UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM

1 X 660 MW PANKI TPS

VOLUME – II

TECHNICAL SPECIFICATION FOR

OIL FILLED SERVICE TRANSFORMERS

BHEL DOCUMENT NO. : PE-TS-426-302-E002, REV-00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA – 201301

695570/2022/PS-PEM-EL

CONTENTS

TOTAL NUMBER OF SHEETS: 74

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'

3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

BIDDER'S STAMP & SIGNATURE

SECTION 'I'

SPECIFIC TECHNICAL REQUIREMENTS

	TITLE : TECHNICAL SPECIFICATION FOR OIL FILLED TRANSFORMERS	SPECIFICATION NO. PE-TS-405-302-E002 VOLUME NO. : II SECTION : I REV NO. : 00 DATE : 18.02.2022 SHEET : 2 of 3

1.0 SCOPE OF ENQUIRY

1.1 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **OIL FILLED SERVICE TRANSFORMERS** as mentioned in different sections of this specification, complete with all accessories for efficient and trouble-free operation.

1.2 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respect to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation.

1.3 Standard technical requirements of the oil filled service transformers are indicated in Section-II. Project specific requirements/changes are listed in Section-I.

1.4 <u>The requirements of Section-I shall prevail and govern in case of conflict between the corresponding requirements of Section-I and Section-II.</u>

2.0 BILL OF QUANTITIES:

2.1 Quantity requirements shall be as per BOQ-cum-price schedule as part of NIT.

3.0 SPECIFIC TECHNICAL REQUIREMENTS

3.1 Refer Annexure-III A attached with Section I for project specific requirements.

S.No.	***Reference Clause No. of Section- II***	***Specific Requirement/ Change***
1.	**7.00.00 COMMISSIONING SPARES, SPECIAL TOOLS & TACKLES AND O & M SPARES**	This clause stands deleted.

4.0 STANDARD QUALITY PLAN

	TITLE : **TECHNICAL SPECIFICATION FOR** **OIL FILLED TRANSFORMERS**	SPECIFICATION NO. **PE-TS-405-302-E002** VOLUME NO. : **II** SECTION : I REV NO. : **00** DATE : 18.02.2022 SHEET : **3** of **3**

S.No.	***Reference Clause No. of Section- II***	***Specific Requirement/ Change***
1.	6.01.00	This shall be read as " Customer's Standard QP (0000-999-QOE-S-036 REV 00) is enclosed as per Annexure-A of section-II, volume-II for reference. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ ultimate customer's approval. There shall be no commercial or delivery implication to BHEL on account of QP approval.
2.	ANNEXURE - A	Project specific requirements are mentioned in annexure II A & annexure-II B to section I. Same are also to be considered along with ANNEXURE-A Standard Quality Plan of Section-II.

5.0 DOCUMENTATION

5.1 Documents required along with technical offer shall be as per annexure-I.

5.2 Documents required after award of LOI shall be as per NIT.

ANNEXURE – I

DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER

a) The enclosed Data Sheet-B filled up completely for each rating/ type of transformers.
b) Schedule of deviations.
c) Schedule of BOQ cum price schedule. (Unpriced)
d) Schedule of Mandatory spares. (Unpriced)
e) GA drg of each of 2 MVA, 5MVA & 10 MVA transformers

Annexure- IIA (Project Specific Requirement)

Any clause mentioned below if not applicable for ONAN type transfomers need not be considered.

Chapter 10 : AUXILIARY POWER TRANSFORMERS

1.00 SCOPE OF SUPPLY

2 MVA /5 MVA/10MVA

ONAN

1.01.00 The scope of supply shall include 11/3.45kV Auxiliary Power transformers as follows and details mentioned in datasheet:

Auxiliary Transformers (~~ex-Unit, Station, CW, CHP, AHP, RW, Intake etc~~) shall be three phase, two winding, 11/3.45 kV, (*) MVA, Dyn1 , 50 Hz, *cooled with ±5% off circuit taps in steps of 2.5% on HV side. 3.3 kV system shall be suitable for medium resistance earthing with earth fault current limited to 300A.

1.02.00 Each transformer shall be furnished complete with

(a) Fittings and accessories

(b) Auxiliary equipment

(c) First filling of oil including 10% extra

1.06.00 All relevant drawings, data and instruction manuals.

2.00.00 CODES AND STANDARDS

2.01.00 All equipment and material shall be designed, manufactured, and tested in accordance with the latest applicable following Indian Standard (IS)/IEC, except where modified and/or supplemented by this specification.

The electrical installation shall meet the requirements of Indian Electricity Rules 1956 & ISO: 10028 'Code of practice ' for selection, installation & maintenance of transformers as named up to date.

2.01.02 Equipment and material conforming to any other international standard, which ensures equal or better quality, may be accepted. In such cases, copies of the English version of the standard adopted shall be submitted along with the proposal.

IS:2026 (Part I to IV)	Power Transformers.

IS:6600/BS: CP:1010	Guide for loading of oil immersed transformers
IS:335	New insulating oil for transformers and switchgears
IS:3639	Fittings and accessories for power Transformers
IS:2099	High voltage porcelain bushings
IS:2705	Current transformers
IS:334	Dimensions for porcelain Transformer bushing
IS:3202	Code of practice for Climate proofing of electrical equipment
IS:2147	Degree of protection
IS:2071	Method of high voltage testing
IS:3637	Gas operated relays
IS:1271	Classification of insulating materials for Electrical Machinery and apparatus in relation to their stability in service.
IS:5	Colours for ready mixed points
IS:10028	Code of practice for selection, Installation and maintenance of transformers Part I, II and III
	CBIP Manual on transformers.

3.00.00 COMPLETENESS OF SUPPLY

3.01.00 It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to the highest standard of engineering, design and workmanship.

3.02.00 Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble-free operation and maintenance of the equipment shall be furnished without any extra charge.

4.00.00 DESIGN CRITERIA

4.01.00 The transformer will be used to supply power to unit and station auxiliaries. The high voltage winding will be connected to HV switchgear.The low voltage winding shall feed 3.3kV switchgear.

4.02.00 The transformer will be installed in hot, humid and tropical atmosphere.All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

4.03.00 The transformer shall be capable of continuous operation at specified rating under the following conditions:

i.	Voltage variation	--	+/- 10%
ii.	Frequency variation	--	+/- 5%
iii	Combined voltage and Frequency variation (absolute sum)	--	10%

4.04.00 Transformers shall withstand, without injurious heating, combined voltage & frequency fluctuations, which produce the following over fluxing condition:

A) 110 % - continuous

B) 125% - for one minute

C) 140% - for five seconds

4.05.00 The transformer shall be free annoying hum or vibration. The design shall be such as not to cause any undesirable interference with radio or communication circuits.

4.06.00 The noise level shall be limited to the value specified by NEMA standard Publication No. TR-1-1993 when measured in accordance with conditions outlines in ANSI/IEEE C57.12.90-1999/IS 13964/CBIP publication.

Transformers shall be capable of operating under natural cooled condition up to the specified load as indicated. ~~The forced cooling equipment shall come into operation by preset contacts of winding temperature indicator & the transformer shall operate as a forced cooled unit as ONAF and also as ONAN.~~

4.07.00 ~~Total cooling system of transformer with oil natural & air forced (ONAF) cooling shall be so designed that during total failure of power supply to cooling fans, the transformer shall be able to operate at full load for at least ten (10) minutes without the calculated winding hot spot temperature exceeding 140 deg. C. Also stopping of one of the cooling fan should not have any effect on the cooling system of transformers.~~

4.08.00 The maximum flux density in any part of the core & yoke at the rated MVA, voltage & frequency shall be such that under 110% continuous voltage condition it does not exceed 1.9 tesla.

