BSES

TECHNICAL SPECIFICATIONS

FOR

THREE PHASE OIL TYPE DISTRIBUTION TRANSFORMER

25 KVA TO 100 KVA

Specification no – BSES-TS-62-TPDT-R0

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Record of Revision

S.No.	Revision No	Item/Clause No.	Nature of change	Approved by

1.0 SCOPE

1.1 This specification covers design, engineering, manufacturing, assembly, testing at manufacture's works, packing, transportation and delivery to store and submission of complete documentation for three phase conventional oil filled distribution transformer of rating 25 to 100KVA rating.

1.2 The transformer shall be complete with all components and accessories, which are necessary or usual for their efficient performance and trouble free operation under the various operating and atmospheric conditions specified in Annexure I : Data sheet of client requirement.

1.3 Such of the parts that may have not been specifically included, but otherwise form part of the transformer as per standard trade and/or professional practice and/or are necessary for proper operation of transformer, will be deemed to be also included in this specification. The successful bidder shall not be eligible for any extra charges for such accessories etc. notwithstanding the fact that at the time of an initial offer bidder had segregated such items and quoted for them separately.

2. CODES AND STANDARDS

2.1 All equipment and material shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards, IEC standard and CBIP manuals enlisted in the Appendix-A, except where modified and / or supplemented by this specification.

2.2 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case copies of English version of the standard adopted shall be submitted by the vendor with the offer.

2.3 The electrical installation shall meet the requirement of Indian Electricity Rules as amended up to date, relevant IS code of practice and Indian electricity act. In addition other rules & regulations applicable to the work shall be followed. In case of any discrepancy, the most stringent & restrictive one shall be binding.

2.4 The equipment offered shall in general comply with the latest issues including amendments of the standards enlisted in Appendix-A but not restricted to it.

2.5 Vendor shall possess valid BIS Certification.

3. DESIGN

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. The features and construction

details of each transformer shall be in accordance with the requirements stated herein under.

3.1 APPLICATION

The transformers are intended to be used for normal operation in Delhi Distribution system for making available three phase and/or single phase supply to the consumers at voltage as indicated in Annexure-I.

3.2 RATINGS

The transformer shall be of rating as indicated in Annexure-I.

3.3 NORMAL SITE CONDITIONS

The distribution transformers to be supplied against this Specification shall be suitable for satisfactory continuous operation under the conditions as per Annexure-I: Data sheet of client requirement.

3.4 TRANSFORMER TANK

3.4.1 The Transformer tank shall be of plain rectangular / octagonal and made of good quality sheet steel of adequate thickness suitably stiffed to provide sturdy and robust construction to withstand extreme pressure conditions. The tank shall be capable of withstanding pressure as per values specified in IS: 1180 (Part - I) in Appendix-A for non-sealed type Transformers.

3.4.2 The tank cover shall have plasticized surface at the top to guard against bird age faults. Alternatively, suitable insulating shrouds shall be provided on the bushing terminals.

3.4.3 Steel surface of the tank shall be prepared by sand/shot blast or chemical cleaning including phosphating as per IS: 3618

3.4.4 Heat resistance paint (Hot oil proof) shall be provided inside the tank.

3.4.5 On external surfaces two coats of zinc chromate primer followed by two coats of anti-condensation type polyurethane paint, having minimum dry film thickness of 80 microns. Paint of shade conforming to No.632, Adminarly grey shade of IS-5 of 1961 as in Annexure-1 shall be provided.

3.4.6 The transformer shall have a self-pressure venting system.

3.5 BUSHING AND TERMINALS

3.5.1 All bushings shall be porcelain clad, and shall be sealed to prevent ingress of moisture and to facilitate removal. The HV bushings shall be fitted with moulded heat shrinkage insulating covers suitable for bare overhead conductor / Aerial bunched cables / U/G cables.

The HV Bushing shall be of open type terminal and LV Terminals shall be inside the Cable Box. The bushing stems/terminals for all HV phases, made of suitable copper alloy shall be so designed as to directly receive aluminium stranded overhead conductors with bolted type clamping arrangement both in horizontal and vertical directions. In case of copper/copper alloy stems, suitable bimetallic clamps with bolted type arrangement described above shall be used. If HT Underground Cables or Aerial bunched cables are used, then all the terminals shall be connected with suitable Al. lugs. Bimetallic washers shall be provided in between connection of Copper and Aluminium conductors.

3.5.2 LV cable box shall be provided with the proper facilities for taking out 3 phase and neutral supplies to the LV distribution board. Additional neutral terminal bushing shall be made available on the cable box for connection to separate earth.

3.5.3 For 25kVA & 63KVA transformer LV Cable box shall be with inbuilt, insulated bus bar with MCCB of appropriate ratings with 25kA breaking current capacity). All covers and flanges and joints shall be fixed by secure tamper- proof anti-theft fasteners with following features:

i. All the fasteners shall be of secure anti-theft design with special non-standard/rare drive head slots and round head such that they cannot be tightened or removed with a regular wrench.
ii. Head slots of shape “plus”, “minus”, or “allen (hexagonal)” shall not be used, as drive wrenches for such head slots are readily available in market.
iii. Special drive bit or wrench or key Special driver bit or wrench or key, one no. per transformer, shall be supplied to tighten or remove such secure fasteners

3.5.4 Suitable gland plate, cable glands and lugs as required shall be supplied with the cable box.

3.6 CONSERVATOR

3.6.1 In the distribution transformers of 63 and 100 kVA, rating the provisions of conservator is mandatory and for 25 kVA transformers the manufacturers may adopt their standard practices.

3.6.2 When a conservator is fitted, the conservator shall be provided with a drain plug and a filling hole with a cover. In addition, the cover of the main tank shall be provided with an air release plug to enable trapped air to be released unless the conservator is so located as to eliminate the possibility of air being trapped within the main tank.

3.6.3 The inside diameter of the pipe connecting the conservator to the main tank shall be within 20 to 50 mm and it should projected into the conservator so that its end is approximately 20 mm above

the bottom of the conservator, so as to create a sump for collection of impurities. The minimum oil level (corresponding to –5deg. C) should be above the sump level.

