100% Load at rated voltage &amp; frequency kW (Max)</td>
<td>13.5kW</td>
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<td>17</td>
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<td>Shall be furnished</td>
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<td>ii. 75% of full load</td>
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<td>39</td>
<td>Quantity of oil required for first filling</td>
<td>To be furnished</td>
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<td>Over all dimensions</td>
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<td></td>
<td>i. Length</td>
<td>To be furnished</td>
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<td>ii. Breadth</td>
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<td></td>
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<td>i. At factory - As per annexure II</td>
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<td>As mentioned under Annexure-II</td>
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<tr>
<td>43</td>
<td>Guarantee Period</td>
<td>12 months or after satisfactory installation and commissioning or 18 months from the date of supply whichever is earlier.</td>
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<td>44</td>
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</table>

**Note:** Acceptance to all the above particulars shall be conveyed by the tenderer. Deviations if any shall be clearly specified and suitably justified in case they are superior to our requirements.
ANNEXURE VI

SPECIAL TERMS AND CONDITIONS

01. The tenderer should be in possession of type and routine test certificate as per IS issued by CPRI or any other testing laboratories and shall enclose with the quotation.

02. The tenderer shall provide all the technical information as called for in the Annexure and also provide all the technical literatures related to their products and all other instructions to be followed for installation along with offer as per rules and regulation.

03. The tenderer shall furnish the list of customers with capacities of transformers supplied and performance certificates who are using their transformers of similar rating along with their offer.

04. All test facilities required shall be provided for the tests prescribed in the schedule by the party without any additional cost at their factory as well as at site for commissioning of transformers. The tests shall be carried out in the presence of our CLIP inspection team before despatch from their works and during commissioning of the same.

05. On receipt of Purchase Order, the agency shall be submitting the following drawings for approval before manufacturing:

   i) General arrangement drawings
   ii) Foundation drawings
   iii) Terminal boxes of HT / LT side with details of HT and LT bushings/insulators
   iv) Marshalling box drawings
   v) Name plate details etc.

06. The scope of work shall include all transportation of the transformers and their accessories to the site of work with utmost care in handling. All loading and unloading arrangements shall form part of the part of the scope and all required man power shall also be provided by the agency for unloading / shifting of the transformers over the plinth, assembling all accessories and installing in position as required. Material handling equipment like hydra / fork lift shall be spared by Dept, based on then availability at free of cost. However mobilising necessary man power required for the above works shall be the responsibility of the supplier.

07. The supplier shall be responsible for handling and ensuring safe custody of the transformers and accessories from the time of supply at site till installation, testing and commissioning and handing over the same to the department on satisfactory completion of work.

08. The supplier shall co-ordinate with other agencies during the course of the installation, testing and commissioning of the transformers and accessories as applicable and to ensure the safe commissioning of transformers.

09. The installation work shall be started and completed immediately once the readiness of site is intimated to the agency without any delay.
10. Details required for installation viz., providing MS channels and locking the transformers shall be furnished. The channels will be embedded over the plinth by Department. Proper installation and positioning of transformers over the plinth/floor. As per manufacturer’s guidelines shall be the scope of the supplier.

11. The works of installation, Testing and commissioning of transformers shall be done by employing qualified competent engineers / supervisors and all instructions of the department shall be strictly followed for the completion of work with good workmanship as required and as per the IE rules and regulations and other mandatory requirements.

12. The transformer oil shall be got tested as per IS – 335 from authorized agencies before commissioning of the transformers and the required di-electric strength of the oil shall be met with and certificate to this effect shall be provided to the department.

13. Any mandatory / statutory requirement specified by the inspection authority (CEA) shall be carried out which is also a part of work.

14. The tenderer shall provide three complete sets of operation and maintenance manuals to the department for the operation and maintenance purpose of the department.

15. The department shall reserve right to accept / reject any part of work, which is not acceptable as healthy engineering practice of carrying out such work as the case may be. In case of any failure to carry out the scope of work in time as per the instruction of department the work shall be carried out / got done by the department at the cost and risk of the agency and the entire amount with supervision charges shall be recovered from the agency.

16. Special terms and conditions in this Annexure shall also form part of the work.

17. The transformers & HT / LT switch gears are proposed to be installed by different agencies in New Substation. Hence the earthing of transformers, cable end terminations and Bus trunking from LT side of transformers to LT panels shall be carried out by other agencies.

18. The terms of payment may be quoted with possible split up details as under:
   i) Supply of transformers at site.
   ii) Testing at factory/works of the manufacturer with further split up for special test if any.
   iii) Installation of transformers as per the specification at site
   iv) Testing and commissioning and satisfactory completion of entire scope of work at site.

19. Bank guarantee to the tune of 10% of the transformers value shall be produced in the required format before releasing the payment for supply of transformers. The bank guarantee will be released only after the lapse of guarantee period, provided that performance of transformer during guarantee period is satisfactory.
# COMPLIANCE CHECKLIST

<table>
<thead>
<tr>
<th>S.NO</th>
<th>General Conditions and Technical Specification</th>
<th>COMPLIANCE (YES/NO)</th>
<th>If not complied, State the deviation</th>
<th>Justification for Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Annexure I-Detailed Specification / Guidelines, Signed and Enclosed</td>
<td></td>
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<tr>
<td>2.</td>
<td>Annexure II-List of Tests to be conducted at Factory / works, Signed and Enclosed</td>
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<td>3.</td>
<td>Annexure III-Installation, Testing and Commissioning, Signed &amp; Enclosed</td>
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<td>4.</td>
<td>Annexure IV-Guarantee and Test certificates, Signed &amp; Enclosed</td>
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<td>5.</td>
<td>Annexure V-Guaranteed Technical Particulars, Signed &amp; Enclosed</td>
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<td>6.</td>
<td>Annexure VI-Special Terms and Conditions, Signed &amp; Enclosed</td>
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<td>7.</td>
<td>Unpriced Price Bid Format</td>
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<td>8.</td>
<td>In case of authorised vendor, undertaking submitted</td>
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