4.09.00 The transformer & all its accessories including CTs etc shall be designed to withstand without injury the thermal & mechanical effects of any external short circuit to earth & of short circuits at the terminal of any winding for a period of 2 secs. Contractor shall submit the short circuit withstands calculations.

4.11.00 The transformers shall be capable of being operated continuously with out danger on any tapping at the rated KVA with voltage variation of ±10% corresponding to the voltage of tapping.

4.12.00 The transformers shall be capable of being loaded in accordance with IS: 6600 / IEC: 354 up to load of 150 %. There shall be no limitation imposed by bushings, tap changers etc. or any other associated equipment.

4.13.00 The transformers shall be designed with particular attention to the suppression of maximum harmonic voltage, especially the third and fifth so as to minimize interference with communication circuit.

5.00.00 ~~**SIZING**~~

5.01.00 ~~It will be the responsibility of the contractor to adequately size the transformers to cater for all the auxiliaries of the main equipment, mechanical systems and all other loads. In case during the operation of plant it is found that the rating selected is not adequate due to incorrect~~

load assumptions or due to any other reason, it will be Contractor's responsibility to replace the transformer and associated switchgear and breakers.

5.02.00 Additionally, a margin of 10% over the MVA arrived shall be provided for variations of the loads. Due consideration shall be given for the reduction in nameplate MVA capacity due to regulations.

6.00.00 SPECIFIC REQUIREMENT

The features & construction details of each transformer shall be in accordance with the requirement stated hereunder.

6.01.00 TANK

6.01.01 Each tank shall be provided with:

1. Lifting lug suitable for lifting the equipment complete with oil.
2. A minimum of four jacking pads in accessible position to enable the transformer complete with oil to be raised or lowered using hydraulic or mechanical screw jacks.All heavy removal parts shall be provided with eye bolt for ease of handling.
3. Suitable haulage holes shall be provided for transformer wheeling in all four directions.

Tank shall be of welded construction & fabricated from tested quality low carbon steel of adequate thickness. The welding procedure specified (WPS), procedure qualification record (PQR), shop welding schedule, welder's qualification shall be subject to Owner's approval. After completion of welding, all joints shall be subjected to dye penetration testing. Weld joints at all loads bearing member shall be left unpainted till carrying out of DP test during final inspection of transformer. Details of acceptance norms of welding shall be submitted for Owner's approval which shall include permissible undercut, overlap, surface crack, porosity, out of alignment of plate surface in butt joints, maximum gap due to incorrect fit up of fillet joint etc.

6.01.02 The tank wall shall be reinforced by stiffener to ensure rigidity so that it can withstand without any deformation:

a) mechanical shock during transportation
b) oil filling by vacuum
c) Short circuit forces
d) Continuous internal pressure of 35 kN/m² over normal hydrostatic pressure of oil.

6.01.03 All removable covers shall be provided with weatherproof, hot oil resistant, resilient gaskets. The design shall be such as to prevent any ingress of water into or oil from the tank.

6.01.04 The transformers are to be provided with flanged bi-directional wheels & axles for rolling the transformer parallel to either center line 1676mm rail guage. Suitable locking arrangement shall be provided for the wheels to prevent accidental movement of transformer. In case more than two rails are required to be provided the rail guage of 1676mm shall be maintained between two adjacent rails.

6.01.05 At least two adequately sized inspection openings one at each end of the tank shall be provided for easy access to bushing & earth connections. The inspection covers shall not weight more than 25 Kg. Handles shall be provided on the inspection cover to facilitate lifting.

6.01.06 Turrets & other parts surrounding the conductor of individual phase shall be non-magnetic.

6.1.07 All bolted connections shall be fitted with weather proof, hot oil resistant, rubberized cork gasket in between for complete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over compression.

6.01.08 ~~The tank shall be designed in such a way that it can be mounted on the plinth directly.~~

6.01.09 Suitable guide shall be provided in the tank for positioning the core and coil assembly.

6.02.00 Core

6.02.01 The core shall be constructed from high-grade non-aging, low loss, high permeability, cold rolled, super grain oriented, silicon steel laminations, known as HI-B steel trade name.

6.02.02 The insulation of core to bolts & core to clamp plates shall be able to withstand a voltage of 2 kV (rms.) for 1 minute in air.

6.02.03 The core earthing has to be done outside the tank with suitable bushing to facilitate core isolation test during pre-commissioning stage.

6.02.04 Adequate lifting lugs will be provided to enable the core & windings to be lifted.

6.03.00 Windings

6.03.01 The contractor shall ensure that windings are made in dust proof & conditioned atmosphere.

6.03.02 The conductors shall be of electrolytic grade copper free from scales & burrs and fully insulated for rated voltage.

6.03.03 Insulating material shall be of proven design. Coils shall be so insulated that impulse and power frequency voltage stresses are minimum.

6.03.04 All windings of the transformers shall be fully insulated and Insulation class shall be of Class A.

6.03.05 Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratio.

6.03.06 Coil assembly shall be suitably supported between adjacent sections by insulating spacers and barriers. Bracing and other insulation used in assembly of the winding shall be arranged to ensure a free circulation of the oil and to reduce the hot spot of the winding.

6.03.07 All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used where practicable.

6.03.08 The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer or under short circuit stresses.

6.04.00 Insulating Oil

6.04.01 The oil supplied with transformers shall conform to all parameters as per IS: 335 while tested at supplier's premises. No inhibitors shall be used in oil.

6.04.02 The transformer shall be filled with mineral insulating oil suitably inhibited to prevent sludging.

64.04.03 First filling of oil along with 10% excess shall be furnished for each transformer. Oil shall be supplied in non-returnable drum suitable for outdoor storage.

4.04.04 Oil preservation shall be by means of bellows/ diaphragm sealed conservator tank with silica gel breather to avoid direct connection between atmosphere and transformer oil. It shall be complete with level gauges, pipes, drain valve, bucholz relay with shut-off valves at both sides etc. The level gauges shall be so placed that same can be readable standing from ground. Necessary device shall be kept to provide annunciation in the event of rupturing of bellow.

6.05.00 Terminal Arrangements

6.05.01 Bushings

The electrical & mechanical characteristics of bushings shall be in accordance with IS: 2099, IS: 3347 & IS: 12676. Bushings of rating below 52 kV shall be solid porcelain or oil communicating type.

6.05.02 Condenser type bushings shall be provided with:

1. Oil level gauge,
2. Oil filling plug & drain valve (if not hermetically sealed)
3. Tap for capacitance & tan delta test.
4. Clamps & fittings shall be hot dip galvanized steel.

6.05.03 Bushing turrets shall be provided with vent pipes that shall be connected to route any gas collection through the Buchholz relay.

6.05.04 No arcing horns shall be provided on the bushings.

6.05.05 Bushings shall be provided with terminal connectors of approved type and size.

6.05.06 Bushing location shall provide adequate phase and ground clearance.

6.05.07 HV terminals for cable connection shall be brought out through top cover mounted bushings to a detachable cable_end box with disconnect link.

6.05.07 Low voltage winding neutral shall be brought out thru' side wall mounted bushing to a detachable cable end-box with disconnect link. Further this neutral shall be connected to NGR by suitably rated cable.

6.05.08 LV Neutral Bushing for ~~Unit Auxiliary~~ Transformer shall be provided with two (2) numbers of independent CTs. One for standby earth fault (E/F) protection and other for restricted earth fault protection.

6.06.00 Bus Duct Terminations

6.06.01 A flanged throat or equivalent connection shall be provided for termination of busduct enclosure. The termination will be of segregated phase type for LV ~~of UAT~~. Phase segregation shall be achieved by metallic barriers.

6.06.02 Low voltage terminals shall be brought out through top cover mounted bushings wih matching flanges around each bushing for connection to SPBD. The contractor shall furnish all necessary details in this connection for co-ordination with the busduct and shall guarantee the matching dimensions with close tolerance.