3.7 FITTINGS

The following standard fittings shall be provided for both sealed and non-sealed type transformers.

a) Two earthing terminals with facility to connect 50x6 MM GI Strip. The terminals Shall be located on the lower side of the transformer and be of M12 size. Each shall be clearly indicated with an engraved 'Earth' symbol.
b) Two Nos heavy duty lifting lugs.
c) Rating and terminal marking plate(s) as per this specification and IS 1180 part 1
d) Plain breathing device comprising an inverted U-pipe with wire gauze at the open end (to prevent entry of insects). Silica gel breather or any other type of breather as required.
e) Drain-cum-sampling valve (steel) welded to the tank. Special tool for operating this valve shall be supplied with the transformer. All valves shall have locking arrangement.
f) Oil filling hole, with cover having 1-1/4" nominal size threads on the transformers body/conservator.
g) Oil level gauge indicating oil levels.
h) Thermometer pocket with cap.
i) Terminal connectors.
j) Pressure relief device or explosion vent.
k) Dial Type thermometer working as OTI for 100 KVA
l) CT Terminal Box for all the ratings.
m) MOG to be provided with 2(NO+NC) for trip and alarm-with aux contact wired up to separate terminal box for 100 KVA

3.8 CORE AND WINDINGS

3.8.1 The core shall be constructed from high grade cold rolled, non-ageing, grain oriented silicon sheet steel and shall be properly annealed to relieve stresses.

- Core shall be in the form of step and stack in three limb format.
  Note: No wound core shall be acceptable

3.8.2 The HV and LV windings for these transformers shall be wound using high conductivity Copper of electrolytic grade for above 25KVA to 100KVA Transformers and high conductivity Aluminium of electrolytic grade for 25KVA & 63KVA Transformer.

- Type of winding
  LV: Spiral/ Helical
  HV: Crossover/Disc
  Note: No foil winding shall be acceptable

3.8.3 DPC insulation shall be used for HV and LV winding wires and electrical grade plain insulation Kraft paper for interleaving, no material which can be deleteriously affected by the action of oil under the operating conditions of the transformers shall be used in the transformers or leads of the bushings.

3.8.4 The core and coil assembly shall be securely held in position to avoid any movement under short- circuit conditions.

3.8.5 All turns of windings shall be adequately supported to prevent movement, in cases where turns are spaced out, a suitable inter-turn packing shall be provided. The insulation between core and bolts and core & clamps shall be suitable for withstanding 2000 Volts minimum, for one minute.

3.8.6 Winding Connections

The primary winding shall be connected in delta and the secondary winding in star (Vector Symbol Dyn11), so as to produce a positive displacement of 30^{O} from the primary to the secondary vector of the same phase. The neutral of the secondary winding shall be connected to a separate insulated terminal.

Off circuit taps shall be provided on HV winding with tapings of +2.5% to -5% (4 Nos. taps in steps of +2.5%, 0, -2.5% & - 5%) etc. Tapping switch shall only be provided for 100KVA transforms.

3.9 TAPS

The tap switch shall be of rotary type with operating voltage of 11KV & continuous current rating of 60Amps for 100KVA rating transformer.

3.10 MOUNTING ARRANGEMENT

The transformers are to be mounted on MS channel on PCC pole DP structure or steel pole DP structure. The transformer therefore shall be provided with suitable and robust mounting arrangement. The under base of transformer shall be provided with two nos. 75 x 40mm MS channel, 460mm long with slots/holes 18 mm x 21mm for fixing on a platform on plinth. The mounting arrangement drawing shall be furnished for approval.

3.11 RATING AND TERMINAL MARKING PLATE

The transformer shall be provided with non-detachable rating marking plate / Diagram plate(s) of non-corroding, weather proof material, fitted in a visible position and showing the complete information as in IS : 1180 (Part - I).Rating plate shall also include Transformer Actual

%Z, No-Load Loss & Full-Load Loss at 75°C and total losses (No load losses + load losses at 75 °C) at 50 % of rated load and at 100 % of rated load along with details like PO No, date, name of the company BSES. The name plate marking shall be done with fluorescent colour. Serial No. of the transformer shall be written with fluorescent paint on the body of each transformer so that the same can be read from the ground.

3.12 LIMITS OF TEMPERATURE RISE

The temperature rise over the maximum ambient temperature of 50^0C shall not exceed the limits of 40^0C (measured by resistance) for transformer windings and 35^0C (measured by thermometer) in top oil, when tested in accordance with IS: 2026.

3.13 LOSSES AND IMPEDENCE VALUES

- The total losses (no load and load losses at 75 ºC) at 50% and 100% of rated load shall not exceed the maximum total load values given in below table.

KVA	Maximum total losses (Watts)	
	50 % load	100 % load
25	190	635
63	340	1140
100	475	1650

These losses are maximum allowable and there would not be any plus tolerance.

- The percentage impedance at 75o C shall be 4.5% with IS tolerances as per IS 1180.

3.14 OVERFLUXING

The transformer shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 12.5%, without injurious heating or saturation at full load conditions.
The maximum flux density in any part of the core under such condition shall not exceed 1.9 Tesla. The supplier shall furnish necessary design data in support of this stipulation.

3.15 TRANSFORMER OIL

- It Should be in accordance with specification as per Annex III of this document One sample of oil drawn from every lot of transformer offered for final inspection should

be tested at CPRI/ERDA for tests as listed in IS 1866.

- Sample for oil testing shall be drawn from any transformer (chosen by BSES) from each offered lot after conducting acceptance tests during final inspection of the offered lot.
- The cost of this testing shall be borne by the transformer manufacturer.
- 10% extra oil to be furnished in separate nonreturnable drum with each transformer

4.0 QUALITY ASSURANCE

4.1 General

The Supplier shall adopt suitable quality assurance program and procedures to ensure that all activities are being controlled as necessary. The Supplier shall indicate following in the quality assurance plan – **Hold Point** "A stage in the material procurement or workmanship process beyond which work shall not proceed without the documented approval of designated individuals or organizations."

The Purchaser's written approval is required to authorize work to progress beyond the Hold Points indicated in approved quality plans.

Notification Point "A stage in material procurement or workmanship process for which advance notice of the activity is required to facilitate witness." If the Purchaser does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice then work may proceed.

4.2 Quality Plans

The Supplier shall draw up for each section of the work quality plans which shall be submitted to the Purchaser for approval at least two weeks prior to the commencement of work on the particular section. Each quality plan shall set out the activities in a logical sequence and, unless advised otherwise, shall include the following:

- An outline of the proposed work and programme sequence
- The structure of the Supplier's organisation for the contract
- The duties and responsibilities assigned to staff ensuring quality of work for the contract
- Hold and notification points
- Submission of engineering documents required by the specification
- The inspection of materials and components on receipt
- Reference to the Supplier's work procedures appropriate to each activity
- Inspection during fabrication/construction
- Final inspection and test

4.3 Sub-suppliers

The Supplier shall ensure that the quality assurance requirements of this specification are

followed by any sub-suppliers appointed by him under the Contract.
The Supplier shall assess the sub-supplier's quality assurance arrangements prior to his appointment to ensure compliance with the specification.
Auditing of the sub-supplier's quality assurance arrangements shall be carried out by the Supplier and recorded in such a manner that demonstrates to then Purchaser the extent of the audits and their effectiveness.

4.4 Warranty

The Supplier shall warranty the following:

- Quality and strength of materials used.
- Satisfactory operation during the warranty period of 60 months from the date of commissioning, or 66 months from the date of delivery of the material at BSES store, whichever is earlier.
- Performance figures as supplied by the Bidder 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.

5.0 INSPECTION AND TESTING

5.1 INSPECTION

5.1.1 The manufacture shall carry out comprehensive inspection and testing during manufacturing of the transformer.

5.1.2 The manufacturer shall carry out all type tests and routine tests on the transformer and special test if required any, shall be carried out as per IS by mutual arrangement between purchaser and supplier. The charges, if any, for conducting each of the type tests and special tests shall be indicated separately in the tender.

5.1.3 The purchaser reserves the rights to waive off certain or all tests.

5.1.4 All external components and fittings that are likely to affect the performance of the transformer during the test shall be in its place.

5.2 TESTS

Following tests are to be conducted by the vendors in the presence of BSES representative, Please note that without BSES clearance, vendor shall not proceed with manufacturing at any stage of work,

5.2.1 CORE TEST

Core cutting and testing to be witnessed by BSES representative in accordance with annexure-IV. One sample of CRGO sheet to be sealed for testing at ERDA/CPRI once per P.O. (applicable for 100 KVA only)

Following Tests shall be conducted on the sample:

- Specific core loss measurement
- Magnetic polarization
- Magnetic permeability
- Specific core loss measurement after accelerated ageing test
- Surface insulation resistivity
- Electrical resistivity measurement
- Stacking factor
- Ductility(Bend test)
- Lamination thickness
- Magnetization characteristics (B-H curve)

5.2.2 STAGE INSPECTION

All winding, core assembly, core-coil assembly and tank shall be witnessed, checked and verified by BSES representative in accordance with annexure-V at manufacturer's works.

5.2.3 ROUTINE & ACCEPTANCE TESTS:

All transformers shall be witnessed, checked and verified by BSES representative to the following routine tests at the manufacturer's works and in accordance with IS: 2026 and IS: 1180 (Part – I & II, Appendix-A) and shall be deemed to be included in the supplier's scope:

- Measurement of winding resistance at all taps.
- Measurement of voltage ratio and check of voltage vector relationship at all taps
- Measurement of impedance voltage/short-circuit impedance and load loss at 50 % &100 % of load.
- Measurement of no-load loss and no load current
- Measurement of insulation resistance and polarization index.
- Magnetic balance test.
- Induced over voltage withstand test
- Separate source voltage withstand test

- Oil breakdown voltage test.
- Over voltage withstand capability Test.
- Pressure test
- Oil leakage test
- Temperature rise test(To be conducted on lowest tap)

5.2.4 TYPE TESTS

Following type tests shall be conducted as per IS

- Lightning impulse test
- Heat run test (HRT)
- Short-circuit test (Dynamic short circuit tests & Thermal withstand test for 3 seconds)
- Air Pressure test

Following procedures are to be complied with respect to type tests:

a) The product offered must be of type tested quality as per relevant IS from. Type test carried out in last five year will be valid.
In case type test report is more than 5 years old & less than10 years old with no change in design, then also it is valid for participation.
Note: In case bidder has conducted type test from KEMA/PEHLA/CESI, same shall be considered for bid participation

b) In case the bidder is 1st time participated in BSES, then they have to conduct the type test from CPRI/ERDA on BSES design without any cost implication to BSES.

c) In case bidder had earlier conducted and having valid type tests report on BSES design/supplies, then they don't need to conduct the type test,
In case type test report is more than 5 years old & less than 10 years old with no change in design, then bidder do not need to conduct the type test from CPRI/ERDA

d) In case type test report is more than 10 years old then bidder has to conduct complete type test from CPRI/ERDA without any cost implication to BSES.

5.2.5 TRANSFORMER OIL TESTING

- Dissolved Gas Analysis (DGA) before and after Heat Run Test (HRT) shall be done on one unit per Purchase order from CPRI/ERDA.
- Complete oil testing as per IS 1866 shall be done on one unit from each lot from CPRI/ERDA.

6 PACKING, SHIPPING, HANDLING AND STORAGE

6.1 Packing shall be sturdy and adequate to protect all assemblies, components and accessories from injury by corrosion, dampness, heavy rains, breakage and vibration encountered during transportation, handling and storage at the plant site. All accessories, which are likely to get damaged during transit if transported mounted on the equipment, shall be removed, adequately packed and shipped separately. All openings shall be sealed. Spare parts shall be packed separately and clearly marked. They shall be specially packed for long storage without injury.

6.2 The bidder shall after proper painting, pack and crate all plant equipment for sea shipment/air freight in a manner suitable for export to a tropical humid and saline air borne climate region as per Internationally accepted export practice in such a manner so as to protect it from damage and deterioration in transit by road, rail and/or sea and during storage at site till the time of erection. The bidder shall be held responsible for all damages due to improper packing.

6.3 The bidder shall give complete shipping information concerning the weight, size, contents of each package including any other information the Purchaser may require. The weight and size of the package shall be such that they can be easily transported from the maker's works to the plant site by ship/air, road ways and railways.

6.4 The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as weights, dimensions, road culverts, overhead lines, free access etc. from the manufacturing plant to the project site; and furnish to the Purchaser confirmation that the proposed packages can be safely transported, as normal or oversize packages, up to the plant site. Any modifications required in the infrastructure and cost thereof in this connection shall be done and borne by the bidder.

6.5 The bidder shall prepare detailed packing list of all packages and containers, bundles and loose materials forming each and every consignment dispatched to 'site'. The bidder shall further be responsible, for making all necessary arrangements for loading, unloading and other handling right from his works; and from Indian port for equipment under the Off-shore Supply till the 'site' and also till the equipment is erected, tested and commissioned. The bidder shall be solely responsible for proper storage and safe custody of all equipment.
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.
- Description and number of contents.
- Manufacturer's name.
- Country of origin.
- Case measurements.
- Gross and net weights in kilograms.
- All necessary slinging and stacking instructions.

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. Six copies of each packing list shall be sent to the Purchaser prior to dispatching the equipment.