6.06.03 The winding termination shall be on outdoor type of bushings. . The material of the busduct termination shall be non-magnetic.

6.06.04 A drain with stopcock arrangement shall be provided at flange to drain leakage of oil/water at termination.

6.06.05 Tolerance permissible for the height of the terminal connected to busduct over rail top level is ± 5 mm.

6.06.06 Contractor has to ensure that radiator & conservator does not obstruct the path of the bus ducts in position & during movement of transformer. The contractor shall co-ordinate final design of terminal arrangement to suit bus duct arrangement.

6.06.07 The transformer bushing enclosed in bus duct enclosure shall be designed for satisfactory operation in the high ambient temperature existing inside the bus duct enclosure.

6.06.08 In general, the arrangement shall be such as to permit removal of transformer and core/coil assembly without dismantling the bus duct/cable connection.

6.07.00 Cable boxes

6.07.01 The cable end-box shall be self-supporting, weather-proof, air filled type complete with all hardware such as gland plate, brass glands, tinned copper lugs, armour clamps etc.

6.07.02 Wherever cable connections are specified, suitable cable boxes shall be provided and shall be air insulated.

6.07.03 The additional supports for the cable boxes shall be galvanized iron.

6.07.04 The contractor shall provide earthing terminals on the cable box, to suit 50 mm x 6 mm GS flat.

6.08.00 Bushing Current Transformer

6.08.01 Current transformer shall comply with IS: 2705. These CTs shall be mounted in the turret of bushing. Provision of the same inside the tank is not permitted.

6.08.02 It shall be possible to remove turret mounted current transformers from the transformer tank without removing the tank cover. Necessary precautions shall be taken to minimize eddy currents & local heat generated in the turret.

6.08.03 All secondary leads shall be brought to a weatherproof terminal box near each bushing. These terminals shall be wired out to cooler control cabinet using separate cables for each core.

6.08.04 All secondary leads of bushing mounted CT's shall be brought to a terminal box near each bushing and then wired upto transformer marshalling box.

6.08.05 The CT terminals shall have shorting facility.

6.09.00 Common Marshalling Box (CMB), ~~Cooler Control Cabinet (CCC) Unit~~

6.09.01 Each transformer shall be provided with ~~one cooler control cabinet housing all the cooler control, OTI, WTI for each winding etc. for one unit. Alternatively the contractor may provide two different boxes; one for housing cooler controls named as cooler control cabinet & separate~~ box for housing OTI, WTI etc. named as Marshalling box.

6.09.02 Tank mounted vermin and dust proof marshalling box shall be provided to accommodate indication circuits and temperature indicators etc. and provided with proper lighting and thermostatically controlled space heaters.

6.09.03 Marshalling Box shall be of CRCA sheet steel construction with protection class of ~~IP-52 for indoor and~~ IP-55 for outdoor installation.

6.09.04 The frames and load bearing panels shall be fabricated of not less than 2 mm thick sheet steel. The doors and covers shall not be less than 1.6mm thick.

6.09.05 All access doors shall be provided with channel rubber/ neoprene gaskets all round.

6.09.06 The operating height shall be limited from 750 mm to 1800 mm.

6.09.07 The operating handle shall have locking arrangement. The panels shall be complete with floor channel sills, vibration damping pads and stainless steel kick plates.

6.09.08 All instrument, relays, switches, etc. mounted on the front face of the panel shall be flush or semi flush type. Switch contacts shall be silver faced and rated at least 10 Amp at operating voltage. Push buttons shall have required number of contacts.

6.09.09 Box shall be provided with internal illumination lamp with door switch, space heater with thermostat one 5A, 3 pin receptacles with plug.

6.09.10 The annunciation system shall be solid-state type with optical isolation for input signals. It shall be complete with its own power supply, audible alarms, acknowledge, reset, and test buttons and other necessary accessories.

6.09.11 Marshalling Box shall be fully wired up at factory. All spare contacts of relays and switches shall be wired upto the terminal blocks.

6.09.1 Marshalling Box shall have provision of cable entry from bottom. Bottom gland plate shall be 3mm thick.

4.09.13 50 x 6 mm GS flat ground bus shall be provided on the panel extending along the entire length of the assembly. The ground bus shall have two-bolt drilling with GS bolts and nuts at each end to receive plant grid's ground connection.

6.09.14 Cubicle lamp with door switch, space heater with thermostat and removable cable gland plate shall be provided, cable entry shall be through bottom.

6.10.00 Terminal Blocks

6.10.01 The terminal blocks to be provided shall be fully enclosed with removable covers & made of molded, non-inflammable plastic material with blocks & barriers molded integrally. The terminal blocks shall be 1100V grade & have 10 A continuous rating. Terminal blocks for current transformer secondary leads shall be provided with test links & isolating facilities. Also current transformer secondary leads shall be provided with short circuiting & earthing facilities .At least 20% spare terminals shall be provided on each panel & these spare terminals shall be uniformly distributed on all terminal blocks.

6.10.02 Terminal blocks shall be suitable for connecting the following conductors on each side:

i)	Current transformer circuits	-	Minimum of two Nos. of 2.5 sq. mm copper wires each side
ii)	Other circuits	-	Minimum of one No. of 2.5 sq. mm copper wire each side

6.10.03 The temperature indicators shall be so mounted that the dials are not more than 1200 mm from ground level. Glazed door of suitable size shall be provided for convenience of reading.

6.10.04 One ~~cooler control cabinet~~ / marshalling box of each type for each rating of transformer shall be tested for IP 55 protection in accordance with IS: 2147.

6.11.00 TAPPING

6.11.01 Off-circuit tap change (OCTC) as specified in the Datasheet-A shall be provided on the high voltage winding.

6.11.02 The transformer shall be capable of operation at its rated kVA on any tap provided the voltage does not vary by more than ±10% of the rated voltage corresponding to the tap.

6.11.03 The winding including the tapping arrangement shall be designed to maintain electromagnetic balance between HV and LV windings at all voltage ratios.

6.12.00 OFF-CIRCUIT TAP CHANGER (OCTC)

6.12.01 The off-circuit tap changing will be affected by a gang operated switch for three-phase unit. Arrangement shall such that switch can be operated at standing height from ground level.

6.12.02 The operating handle can be padlocked at any tap position. The design shall be such that the lock cannot be inserted unless the contacts are correctly engaged.

6.12.03 The mechanism shall be provided with a mechanical tap position indicator and an operation counter.

6.12.04 All contacts shall be silver plated and held in position under strong contact pressure to ensure low contact drop and avoid pitting.

6.13.00 Cooling Equipment

6.13.01 Cooling equipment shall conform to the requirement stipulated below:

a) The cooler shall be designed using 2x50% radiator banks. ~~Design of cooling system shall satisfy the requirements as stipulated.~~

b) Transformer fitted with multiple cooling units but without having stand-by cooling units, it shall be able to deliver its rated output not exceeding specified temperature rise and calculated hot-spot temperature of 150°C under following conditions:

~~(i.) for 20 minutes after failure of the blowers of one unit~~

(ii.) for 10 minutes in the event of failure of the cooler units

c) Each radiator bank shall have its own ~~cooling fans,~~ shut off valves at the top and bottom (80mm size) lifting lugs, top and bottom oil filling valves, air release plug at the top, a drain and sampling valve and thermometer pocket fitted with captive screw cap on the inlet and outlet. Radiators shall be detachable type with top and bottom isolating valve to permit removal of the same without draining oi from the tank.