7 INSPECTION EXPENSES

Inspection (i.e. routing test, acceptance test, type test, factory visit etc.) shall be done any time by BSES on the basis of P.O. or may involve 3rd party as per BSES requirement.
Any kind of test (routine/type test/acceptance test if any) at 3rd lab (i.e. CPRI/ERDA/NABL approved lab) shall be carried out by seller at their own cost.

APPENDIX-A

LIST OF APPLICABLE CODES AND STANDARDS

All Material against this specification shall conform in all respect to the relevant Indian standard specification
/ International Standard Specification, with latest amendments from time to time, thereof, some of which are listed below:

Indian Standard	**Title**
IS-2026/2011	Specification for Power Transformer
IS-1180/2014	Outdoor distribution transformer up to and including 2500 KVA
IS-335/2018	Specification for oil
IS-2099-1986	Specification for High voltage Porcelain Bushings
IS-7421/1976	Specification for Low voltage Bushings
IS-3347	Specification for Outdoor Bushings
IS-12444	Specification for Cu Wire rods
IS-5484	Specification for Al Wire rods
IS-5/1961 No. 632	Specification for Colors for ready mixed paints.
IS-6600/1972	Guide for loading of oil immersed Transformers.
IS-13947-Part 2	Low voltage switchgear and control gear.
IS-10028/1985	Code of Practice for Selection, Installation and Maintenance of Transformers.
IS-5 / 1994	Colours for ready mixed paints and enamels
IS-3618 / 1966	Specification for phosphate treatment of iron and steel for protection against corrosion
IEC Standard	**Title**
IEC 60296	Specification for unused and reclaimed mineral Insulating oil for transformer and switchgear.
IEC 60076	Specification for power transformer.
IEC 60076-1	General
IEC 60076-2	Specification for temperature rise requirement
IEC 60076-3	Specification for insulation levels and dielectric tests.
IEC 60076-4	Specification for tapping and connections
IEC 60076-5	Specification for ability to withstand short circuit
IEC 60551	Determination for transformer and reactor sound levels
IEC 60354	Guide to loading of oil immersed power transformer
IEC 60137	Insulated bushings for alternating voltage above 1kV

Other International and Internationally recognized star	Title
BS148, ASTM D-1275 D-1473, D-1533-1934	Specification for oil
DIN 42531 to 33	Specification for Outdoor Bushings
ASTM B-49	Specification for Cu Wire rods
ASTM B-233	Specification for Al Wire rods

Material conforming to other internationally accepted standards, which ensures equal or better quality than the standards mentioned above would be acceptable, subject to prior approval of Owner. In case the Bidders who wish to offer material conforming to the other standards, salient points of difference between the Standards adopted and the specific standards shall be clearly brought out in relevant schedule. Four copies of such standards with authentic English Translation shall be furnished along with the offer. In the case of conflict the order of precedence shall be 1) Indian Standards, 2) IEC Standards, 3) Other alternative standards.

APPENDIX-B

DRAWINGS SUBMITTAL REQUIREMENT OF THE SUPPLIER

Drawings, Data and Manuals shall be submitted with the bid and after the bid in quantities and procedures as specified in this specification for approval and subsequent distribution after the issue of Notice to proceed.

S.No	Description Of Drawing / Data / Manuals	With bid	Post bid	
		(2 sets of hard copies)	For review & approval (2 sets of hard copies)	Prior to Dispatch (2 sets of hard copies and 1 CD-ROM)
1	Completed technical data schedule;	Y		
2	Descriptive literature giving full technical details of equipment offered;	Y		

3	Outline dimension drawing for each major component, general arrangement drawing showing component layout and general schematic diagrams;	Y		
4	Type test certificates, where available, and sample routine test reports;	Y		
5	Detailed reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating;	Y		
6	Details of manufacturer's quality assurance programme and ISO 9000 series or equivalent national certification;	Y		
7	vii) Deviation from this specification. Only deviations approved in writing before award of contract shall be accepted	Y		
8	Recommended spare parts and consumable items for five years of operation with prices and spare parts catalogue with price list for future requirements	Y		
9	Quality Assurance Program	Y		
10	Programme for production and testing (A)		7	
11	Guaranteed Technical Particulars (A)		7	
12	General description of the equipment		7	

	and all components, including brochures (R)			
13	Calculations to substantiate choice of electrical, structural, mechanical component size/ratings (A)		7	
14	Detailed loading drawing to enable the buyer to design and construct foundations for the transformer(R)		7	
15	Transport / shipping dimensions with weight , wheel base details , untanking height etc. (R)		7	
16	Terminal arrangements and cable box		7	
17	Drawings of major components like Bushing, Ct etc. (A)		7	
18	List of makes of all fittings and accessories (A)		7	
19	Statement drawing attention to all exposed points in the equipment at which contact with or in close proximity to other metals and stating clearly what protection is employed to prevent corrosion at each point (A)		7	
20	Detailed installation and commissioning instructions		7	
21	Quality Plan		7	
22	Inspection and test reports carried out in manufacturer's works (A)			Y
23	Test certificates of all bought out items			Y
24	Operation and maintenance Instruction as well as trouble shooting charts / manual			Y

Legend:

Y: The drawing / document is required from the supplier.

7: Within 7 days of LOI / PO / award of contract.

'A' → Means required for review and approval. 'R' → Means required for reference only.

NOTES:

1 The delivery period shall be reckoned from the date of placement of the order and not from the date of approval of drawings. Thus the delay in the submission of drawings for approval shall result in invoking the provisions of the penalty clause and the no. of days by which the delay has occurred shall be reckoned as delay in delivery. Accordingly it is the responsibility of the bidder to ensure that drawings are submitted within the stipulated number of days.

2 Two (2) sets of all drawings, data sheets shall be furnished in HARD COPY (with a forwarding letter, listing therein all the documents furnished for review / approval) to the Head – Engineering BSES. Drawing submittal by e-mail (soft copies) shall NOT be considered for review.

3 Accordingly the entire review / approval cycle shall be completed within 10 working days from the date of receipt of the first submittal from the supplier.

ANNEXURE- I

DATA SHEET OF CLIENT REQUIREMENT

1 Electrical System Data

Sl. No.	Continuous rated capacity	25 kVA	63 kVA	100 kVA
1	Location of equipment	Generally outdoor but may be located indoor also with poor ventilation		
1.1	Reference design ambient temperature	50^0C		
1.2	Type	Oil immersed, core type, step down		
1.3	Type of cooling	ONAN		
1.4	Tank	As per Clause no 3.4		
1.5	Reference standard	IS-1180 & IS: 2026		
1.6	No. of phases	3		
1.7	No. of windings per phase	2		
1.8	Rated voltage HV	11kV		
1.9	Highest System voltage –H.V	12kV		
1.10	Highest system voltage LV side	476 Volt		
1.11	HV system voltage variation	+/-10%		
1.12	Frequency variation	+/- 5%		
1.13	Combined voltage frequency variations	-20% or +10%		
1.14	Power frequency withstand voltage (kV rms) –H.V	28kV		
1.15	Impulse withstand voltage (kVpeak)- H.V	75kV (peak)		
1.16	Rated voltage LV	415 V		
1.17	Line current HV	1.31A	3.306A	5.25A
1.18	Line current LV	33.33A	84.0A	133.0 A
1.19	% Impedance (at 75°C)	4.5% with IS tolerance		
1.20	Guaranteed Total Losses			
1.21	Guaranteed Losses(no load +load losses at 75 °C) (watts) @ 50 % rated load	190	340	475

1.22	Guaranteed Losses(no load +load losses at 75 °C) (watts) @ 100 % rated load	635	1140	1650
1.22	No. of phases	Three		
1.23	Connection HV	Delta		
1.24	Connection LV	Star with Neutral brought out for external earth		
1.25	Vector Group reference	Dyn11		

1.26	No load voltage ratio	11kV/415V
1.27	Max. System fault level at HV Side	500 MVA
3	Short circuit Withstand capacity of the transformer	
3.1	Three phase dead short circuit at secondary terminal with rated voltage maintained on the other side	For 3 sec
3.2	Single phase short circuit at secondary terminal with rated voltage maintained on other side	For 3 sec
4	Noise Level	48/51/51 dB for 25, 63, 100 KVA transformers Respectively.
5	Power frequency withstand voltage kV rms	
5.1	Lighting impulse voltage for nominal system voltage of 11KV	75 KV
5.2	For nominal system voltage of 415V	3 KV
6	Clearances Phase to Phase in mm	
6.1	For nominal system voltage of 11KV	280MM.
6.2	For nominal system voltage of 415V	25 MM.
7	Clearances Phase to earth, Mm	
7.1	For nominal system voltage of 11KV	140 MM
7.2	For nominal system voltage of 415V	25 MM
8	System Fault Level, LV side	35MVA
9	HV	Solidly earthed
9.1	LV	Solidly earthed
10	Maximum overall dimension acceptable (Length x Width x height) mm x mm x mm	(1150 X 1010 X 1380) mm
11	Overload Capability	As per IS 6600
12	Radio Influence Voltage	Maximum 25 microvolt
13	Harmonic suppression	Transformer to be designed for suppression of 3rd, 5th, 7th harmonic voltages and high frequency disturbances.
14	Partial Discharge	Transformer to be free from partial discharge up to 120 % of rated voltage

		as the voltage is reduced from 150 % of rated voltage i.e. there shall be no significant rise above background level
15	Tapping's for 100kVA	Off circuit taps on HV winding, +2.5 to -5% in steps of 2.5%, change of taps by externally operated switch
16	Rotary tap switch operating voltage	11Kv
16.1	Rotary tap switch current rating Amp.	60AMP
17	Temperature rise over reference ambient of 50^0C	
17.1	Top oil by thermometer ^{0}C	35^0C
17.2	Winding by resistance ^{0}C	40^0C
18	Thickness of radiator tubes, Mm	Minimum 1.2mm
19	Details of Tank	
19.1	Material	Robust mild steel plate without pitting and low carbon content
19.2	Vacuum mm of Hg./ (kN/m2)	As per IS
19.3	Pressure mm of Hg.	
19.4	Is the tank lid sloped	Yes
20	Type	Core
20.1	Core material grade	Premium grade minimum M3
20.2	Insulation of lamination	With insulation coating on both sides
20.3	Design Flux density	1.6Tesla
21	Maximum flux density at 10%over excitation / over fluxing, Tesla	1.9Tesla
22	Conductor material	Copper for 100KVA Aluminum for 63KVA & 25KVA
22.1	Current density (HV/LV)	Maximum allowed 3.0 A per sqmm at all taps for CU winding Maximum allowed 1.5 A per sqmm at all taps for AL winding
23	Bushing / Support Insulator	
23.1	HV side Bushing /Support Insulator	12kV
23.2	LV side line and neutral bushing / Support Insulator	1.1kV

23.3	Creepage factor for all bushing / Support Insulator mm/KV	31 mm / kV
24	Rated thermal short time current	
24.1	HV bushing	25 times rated current for 2 secs
24.2	LV line and neutral bushing	25 times rated current for 2 secs
25	LV Cable termination arrangement	With LT cable box, (with O/G cable termination arrangement) For 25kVA & 63KVA Cable box shall have MCCB of appropriate rating with 25kA breaking current capacity Insulated bus bar.
25.1	Suitable for cable type, size	Outgoing LT cable of size up to 4C x150sqmm
25.2	Termination height, mm	As per cable box design
25.3	Gland Plate dimension, mm x mm	As per cable box design
25.4	Gland Plate material	MS / Aluminum
25.5	Gland Plate thickness, mm	5mm minimum
25.6	Phase to clearance inside box, mm	25 mm minimum
25.7	Phase to earth inside, mm	25 mm minimum
26	L.V neutral Cable termination arrangement	Additional LV Neutral shall be provided on LV Cable Box for direct earthing on separate pit.
27	Current Transformers	
27.1	Provision	ON all three phases on LV side
27.2	Mounting	On LV side bushing an all three phases with the help of fibre glass mounting plate affixed to main tank by nut bolt arrangement.
27.3	Maintenance requirements	Replacement should be possible by removing fixing nut of mounting plate after removal of LT cable without disturbing LT bushing.
27.4	Accuracy Class	0.5
27.5	Burden	5 VA
27.6	Type	Cast resin ring type suitable for outdoor use
27.7	CT ratio	200/5 for 100 KVA 100/5 for 25 to 63 KVA
27.8	CT terminal Box	
27.9	Size	As per vendor standard practice
27.11	No. of horizontal channels to be provided	Four
27.12	Fixing of terminals within the box	On horizontal slotted channel with the help of C channel available with the terminals
27.13	Location	On tank wall