d) ~~Cooling fans shall not be directly mounted on radiator bank which may cause undue vibration. These shall be located so as to prevent ingress of rain water. Each fan shall be suitably protected by galvanized wire guard. The exhaust air flow from cooling fan shall not be directed towards the main tank in any case.~~

e) ~~Cooling fan motor shall be suitable for operation on 415 ±10% V, three phase, and 50 Hz ±5%, power supply & shall conform to IS: 325. Each cooling fan motors shall be provided with starter with thermal overload & short circuit protection. Motor shall have enclosure with degree of protection equivalent to IP 55 as per IS: 4691. The temperature rise of the motor shall be limited to 70 deg. C above ambient of 50 deg. by winding resistance method & shall comply with IS: 325.~~

f) The cooler & its accessories shall preferably be hot dip galvanized or corrosion resistant paint should be applied to it.

g) Fault Indicating device

h) For each transformer, an alarm contact shall be furnished to indicate the unintended stoppage of a fan. The contractor shall also indicate if any additional alarm/indication lamp is required to be provided in Central control room.

i) Following lamp indications shall be provided in CCC:

(i.) Cooler supply failure (main)
(ii.) Cooler supply changeover
(iii.) Cooler supply failure (standby)
(iv.) Control supply failure
(v.) Common thermal overload trip
(vi.) Cooling for failure for each bank

One potential free initiating contact for all the above conditions including alarm for "failure of supply changeover" shall be wired independently to the terminal blocks of CCC exclusively for elsewhere.

j) All fans shall have safety guard.

k) Convenient means shall be provided to remove or replace any fan with the transformer in service.

l) Complete control for fans inclusive of all switches, fuses, starters, relays and wiring shall be furnished. Each motor circuit shall have over load and short-circuit protection.

m) Fan motor controls will be actuated automatically from winding temperature indicator contacts. Provision shall however be kept for manual operation from local cooler control panel and remote from central control room by serial link communication with the plant DCS.

6.13.02 Cooling Equipment Control

a) Automatic operation control fans/pumps shall be provided (with temp. change) from contacts of winding temperature indicator. The Contractor shall recommend the setting of WTI for automatic change over of cooler control from ONAN to ONAF. The setting shall be such that hunting i.e. frequent start-up operation for small temperature differential does not occur.
b) Suitable manual control facility for cooler fans shall be provided.
c) Selector switches and push buttons shall also be provided in the cooler control cabinet to disconnect the automatic control and start/stop the fans manually.

6.14.00 Auxiliary Power Supply as applicable

6.14.01 Two Auxiliary Power Supplies at 415 V three phase four wire at marshalling box cabinets.

6.14.02 All loads shall be fed by one of the two feeders through an electrically interlocked automatic transfer switch housed in the CCC for transformers. Design features of the transfer switch shall include the following:

a) Provision for the selection of one of the feeder as normal source & other as standby.

b) Upon failure of the normal source, the loads shall automatically transfer, after an adjustable time delay, to standby source.
c) Indication to be provided for failure of normal source & for transfer to standby source.
d) Automatic re-transfer to normal source without any intentional time delay following re-energization of the normal source.
e) Both the transfer & the re-transfer shall be dead transfers & AC feeders shall not be paralleled at any time.

6.15.00 Control Wiring & Cabling.

6.15.01 All control, alarm and indication devices provided with the transformer shall be wired upto the terminal blocks.

6.15.02 Wiring shall be done with flexible, 1100V grade PVC wires in conduit or PVC armored cable. Minimum wire size shall be 2.5 mm^2 copper. Not more than two wires shall be connected to a terminal. 10% spare terminals shall be provided.

6.15.03 Multi-way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm^2 stranded copper conductor and provided with acrylic insulating cover. Terminals for C.T. secondary leads shall have provision for shorting and grounding.

6.15.04 All devices and terminal blocks shall be identified by symbols corresponding to those used in applicable schematic or wiring diagram. Each wire shall be identified, at both ends, with interlocking type permanent markers bearing wire numbers as per Contractor's Wiring Diagrams. AC / DC wiring shall have separate color-coding.

6.15.05 Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

6.16.00 GROUNDING

6.16.01 The grounding pads, located on the opposite sides of the tank, shall be provided for connection to station ground mat.

6.16.02 Grounding pad shall have clean buffed surface with two tapped holes, M10 G.S. bolts and spring washers for connection to 75x10 mm G.S. flat.

6.16.03 Ground terminals shall be also provided on marshalling box to ensure its effective earthing.

6.16.04 For continuity of earth connection, all gasketted joints shall be provided with braided copper wire jumpers.

6.16.05 LV Neutral earthing shall be done by using an earthing resister to limit the fault current to 300 A.

6.17.00 GALVANIZING

6.17.01 Galvanizing where specified shall be applied by the Hot-dipped process or by electro-galvanizing process and all parts and steel wires as specified and shall

consist of zinc coating equivalent to not less than 750gm of zinc per square meter of surface. The zinc coating shall be smooth, clear and uniform thickness and free form defects. The preparation of galvanizing and galvanizing itself shall not adversely affect the mechanical properties of material and coated material.

6.17.02 Galvanizing of wires shall be applied by the hot-dipped process and shall meet the requirements of relevant standards.

6.17.03 All drilling, punching, cutting, bending and welding of parts shall be completed and all burrs shall be removed before the galvanizing process is applied.

6.17.04 Surfaces, which are in contacts with oil, shall not be electro galvanized/ cadmium plated.

6.18.00 Painting

6.18.01 The paint inside the tank shall be of white colour. The internal & external surface including oil filled chambers & structural steel work to be painted shall be shot or sand blasted to remove all rust & scale or foreign adhering matter. All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant, oil insoluble, insulating varnish. No grinding is permitted afterwards.

6.18.02 All steel surfaces exposed to weather shall be given a primary coat of Zinc chromate, second coat of oil & weather resistant varnish of a colour distinct from primary & final two coats of glossy oil & weather resisting non fading paint of colour corresponding to shade RAL 7032

6.18.03 All paints shall be carefully selected to withstand heat & extremes of weather. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

6.18.04 Sufficient quantity of touch up paint shall be furnished for application after installation at site.

6.18.05 If it is considered necessary, the transformer may be given a further coating at site by the Owner/Purchaser.

7.00.00 TRANSPORTATION

7.01.00 Transformer tank shall be dispatched filled with oil or pure dry inert Nitrogen gas depending upon the transport weight limitations. A positive pressure of 2 to 2.5 Psi at temperature of 36oC approximate shall be kept. In case the tank is filled with oil, sufficient space is left above the oil to take care of the expansion of the oil. The space is filled with pure dry air or inert gas under atmospheric pressure.

7.01.02 The temperature and pressure at the time of gas filling shall be marked on a tag. A graph showing pressure vs. temperature shall be attached for reading pressures at different temperatures. Necessary valves, two stage pressure regulators, filled up Nitrogen cylinder etc. along with other accessories required shall be provided with the tank for intermittent replenishment during transportation.

7.01.03 Impact Recorder

Impact recorder/indicator shall be provided to monitor the impact experienced by the transformer during transport & it shall be returnable.

8.00.00 INSPECTION AND TESTING

a) The contractor shall carry out a comprehensive inspection and testing program during manufacture of the transformer. It is Contractor's responsibility to draw up and carry out such a program in the form of detailed quality plan duly approved for necessary implementation.

b) The Contractor shall carry out all type tests and routine tests on the transformers. Special tests other than type and routine tests as listed in below shall be carried out as per IS: 2026.

8.01.00 List Of Tests to be Conducted

I. Routine test

1. All routine test in accordance with IS 2026 / IEC 60076 shall be carried out on all transformer. Measurement of no load losses & current shall be done at 90%, 100% & 110% of rated voltage. Impedance & load loss measurement are to be done at max., min & normal tap position. Dielectric test shall be carried out as per IEC- 60076-3.

   In addition, the following tests shall be performed on each transformer:

   1) Transformer tank with coolers shall be tested for leaks with normal head of oil plus 35 KN/m² for a period of 8 hours. If any leak occurs, the test shall be conducted again after all leaks have been repaired.