27.14	Box door design	Openable from outside with antitheft hinge, padlock facility, door fixed by stainless steel allen screw M6 size, Door shall have canopy for rain protection.
27.15	Terminal strip	Nylon 66 material, minimum 4 sq mm, screw type for control wiring and potential circuit.
27.16	Cable and wires	PVC insulated, extruded PVC inner sheathed, armoured, extruded PVC outer sheathed 1100 V grade control cable as per latest edition of IS 1554 part 1 minimum 2.5 sq mm for signals and 4 sq mm for CT with multi strand copper conductor
27.17	Cable Glands	Nickel plated brass double compression weatherproof cable gland
27.18	Lugs on wires	Tinned copper pre insulated Pin, Ring, Fork type as applicable
27.19	Potential signal in CT box	Tapped from main LV bushing
27.20	Essential provision	Wiring diagram to be fixed on the back of door along with CT Sec. on Aluminum engraved plate fixed by rivet.
28	Terminal Blocks to be used by the vendor	Nylon 66 material, minimum 4 sq mm, screw type for control wiring and potential circuit. Terminal blocks to be located in such a way to achieve the termination height as min 250mm from gland plate.20%. Spare TBs to be provided
28.1	Essential provision for CT terminals	Sliding link type disconnecting terminal block screwdriver operated stud type with facility for CT terminal shorting material of housing melamine/Nylon66
29	Cable glands to be used by the vendor	Nickel plated brass double compression weatherproof cable gland
30	Painting of transformer, Radiator, cable boxes etc.	
30.1	Surface preparation	By 7 tank pre-treatment process or shot/ sand blasting method
30.2	Finish on internal surfaces of the transformer	Bright Yellow heat resistant and oil resistant paint two coats. Paint shall neither react nor dissolve in hot transformer insulating oil.
30.3	Finish on inner surface of the CT terminal box, HV/ LV/LVN cable box	White Polyurethane paint ant condensation type two coats, minimum dry film thickness 80 microns
30.4	Finish on outer surface of the transformer, radiator, CT terminal box, HV/LV/LVN cable box	Adminarly Grey shade 632 Polyurethane paint two coats, minimum dry film thickness 80 microns
30.5	Frame parts	Paint shade- 632 as per IS 5, with 80 microns (min.), Insulating oil resistant paint. Paint shall neither react nor dissolve in hot transformer insulating oil.

31	Fittings and Accessories on Transformer	
31.1	Rating and Diagram Plate	Required
31.2	Material	Anodized aluminum 16SWG

31.2	Background	SATIN SILVER
31.3	Letters, diagram & border	Black
32	Rating and Diagram Plate details	Following details shall be provided on rating and diagram plate as a minimum, requirement.
		i) type/kind of transformer with winding material
		ii) Standard to which it is manufactured
		iii) Manufacturer's name
		iv) Transformer serial number
		v) Month and year of manufacture
		vi) Rated frequency in HZ
		vii) Rated in kV
		viii) Number of phases
		ix) Rated power in kVA
		x) Type of cooling (ONAN)
		xi) rated currents in A
		xii) Vector group connection symbol
		xiii) 1.2/ 50 wave impulse voltage withstand level in kV
		xiv) Power frequency withstand voltage in kV
		xv) Impedance voltage at rated current and frequency in percentage at principal, minimum and maximum tap
		xvi) Max. Total losses at 50 % rated load & at 100% rated load
		xvii) No-load loss at rated voltage and frequency
		xviii) Continuous ambient temperature rise at rated load in deg C
		xix) Top oil and winding temperature rise at rated load in deg. C
		xx) Winding connection diagram with taps and table of tapping voltage, current and power
		xxi) Transport weight of transformer
		xxii) Energy efficiency level.
		xxiii) Weight of core
		xxiv) Weight of winding
		xxv) Weight of core and winding
		xxvi) Total weight
		xxvii) Volume of oi
		xxviii) Weight of oil

		xxix) Name of the Purchaser
		xxx) PO no and date
		xxxi) Guarantee period
33	Transformer oil	It should be in accordance with specification as per Annex III of this document 10% extra oil to be furnished in separate nonreturnable drum with each transformer

2 Transformer Requirements

Type of transformer	Conventional distribution transformer
Type of construction	Core type, Oil immersed
Type of cooling	Oil Natural Air Natural (ONAN)
No of phases	Three phase on primary & secondary side
No of windings	Two (one each for 3 phase primary & 3 phase secondary)
Type of service	Outdoor application
Type of mounting	Suitable for pole mounting, Double pole structure

The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits, as specified in -"IEC 76-5: Ability to withstand short circuits" Each transformer shall be capable of withstanding for 3 seconds a bolted metallic short circuit on the terminals of either winding, with rated voltage on the other winding.

The transformers will be installed outdoor.

The transformers shall be capable of continuous operation of rated output under the operating conditions of voltage and frequency variations.

2 APPROVED MAKES OF COMPONENTS

3.1	CT	Pragati / ECS / Kappa/Narayan Powertech /Nortex/Adcon/Amity Electricals/Maxwell Gilbert
3.2	Bushings	Baroda Bushing/CJI/Jaipur/Genesis
3.3	Tap Changer	Alwaye /Paragon
3.4	MOG	Sukrut/Atvus
3.5	Valves	Newman
3.6	CRGO	Nippon/JFE/Posco/Thyssenkrupp
3.7	Copper	Birla copper/Sterlite
3.8	Pre compressed Pressboard	Raman Board, Mysore/ Senapathy Whiteley
3.9	Laminated Wood	Permalli Wallance / Rochling Engineers
3.10	Oil	Apar/Savita/Raj Petro/Gandhar/Columbia

3.11	Steel	TATA/Jindal/SAIL
3.12	Lugs/Glands	Jainson/Dowells/Comet
3.13	Radiators	CTR/Hi-Tech Radiators /Tarang Engineers
3.14	OTI and WTI	Precimeasure/Pecon

Note - Any other make of component shall be approved by BSES during Detailed Design Engineering

3 SERVICE CONDITIONS

3.1 Site Conditions

S.no.	Description	Details
1	Relative humidity	
	a) Maximum	100%
	b) Minimum	10%
2	Average annual rainfall	750mm
3	Average no. of rainy days	50 per annum
4	Temperature max/min/year average	50^0C / -5^0C/32^0C
5	Average no. of thunder storm days	40 per annum
6	Rain Months	June to October
7	Wind pressure	195 kg/m2 up to an elevation of 30 mt. As per IS:875/ 975

4 GENERAL PARTICULARS AND GUARANTEES

4.1 COMPLIANCE WITH SPECIFICATION

The transformers shall comply in all respects with the requirements of this specification. However, any minor deviations from the provisions of the specification shall be disclosed at the time of tendering.

4.2 COMPLIANCE WITH REGULATIONS

All the equipment shall comply in every respect with the Indian Regulations and acts in force.

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

ANNEXURE II VENDOR DATA

(GURANTEED TECHNICAL PARTICULARS)

Note: This GTP is to be filled by the supplier in accordance with the given specification. Any deviation from the same shall be clearly highlighted and shall be supported with relevant documents.