   2) During fabrication stage, the tank shall be pressure tested with air at a pressure corresponding to twice the normal head of oil or normal pressure plus 35KN/m² whichever is lower for a period of one hour. Also the tank designed for full vacuum shall be tested for maximum internal pressure of 3.33KN/m² for one hour. The permanent deflection of flat plates shall not exceed CBIP specified figures on release of excess pressure of pressure test and on release of vacuum.

   3) After assembly, each core shall be pressure tested for one minute at 2kV (r.m.s.) A.C. between all bolts, side plates, structural steel works and the core.

   4) The wiring for auxiliary power and control circuitry shall be subjected to withstand one minute power frequency test with 2kV (r.m.s.) to earth.

   5) Magnetic balance test

   6) Repeat no load current/loss measurement after completion of all electrical tests.

   7) Oil leakage test: This test shall be done on completely assembled transformer for the unit on which type test shall be done. On the other units this may be conducted without conservator & coolers.

   8) D.P. test.

9) 2 kV for one minute isolation test for core.

10) Measurement of no load current with 415 V, 50 Hz AC supply.

11) Measurement of capacitance & tan delta between winding & earth.

12) IR measurement.

13) Frequency response analysis test

14) All test on transformer oil as per IS 335.

II. Type Tests

Following type tests shall be conducted on one transformer of each rating:

1) Temperature rise test: Temperature rise test shall be performed at a tap corresponding to maximum losses. The test shall be carried out at minimum 110 % of rated current. Oil samples as per IEC 567 shall be taken before & immediately after temperature rise test. DGA shall be conducted on this oil sample & the values shall be recorded in the report. For evaluation of gas analysis in temperature rise test the procedure shall be as per IS: 9434 (based on IEC: 567) & results will be interpreted as per IS: 10593 (based on IEC: 599).

2) Tank vacuum test as specified elsewhere in this specification.

3) Tank pressure test as specified elsewhere in this specification.

4) Lightning impulse test on HV & LV winding for ~~UAT~~ as per Cl. 14 of IEC 60076-3.

5) Short circuit test: The test procedure shall be as per IEC 76-5. All type tests other than tank tests shall be conducted only after S.C. test to ensure delivery of healthy & proven transformer. All dielectric routine tests shall be conducted before & after S.C. test at full value.

   Further following shall also be done before & after S.C. test:
   a. Dissolved gas analysis
   b. Frequency response analysis

6) Recurrence surge oscillograph Measurement. (if applicable for transformer)
7) Reports for DOP test - IP-55 test on CCC / CMB~~/OLTC~~ cabinet of each type for each rating of transformer to be submitted.

Special Test

Following special test shall be conducted on the transformer of each rating

a. Power taken by cooling equipment
b. No load harmonic measurement
c. Noise level measurement as per NEMA TR-1
d. Zero sequence impedance measurement

~~**9.00.00 INSPECTION AND TESTING AT SITE**~~

10.00.00 MISCELLANEOUS

All component parts and auxiliary equipment such as oil, bushings, C.Ts etc. shall be routine tested as per relevant Indian Standards.

11.00.00 TEST WITNESS

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at lest fifteen (15) days advance notice of the date when the tests are to be carried out.

12.00.00 TEST CERTIFICATES

Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner/Purchaser.

The equipment shall be dispatched from works only after receipt of Owner/Purchaser's written approval of the test reports.

14.00.00 FITTINGS & ACCESSORIES

Transformer shall be equipped with fittings and accessories as listed below:

i. Oil conservator with filler cap, drain plug, plain oil level gauge and alarm contacts for rupturing of bellows/diaphragm.

ii. Oil preservation system complete with accessories.

iii. Air release plugs.

iv. Pressure release device with trip contacts. Explosion vent, if provided, should be double diaphragm type.

v. 150 mm dial magnetic oil level gauge with low level alarm contacts

vi. 150 mm dial oil temperature indicator with maximum reading pointer and electrically separate contacts for trip and alarm and embedded temperature detectors (PT-100) with suitable output for remote indication (data logging).

vii. 150 mm dial winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip, alarm and cooler control and embedded temperature detectors (PT-100) with suitable output for remote indication (data logging).

viii. Remote winding temperature indicator for mounting on panel with a separate detector element.

ix. Thermometer pockets.

x. Double float Buchholz relay with gas release cock, shut-off valve on either sides with separate sets of contacts for trip and alarm.

xi. Filter valve with threaded adopter (top and bottom).

xii. Drain valve with threaded adopter.

xiii. Sampling valve.

Necessary valves for detachable cooler units.

i. 7.15 Jacking pads, handling and lifting lugs.

ii. 7.16 Cover lifting eyes.

iii. 7.17 Bi-directional flanged wheels and skids.

iv. 7.18 Clamping device with bolts & nuts.

v. 7.19 Hand-hole of sufficient size for access to interior of the tank.

vi. 7.20 Two-grounding pads.

vii. Ladder with safety device for access to the top of transformer tank.

viii. Weather proof marshalling box for housing control equipment and terminal connections.

ix. H.V. and L.V. bushing terminal connectors.

x. Rating and terminal marking plates.

xi. Cooler units complete with valves, fans, supporting structure with fixing and foundation bolts etc as required and Cooler Control panel.

xii. Tap-changing gear complete with tap position indicator, operation counter etc.

xiii. Note: All indication, alarm, trip contacts provided shall be rated for 0.5A at 220 V D.C. and 5A at 240 V A.C.

15.00.00 AUXILIARY EQUIPMENT

Transformer shall be provided with LV and Neutral bushing current transformers as specified as indicated below:

	L.V Phase CT	**L.V. Neutral CT**	
Application	CT-1	CTN-1	CTN-1
	Restricted	Restricted	Stand by
	Earth Fault	Earth Fault	Earth Fault

630A /1000A/2000A

Quantity	3	1	1
Current Ratio	300/1 (Ith≥Continuous current with 10% margin)	300/1	300/1
Class	PS	PS	5P20
Burden VA	-	-	30
Rated frequency	50	50	50
Voltage class kV	3.6	3.6	3.6

The arrangement shall be such that the C.T. can be removed from the transformer without removing the tank cover.

CT secondary leads shall be wired upto the terminal blocks.

CT details indicated are tentative. CT detailed particulars shall be given to successful bidder during detailed engineering. There shall be no commercial implication to BHEL on this account

ANNEXURE II B

E7: AUXILIARY POWER TRANSFORMERS

ATTRIBUTES / CHARACTERISTICS → ↓ ITEMS, COMPONENTS, SUB SYSTEM ASSEMBLY	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatiblity with oil	Core Loss (on first job only), Hot Spot	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	10 kV Isolation test on core	WPS & PQR	Routine Test as per relevant standard	Vacuum & Pressure Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y						Y							Y
Conservator / Radiator / Cooler / Pipes	Y	Y						Y							
Copper Conductor (IS:191)	Y	Y	Y		Y										
Insulating Material	Y	Y	Y	Y	Y	Y									
CRGO Lamination & Built Core	Y	Y	Y		Y	Y	Y								
Bushing / Insulator (IS:2544 / 5621)	Y	Y												Y	
Gasket	Y				Y	Y			Y					Y	
Air Cell	Y													Y	
Transformer Oil (IS:335)														Y	
On Load / Off-Circuit Tap Changer (IEC :214)	Y													Y	
Core Coil Assembly & Pre-tanking	Y									Y		Y			

Marshalling Box	Y	Y					Y					Y	
WTI, OTI, MOG, PRD, Thermister, Breather, Terminal Connector, Bushing CT, ~~Fan & Pumps with Drives~~, Impact Recorder, Bucholz Relay, Globe & Gate Valve, PD Detector, FRA and DGA Equipment									Y			Y	
Welding (ASME Sect-IX)	Y										Y		

ATTRIBUTES / CHARACTERISTICS ↑ → ITEMS, COMPONENTS, SUB SYSTEM ASSEMBLY	Oil Leakage Test	Jacking test followed by DP Test om load bearing Member	DGA of Oil for main tank and OLTC Chamber	Measurement of capacitance and tan delta	Partial Discharge measurement (long duration)as per IEC-76 clause No. 12.4	Routine Test	Paint Shade, Thickness and finish	Nitrogen Dew Point Measurement before final packing on transformer at receipt at site.
Complete Transformer (IS: 2026 / IEC:76)	Y	Y	Y	Y	Y	Y	Y	Y

Notes :

1) This is an indicative list of checks / tests. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents during QP finalisation for all items.
2) All major Bought Out Items will be subject to Owner / Owner Engineer approval.