S. No.	Description	UNIT	25kVA	63kVA	100kVA
1	Name of manufacturer				
2	Type				
3	Ratings				
(a)	Rated output	kVA			
(b)	Rated voltage-HV	Volts			
(C)	Rated voltage-LV	Volts			
(d)	No load voltage ratio				
(e)	Number of phases				
(f)	Frequency	Hz			
4	Connections				
(a)	High voltage				
(b)	Low voltage				
(c)	Vector group symbol				
5	Method of cooling				
6	Internal dimensions of tank				
(a)	Length	mm			
(b)	Breadth	mm			
(C)	Height	mm			
(d)	Thickness of tank sheet				
	i)Sides	mm			
	ii)Top	mm			
	iii)Bottom	mm			
7	Details of core				
(a)	Diameter	mm			
(b)	Cross sectional area				
	i) Gross	mm^2			
	ii)Net	mm^2			
(c)	Window height	mm			
(d)	Limb center	mm			
(e)	Maximum flux density at rated voltage and	Tesla			

	Frequency (to be supported by calculations)				
(f)	Material and thickness of lamination	mm			
(g)	Weight of stamping in core and yoke separately				
	i) Core	Kgs			
	ii)Yoke	Kgs			
	iii)Total	Kgs			
8	HV coil constructional details				
(a)	Type of winding	mm			
(b)	Size of conductor (Bare)	mm^2			
(C)	Cross sectional area of conductor				
	i) Gross				
	ii) Net				
(d)	Number of coils per limb				
(e)	Outer diameter of coil	mm			
(f)	Inner diameter of coil	mm			
(g)	Mean diameter of coil	mm			
(h)	Insulation of conductor				
(i)	Interlayer reinforcement detail				
(j)	Current at full load	Amp			
(k)	Normal working current density	Amp/ mm^2			
(l)	End turn insulation				
(m)	Weight of bare conductor used in one leg of HV	Kg			
(n)	Weight of insulated conductor used in one leg of HV	Kg			
(o)	Number of turns per leg				

(p)	Length of mean turns	mm			
(q)	**I^2R at 75^{O}C (To be supported by**				
	calculations)				
(r)	Axial length	mm			
(s)	Resistance per phase at **75^{O}C** (Max)	Ohms			
(t)	Weight of winding with insulation in one leg ofHV	Kg			
9	LV coil constructional details				
(a)	Type of winding				
(b)	Size of conductor (Bare)	mm			
(C)	Cross sectional area of conductor	mm^2			
	i) Gross				
	ii) Net				
(d)	Number of coils per limb				
(e)	Outer diameter of coil	mm			
(f)	Inner diameter of coil	mm			
(g)	Mean diameter of coil	mm			
(h)	Insulation of conductor				
(i)	Interlayer reinforcement detail				
(j)	Current at full load	Amp			
(k)	Normal working current density	Amp/ mm^2			
(l)	End turn insulation				
(m)	Weight of bare conductor used in one leg of LV	Kg			

(n)	Weight of insulated conductor used in one leg of LV	Kg			
(o)	Number of turns per leg				
(p)	Length of mean turns	mm			
(q)	**I^2R at 75°C (To be supported by calculations)**				

(r)	Axial length	mm			
(s)	Resistance per phase at **75°C** (Max)	Ohms			
(t)	Weight of winding with insulation in one leg of LV	Kg			
10	Insulation details material and size				
(a)	HV coil end packing				
(b)	LV coil end packing				
(C)	Inter coil spacer of HT sections				
(d)	Bottom core strip insulation				
(e)	Yoke insulation				
(f)	Clamp insulation				
(g)	Inter phase barrier				
(h)	Core wrap				
(i)	Cylindrical insulation between HT & LT				
(j)	Type of blocks used between coils				
11	Details of clearances				
(a)	Internal clearance between inner walls of tank and core coil assembly unit	mm			
	i) On length (Bushing side)				
	ii) On breadth (Non Bushing side)				

(b)	Radial clearance between LV and HV winding	mm			
(C)	Phase to phase clearance between HV limb	mm			
(d)	Clearance from top of the yoke to the inside of the top cover of tank	mm			
(e)	Radial clearance of LV coil from core	mm			
(f)	Horizontal duct				
	between HT sectional coil				
(g)	End clearance of HT coil from yoke	mm			
(h)	Minimum clearance between core and tank bottom	mm			
12	Impulse test voltage of winding for 1.2/50 micro seconds wave according to relevant ISS				
(a)	HV				
(b)	LV				
13	Volts per coil of HV winding	Volts			
14	Approximate volts per layer of HV winding	Volts			
15	Performance reference temperature	Deg. C			
16	No load loss at rated primary voltage and frequency.(Guaranteed value without any positive tolerance)	Watts			
17	Total losses				

17.1	Total losses(no load load losses at **75°C @ 50 % load)** (Guaranteed value without any positive tolerance)	Watts			
17.2	Total losses(no load load losses at **75°C @ 100 % load)** (Guaranteed value without any positive tolerance)				
18	Induced over voltage test at double frequency				
19 (a)	No load current at 100% rated voltage and rated frequency as percentage of full load current.				
(b)	No load current at 112.5% of rated voltage as percentage of full load current				
20	Regulation at normal full load and UPF at 75°C				
21	Regulation at normal full load and 0.8 Lag PF at 75°C				
22	Impedance voltage at rated voltage and frequency at 75°C	Volts			
23	Percentage reactance at rated voltage and frequency at **75°C**				
24	Percentage Resistance at **75°C**				
25	Percentage impedance at 75°C				

(a)	With respect to high voltage								
(b)	With respect to low voltage								
26	Unbalance current as percentage of full load current								
27	Percentage efficiency		At UPF	At 0.8 Lag PF		At UPF	At 0.8 Lag PF	At UPF	At 0.8 Lag PF
(a)	Full load								
(b)	¾ full load								
(c)	½ full load								
(d)	¼ full load								
28	Permissible duration of overload following continuous running at normal rated load in ambient temperature of 50°C								
(a)	10%overload								
(b)	20%overload								
(c)	30%overload								
29	RMS value of symmetrical short								

	circuit current which the transformer can withstand and its duration according to clause 9.1 of ISS-2026 or clause –1001 of BSS with latest Amendment.				
30	Increase in Temperature of winding at full load by resistance method in an ambient temperature of 50°C				
31	Increase in temperature of oil by thermometer at full load in an ambient				

	temperature of 50°C				
32	Temperature of hottest spot in the winding at full load in an ambient temperature of 50°C				
33	Terminal arrangement of HV side				
34	Terminal arrangement of LV side				
35	Particulars of HV bushing				
(a)	Name of manufacturer				
(b)	Type				
(c)	Dry withstand voltage for one minute				
(d)	Wet withstand voltage for thirty minutes				
(e)	Voltage rating				
(f)	Impulse withstand voltage 1.2/50 micro second wave				
	i)Positive				
	ii)Negative				
(g)	Total creepage distance in air	mm			
(h)	Height of bushing above transformer				

	tank				
36	Particulars of LV neutral bushing				
(a)	Name of manufacturer				
(b)	Type				
(c)	Voltage rating				
(d)	Dry withstand voltage for one minute				

(e)	Wet withstand voltage for thirty minutes				
(f)	Total creepage distance in air	mm			
(g)	Height of bushing above transformer tank	mm			
37	Time constant of transformer				
38	Transformer oil				
(a)	Dielectric strength				
(b)	Resistivity				
(c)	Acidity				
(d)	Tan delta				
(e)	Name of supplier				
39	Quantity of transformer oil	Litres			
40	Weight of the following				
(a)	Tank and fittings	Kgs			
(b)	Core and windings	Kgs			
(c)	Transformer oil	Kgs			
(d)	Total weight of transformer including oil	Kgs			
41	Overall dimensions of transformer				
(a)	Length	mm			
(b)	Breadth	mm			
(c)	Height	mm			
42	Name of material and size used for clamping of core winding				
(a)	Core clamp				
(b)	Tie rod				
(c)	Core bolt				

(d)	Bottom plate				
43	Size of conservator				
(a)	Volume				
(b)	Length/ diameter				
(c)	Sheet thickness				

44	Size of material of delta and line leads							
45	Core earthing material							
46	Silica gel breather							
	i)Make							
	ii)Size							
47	Clearance between phases and phases to earth in air							
(a)	Phase to phase(HV side)	mm						
(b)	Phase to phase (LV side)	mm						
(c)	HV to earth	mm						
(d)	LV to earth	mm						
48	Type testing							
(a)	Is the offered 11kV/415V, conventional distribution transformer type tested? (Yes, No)							
(b)	If yes, when and where was it type tested?							
(c)	Is there any deviation in the technical specification of offered 11kV/415V conventional type distribution transformer? If yes, give details.							
	Name of test	Date of test	Whether test report enclosed or not(Y/N)	If yes, No. of sheets enclosed	Whether test report enclosed or not(Y/N)	If yes, No. of sheets enclosed	Whether test report enclosed or not(Y/N)	If yes, No. of sheets enclosed

i)	Unbalance current Test							
ii)	Impulse voltage withstand test							
iii)	Temperature rise test							
iv)	Short circuit test							
v)	Thermal ability test							
vi)	Air pressure test							
49	Whether you will use specified aluminium alloy or brass copper with suitable bimetallic arrangement for HV/LV Connector							
50	Have you submitted drawing and calculation of cross sectional area of core?(Yes/No)							
51	Have you submitted calculation for computation of no load and load loss at 750Cas per design data of offered transformers? (Yes/No)							
52	Any other information							

ANNEXURE III
TRANSFORMER OIL

The insulating oil shall have following features :

S.No.	Item description	Specification requirement
1.1	Appearance of oil	Clear, free from sediment and suspended matter
1.2	Viscosity Max.	15 mm2 /s at 40°C 1800 mm2 /s at 0°C
1.3	Pour Point, Max	-10°C

1.4	Water content, Max	30 mg/Kg
1.5	Breakdown voltage	
i)	New unfiltered oil. Min.	30 kV
ii)	After filtration Min.	70 kV
1.6	Density Max.	0.895 g/ml at 20°C
1.7	Dielectric dissipation factor Max	0.005 at 90 °C,
1.8	Particle Content	Value to be provided by the vendor
1.9	Acidity Max	0.01 mg KOH/g
1.10	Interfacial tension at 27°C Min	40 mN/m
1.11	Total sulphur content	Value to be provided by the vendor
1.12	Corrosive sulfur	Not-corrosive
1.13	Potentially Corrosive sulfur	Not-corrosive
1.14	DBDS	Not detectable (<5 mg/kg)
1.15	Inhibitor	Not detectable (<0.01%)
1.16	Metal Passivator	Not detectable (<5 mg/kg)
1.17	Other additives	Type and concentration of additives to be provided by the vendor
1.18	2-furfural and related Compounds content	Not detectable (<0.05 mg/kg) for each individual compound
1.19	Oxidation stability	
a)	Total acidity, Max	1.2 mg KOH/g
b)	Sludge Max	0.8%
c)	DDF at 90 °C, Max	0.5
1.20	Gassing Tendency	Value to be provided by the vendor
1.21	ECT	Value to be provided by the vendor
1.22	Flash point Min.	135°C,
1.23	PCA content Max	3%
1.24	PCB content	Not detectable (<2 mg/Kg)

ANNEXURE-IV: CRGO & TESTING REQUIREMENT

In addition to the BSES specification following points to be verified during manufacturing/inspection (Valid for 100kVA DT only)	
1	Transformer core shall be low loss, non-ageing, high permeability PRIME GRADE CRGO with M3 Grade or better with max thickness of 0.23mm and with max core loss of 1W/Kg, perfectly insulated and clamped to minimize noise and vibrations.
2	Following stage inspections will be carried out by purchaser or by third party engineers appointed by BSES:
2.1	Reconciliation of mother coil by checking stamp & seal at factory before slitting. One sample of CRGO to be sealed for testing at CPRI/ERDA.
2.3	Following documents to be submitted during the stage inspection :
2.3.1	Invoice of supplier
2.3.2	Mills test certificates

2.3.3	Packing list
2.3.4	Bill of lading
2.3.5	Bill of entry certificates by customs
2.4	BSES may appoint recognized testing authority like CPRI /ERDA with their instruments & engineer's team and measure no load loss, load loss and percentage impedance of the transformer at supplier's works at our own cost. Bidder shall agree and give them full co-operation during their stay & testing at shop floor. The losses & impedance values so obtained will be considered as final.
2.5	Bidder should have in-house NABL accredited testing facility. In case of unavailability of in house NABL accredited lab testing of bidder, one Transformer of each rating shall be randomly selected and sealed by BRPL representative for complete acceptance test as per IS -1180(including temperature test) at third party NABL Lab. Tests shall be conducted once per Rate contract at bidder's cost.

ANNEXURE-V: STANDARD BSES QAP (to be followed for testing/ inspection)