	TITLE :	SPECIFICATION NO.
BHEL	**TECHNICAL SPECIFICATION FOR**	**PE-TS-426-302-E002**
		VOLUME NO. : **II**
	OIL FILLED TRANSFORMERS	SECTION : I
		REV NO. : **00** DATE : 18.02.2022
		SHEET : 1 of

DATA SHEET –A

11/3.45 kV
OIL FILLED TRANSFORMER

S. No.	Description		Unit	Particulars
1.0	Quantity	No. & kVA		4 no. of 2000 KVA 4 no. of 5000 KVA 2 no. of 10000 KVA
2.0	Installation			Out Door
3.0	Type of insulating oil			Mineral
4.0	No. of phase		No(s)	03
5.0	Frequency		Hz	50
6.0	Type of cooling			ONAN
7.0	Rated Voltage a) HV Winding b) LV Winding		 kV kV	 11.0 3.45
8.0	No Load transformation ratio			11/3.45
9.0	Vector group			Dyn1
10.0	Impedance voltage at rated current and frequency		%	2000 kVA : 6% 5000 kVA : 7% 10000 kVA : 9%
11.0	Total range of tapping's and tapping steps			± 5% in steps of 2.5%
12.0	Type of tap changing equipment			Off-Circuit
13.0	Temperature rise a) Top oil by thermometer b) Winding by resistance 	 deg.C deg.C	 deg. C deg. C	 40 deg. C above ambient of 50 45 deg. C above ambient of 50
14.0	System Highest Voltage			

	TITLE :	SPECIFICATION NO.
BHEL	**TECHNICAL SPECIFICATION FOR** **OIL FILLED TRANSFORMERS**	**PE-TS-426-302-E002** VOLUME NO. : **II** SECTION : I REV NO. : **00** DATE : 18.02.2022 SHEET : of

	a) HV Winding		kV	12 kV,
	b) LV Winding		kV	3.6kV
15.0	Phase Connection			
	a) HV Winding			Delta
	b) LV Winding			Star
16.0	Insulation Levels			
16.1	One minute power frequency withstand voltage			
	a) HV Winding		kV	28
	b) LV Winding		kV	10
16.2	Impulse withstand voltage			
	a) HV Winding		kVp	75
	b) LV Winding		kVp	40
17.0	Terminal details			
	a) HV Line			Cable box (XLPE cables)
	b) HV Neutral			N.A.
	c) LV Line			
	i) 11KV/3.45KV			Flange throat for TPN segregated Al Busduct
	d) LV Neutral			
	i) 11KV/3.45KV			Cable box (XLPE cables)
18.0	System Fault Level			
	a) HV Winding	kA		50 kA RMS
	b) LV Winding	kA		40 kA RMS
19.0	Method of System Earthing			
	a) HV System			NA
	b) LV System			Low resistance earthed to limit earth fault current to 300A
	c) Through fault withstand time			2 Sec.
20.0	Details of Cooling Equipment			Detachable tank mounted radiators
21.0	Provision/ accommodation of CTs			

LV Phase	PS class 300/1 (Ith>=630A) 2000 KVA PS class 300/1 (Ith>=1000A)5000 KVA PS class 300/1 (Ith>=2000A)10000 KVA
LV Neutral	**2** Core(300/1A, PS CLASS & 300/1A 5P20) For 2 MVA,5 MVA & 10 MVA

CT detailed particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.

22.0 Colour Shade :

a) Interior (For M. Box) Refer Cl. No. 6.18.00

b) Exterior Refer Cl. No. 6.18.00

Painting details not covered in cl. no. 6.18.00 shall be given to vendor during DDE There shall be no commercial implication to BHEL on this account.

23.0 Space/ Layout Limitation if Any

24.1 Cable details (11KV/3.45KV) (Not in bidder scope of supply)

a) HV side

i)	Type	XLPE
ii)	Voltage Grade	11kV Unearthed
iii)	Conductor material & size	Stranded Aluminium,
	No. of cores & runs	1-3C-240 sq mm (2 MVA transformer) 1-1C-400 sq mm/ph (5 MVA transformer) 1-1C-630 sq mm/ph (10 MVA transformer)

b) LV side

i)	Type	N.A
ii)	Voltage Grade	kV N.A
iii)	Conductor material & size	N.A
iv)	No. of cores & runs	N.A

c) LV Neutral

i)	Type	XLPE
ii)	Voltage Grade	3.3kV Unearthed
iii)	Conductor material & size	Stranded Aluminium, 1C-240 sq mm
iv)	No. of cores & runs	One core, single run

25.0 Penalty for Losses

	TITLE :	SPECIFICATION NO.
BHEL	**TECHNICAL SPECIFICATION FOR** **OIL FILLED TRANSFORMERS**	**PE-TS-426-302-E002** VOLUME NO. : **II** SECTION : I REV NO. : **00** DATE : 18.02.2022 SHEET : of

	a) Rates for bid evalution		N.A.	
	b) i)'A' (for no load loss)		losses not to exceed max losses as per annexure-B to section-II, vol-II of the specification	
	ii) 'B' (for load losses)		- Do-	
	a) Rates for penalty			
	i) 'A' (for no load loss)		INR 2,46,000/- per kW	
	ii) 'B' (for load loss)		INR 2,46,000/- per kW	
26.0	Creepage distance		31mm/kV	
27.0	Method of Tap change Control			
a)	Manual local		Yes	
b)	Electrical local		No	
c)	Electrical Remote		No	
d)	Automatic		No	
28.0	Type of tank construction (bell type or conventional tank with cover)		Convention tank with cover	
29.0	Type of Oil preservation system		Bellows/ diaphragm sealed conservator with silica gel	
30.0	TRANSFORMER BUSHING	HV	LV	LV-N
	Voltage class kV(r.m.s.)	17.5	7.2	7.2
31.0	Full power tapping provided		Yes	

	TITLE : TECHNICAL SPECIFICATION FOR OIL FILLED TRANSFORMERS	SPECIFICATION NO. PE-TS-426-302-E002
		VOLUME NO. : II
		SECTION : I
		REV NO. : 00 DATE : 18.02.2022
		SHEET : of

DATA SHEET –B

TECHNICAL PARTICULARS

[*TO BE SUBMITTED ALOGWITH TECHNICAL OFFER*]

FOR 11kV/3.45kV

S. No	Description	Unit	Requirement	To be filled by bidder
1.	Rating	MVA	2/5/10	
2.	No Load transformation ratio	kV	11/3.45	
3.	Maximum No- load losses at rated frequency and 100% rated voltage	kW	2.4kW (Max.) for 2 MVA 5.5kW (Max.) for 5 MVA 9.0 kW (Max.) for 10 MVA	
4.	Maximum load losses at normal ratio, rated current and 75 deg. C	kW	24 kW (Max.) for 2 MVA 36 kW (Max.) for 5 MVA 72.0 kW (Max.) for 10 MVA	
5.	Overall Dimensions	mm x mm x mm		
6.	Total weight	kg		
7.	Total oil Quantity	kg		

	TITLE : TECHNICAL SPECIFICATION FOR OIL FILLED TRANSFORMERS	SPECIFICATION NO. PE-TS-426-302-E002
		VOLUME NO. : II
		SECTION : I
		REV NO. : 00 DATE : 18.02.2022
		SHEET : of

DATA SHEET –C

TECHNICAL PARTICULARS

[***TO BE SUBMITTED AFTER AWARD OF CONTRACT***]

DATA RELEVANT TO ONAN TYPE TRANSFORMER TO BE FURNISHED AFTER AWARD OF CONTRACT

7.00.00	**UNIT TRANSFORMERS & AUXILIARY TRANSFORMERS** (to be filled separately for each type)		
S. No.	**Description**		
1.00.00	**General**		
1.01.00		Service	
1.01.00		Make	
1.02.00		Type	
1.03.00		Number of windings per phase	
1.04.00		Number of phases	
1.05.00		Reference Standard	
2.00.00		**Rating**	
	-	Full load rating	
	-	Rating of each winding	
	-	Rating no load voltage	HV/LV
2.01.00		Type of cooling	
2.02.00		Rated output	MVA
	i)	With ONAN cooling	
	ii)	With ONAF cooling	
	iii)	With OFAF cooling	
2.03.00		Rated Voltage	kV
	L.V. H.V.		
2.04.00		Rated Current	Amps.
	L.V. H.V.		
2.05.00		Rated Frequency	Hz
2.06.00		Voltage Withstand Time	Sec.
	a)	110% of rated voltage	
	b)	120% of rated voltage	
	c)	125% of rated voltage	

	d) 130% of rated voltage		
	e) 140% of rated voltage		
	f) 150% of rated voltage		
2.07.00	Overfluxing Capability		Sec.
	a) For Overfluxing Factor 1.10		
	b) For Overfluxng Factor 1.20		
	c) For Overfluxing Factor 1.25		
	d) For Overfluxing Factor 1.30		
	e) For Overfluxing Factor 1.40		
	f) For Overfluxing Factor 1.50		
2.08.00	Rated no load voltage HV/LV	kV	
2.09.00	Full power tapping provided	Yes/No	
2.10.00	Power frequency withstand voltage of winding neutral of HV/ LV/HV(Dry &Wet)	kV /rms	
2.11.00	Type of voltage variation (CFVV/VFVV/C BVV)		
3.00.00	**Temperature**		
3.01.00	Reference		
	a) Ambient Temperature (max./max daily/min.)		
3.02.00	Temperature rise over reference ambient Deg. C.		
	a) Of top oil by thermometer		
	b) Of winding by resistance at OFAF rating		
3.03.00	Maximum continuous over loading capacity of transformer without exceeding the specified winding temperature		
4.00.00	**Insulation Level** H.V.	**kVp / kV**	

	L.V.	
	H.V. Neutral	
4.01.00	HV/LV imepedance voltage at rated current for the normal tapping HV/LV winding	
4.02.00	HV/LV reactance at rated current and rated frequency	
4.03.00	Separate source power frequency voltage withstand HV/LV winding	
4.04.00	Inducted over voltage withstand HV/LV winding	
4.05.00	Full wave lightening impulse withstand voltage	
5.00.00	**Impedances at Principal Tap at Rated Frequency and 75° C winding temperature**	
5.01.00	Base MVA	
5.02.00	Impedance	
5.03.00	Reactance	
5.04.00	Resistance at 75° C	
5.05.00	Zero sequence Impedance at 75°C	
5.06.00	Capacitance of windings micro farad / phase	
	H.V. - Earth	
	L.V. - Earth	
	H.V - L.V	
6.00.00	**Guaranteed Losses at Principal Tap, Full Load and 75°C.**	**kW**
6.01.00	No Load Losses	
6.02.00	Load Losses	
6.03.00	Cooler Losses	
6.04.00	Tolerance on Losses	
7.00.00	**Efficiency at 75°C and 0.8 power**	

	factor lag	**%**
7.01.00	At full load	
7.02.00	At 3/4 full load	
7.03.00	At 1/2 load	
7.04.00	Maximum Efficiency	
7.05.00	Load and power factor at which the max. efficiency occurs	
8.00.00	**Regulation at full load at 75°C**	
8.01.00	At unity power factor	
8.02.00	At 0.8 power factor lagging	
9.00.00	**No load current referred to HV**	**A**
9.01.00	At 90% rated voltage	
9.02.00	At 100% rated voltage	
9.03.00	At 110% rated voltage	
9.04.00	At 125% rated voltage	
9.05.00	At 140% rated voltage	
10.00.00	**Approximate Maximum Flux Density**	**Web / Sq.m**
10.01.00	At 90% rated voltage	
10.02.00	At 100% rated voltage	
10.03.00	At 110% rated voltage	
10.04.00	At 125% rated voltage	
10.05.00	At 140% rated voltage	
11.00.00	**Maximum Current Density A/Sq.cm**	
	H.V.	
	L.V.	
12.00.00	**Cooling System**	
12.01.00	a) Type of cooling Input to cooling plant	(KW)

b) Number X capacity of Cooler units furnished

c) No. of cooler units required for full load operation

12.02.00 Each cooler unit is provided with

a) No. X kW of oil pump motor (running)

b) No of standby pump

c) No. X kW of fan motor(running)

d) No. of standby fan

12.03.00 Motors rated for voltage, phase, frequency

12.04.00 a) Automatic operation of cooler fans provided

b) Automatic operation of cooler pumps provided

12.05.00 Transformer is capable of delivering rated output under following conditions

a) Failure of all pumps and fans of one cooler unit

1) Continuous in % rated MVA

2) Rated output for ---min.

b) Failure of one complete cooler unit including radiator, fans pumps etc.

1) Continuous in % rated MVA

2) Rated output for ---min.

c) Failure of all pumps and fans of both cooler units

1) Continuous in % rated MVA

2) Rated output for ---min.

d) Failure of complete cooler system including radiator, fans pumps etc.

1) Continuous in % rated MVA

2) Rated output for ---min.

13.00.00	**Details of Tank**	
13.01.00	Material	
13.02.00	Thickness of sides	mm.
13.03.00	Thickness of bottom	mm.
13.04.00	Thickness of cover	mm.
13.05.00	Tank Designed for	
	Vacuum	mm of Hg
	Pressure	kN / Sq.m
14.00.00	Insulating Material	
	a) H.V Turn	
	b) L.V Turn	
	c) H.V - L.V	
	d) H.V Earth	
	e) L.V Earth	
14.01.00	H.V Winding provided with graded insulation	
15.00.00	**Tap Changer**	
15.01.00	Type and make	
	a) Rated voltage	
	b) Rated current	
	c) Step voltage	
	d) No. of steps	
15.02.00	Range- Steps X % Variation	
15.03.00	Taps provided on HV winding	
15.04.00	Number of taps	
15.05.00	Auxiliary Power	(kw)
15.06.00	Time required for one step change	(sec.)
15.07.00	Tap Change motor.	

15.08.00	Control circuit		
15.09.00	Local manual operation feasible from standing height from ground		
15.10.00	a) Local tap position indicator furnished		
	b) Local operation counter furnished		
15.11.00	Provision for padlocking provided		
15.12.00	Auxiliary switch for interlock provided as specified		
15.13.00	Safety limit switch provided		
15.14.00	Are all contacts silver plated		
16.00.00	**Insulating Oil (EHV Grade)**		
16.01.00	Approximate volume	Litre	
16.02.00	10% excess oil furnished		
16.03.00	Oil conforms to		
16.04.00	Details of oil furnished		
16.05.00	a) Oil preservation system provided		
	c) Type		
	d) Quantity of oil in main tank	Litre.	
	e) Quantity of oil for topping of main tank	Litres.	
	f) Quantity of oil for conservator, radiator, pipe work etc.	Litres.	
	g) Total Oil	Litres.	
	h) 10% extra oil	Litres	
	i)Total oil to be dispatched		
	k) Oil to be dispatched in main tank	Litres	

	l)	Dispatched in barrels	Litres.
	m)	Each barrel contains	Litres.
	n)	Total No. of barrels to be dispatched	
17.00.00	**Bushings**		
17.01.00	Make		
17.02.00	Type		
17.03.00	Reference Standard		
17.04.00	Voltage Class		kV
17.05.00	Type of atmosphere		
17.06.00	Creepage Distance		mm.
17.07.00	Weight		
17.08.00	Free space required for bushing removal		
17.09.00	Test terminals for HV bushings provided		Yes/No
17.10.00	One minute power Frequency withstand dry and wet		
18.00.00	**Minimum Clearance**		
18.01.00	Between Phases		
	a)	In air	mm.
	b)	In oil	mm.
18.02.00	Between Phase and earth		
	a)	In air	mm.
	b)	In oil	mm.
19.00.00	**Terminal Connections**		
19.01.00	H V		
19.02.00	L V		
19.03.00	H.V Neutral		
20.00.00	**Marshalling Box**		

20.01.00	Weather proof, suitable for outdoor duty		Yes/No
20.02.00	Degree of protection		
21.00.00	**Terminal Blocks**		
21.01.00	Make		
21.02.00	Type		
21.03.00	20% spare terminals furnished		
22.00.00	**Wiring**		
22.01.00	Cable Type		
22.02.00	Voltage grade		
22.03.00	Conductor		
	a) Size	Sq. mm	
	b) Material		
	c) Stranded		
22.04.00	All wires as per specification provided		
23.00.00	**Ratings of Trip and Alarm contacts**		
23.01.00	Voltage		V
23.02.00	Rated making current		A
23.03.00	Rated breaking current		A
24.00.00	**Accessories**		
	Transformer furnished with fittings and accessories as per specification		
25.00.00	**Details of Conservator**		
25.01.00	Volume of conservator		
25.02.00	Volume of oil between the highest and lowest levels		
26.00.00	**Pressure Release Device**		
	a) Minimum pressure the device is set to		

	operate/rupture KN/Sq.m	
	b) Trip contacts provided	
27.00.00	**Approximate Overall Dimensions**	
27.01.00	Length	mm.
27.02.00	Breadth	mm.
27.03.00	Height	mm.
27.04.00	Crane lift for	
	a) Untanking core and coil assembly (including sling)	
	b) Tank cover for bell type tank	mm.
28.00.00	**Approximate Weights**	
28.01.00	Core and coil	Kg.
28.02.00	Tank cover for bell type tank	Kg.
28.03.00	Tank and fittings	Kg.
28.04.00	Oil	Kg
28.05.00	Total Weight	Kg.
29.00.00	**Shipping Data**	
29.01.00	Weight of the heaviest package	Kg.
29.02.00	Dimension of the largest package (LXBXH)	mm.
30.00.00	**BUSHING CURRENT TRANSFORMER**	
30.01.00	**General**	
30.01.01	Make	
30.01.02	Type	
30.01.03	Reference Standard	
30.01.04	Use	
30.02.00	**Rating**	

30.02.01	CT Ratio	
30.02.02	Class	
30.02.03	Insulation Level	
30.02.04	Burden	
30.03.00	**Insulation Class**	
30.03.01	Temperature Rise at rated overburden over top oil temperature	Deg.C
30.04.00	**Characteristics**	
30.04.01	Secondary Resistance R_{CT} at 75Deg.C	Ohm
30.04.02	Knee Point Voltage Vk	Volt
30.04.03	Excitation Current at Vk/2	Amps
30.05.00	**Dimensions and Weights**	
30.05.01	Dimension (LxBxH)	mm
30.05.02	Weight	Kg
30.06.00	**Tests**	**As Per Standard**
30.07.00	Rated no load voltage HV/LV	in kV
30.08.00	One minute power Frequency withstand dry and wet	kV (rms)KV/rms

SECTION ‘II’

STANDARD TECHNICAL SPECIFICATION

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 2 of 30

1.00.00 SCOPE

1.01.00 This specification covers the design, manufacture, inspection & testing, packing at manufacturer's works and delivery to site of mineral oil filled service Transformers complete with all fittings & accessories for satisfactory operation at site.

1.02.00 **TERMINAL POINTS**

1.02.01 HV bushings with terminal connector for bus duct/ cable glands & lugs in case of cable connection.

1.02.02 LV bushings with terminal connector (3 Phase + 1 Neutral) for bus duct/ cable glands & lugs in case of cable connection.

1.02.03 For HV Earthing : (Applicable in case of star connection of HV) - neutral earth busbar brought near the base of transformer/ Cable glands & lugs in case of cable connection.

1.02.04 For LV Earthing : - neutral earth busbar brought near the base of transformer/ Cable glands & lugs in case of cable connection

1.02.05 Transformer earthing pads.

1.02.06 Terminals of marshalling box for external connection to equipment supplied by the purchaser.

`

	TITLE :	SPECIFICATION NO.
BHEL	STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	PE-SS-999-302-E001 VOLUME NO. : II SECTION : II REV NO. : 00 DATE : 30/06/2016 SHEET : 3 of 30

2.00.00 CODES AND STANDARDS

S.NO.	STANDARD NUMBER	STANDARD TITLE
1 I	S:2026 IEC: 60076	POWER TRANSFORMERS
2	IS:1180	OUTDOOR TYPE OIL IMMERSED DISTRIBUTION TRANSFORMERS UPTO AND INCLUDING 2500 kVA, 33kV - SPECIFICATION
2 I	S:6600	GUIDE FOR LOADING OF OIL IMMERSED TRANSFORMER
3 IS:	3639	FITTINGS & ACCESSORIES FOR POWER TRANSFORMER
4 IS:	335 IEC: 60296	NEW INSULATING OILS
5 IS:	2099 IEC: 60137	Bushing for alternative voltage above 1000 volts
6	IS: 3347	Dimension for porcelain transformer bushings
7 IS:	2705 IEC: 60185	Current transformers
8	IS: 3637	Gas operated relays
9 I	S:1271 IEC: 60216	Classification of insulating material for electrical machinery & apparatus in relation to their thermal stability in service
10	IS/IEC: 60529	Classification of degrees of protection provided by enclosures of electrical equipment
11 IS:	2071 IEC: 60060	Method of high voltage testing
12	IS: 5	Colours for ready mixed paints & enamels
13 NEMA,	STANDARD-TR1	Noise level
14 CBIP	Publication (latest edition)	Manual on transformers

2.01.00 The equipment shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the equipment is to be installed including Indian Electricity Act , Indian Electricity Rules and Bureau of Indian Standards.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 4 of 30

3.00.00 TECH NICAL REQUIREMENTS

3.01.00 Technical p articulars of transformers are s pecified i n Data S heet –A of se ction-I, volume-II.

3.02.00 All windings shall be fully insulated. Material of the windings shall be electrolytic grade copper, free from scales and burrs. Winding shall be uniformly insulated.

3.03.00 The core shall be constructed from high grade, non-ageing, cold rolled, grain oriented silicon steel laminations.

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

3.05.00 Nuts, bolts and pins used inside the transformer shall be provided with lock washers & locknuts

3.06.00 **Tank**

3.06.01 Under base of tank shall be fixed type.

3.06.02 Tank shall be of welded construction & fabricated from tested quality low carbon steel of adequate thickness. Tank shields, if provided, shall not resonate at natural frequency of equipment.

3.06.03 All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant oil in soluble insulating varnish.

3.06.04 Auxiliary transformers shall have suitable bi-directional skids, however auxiliary transformers above 2 MVA shall be provided with four no. of bi-directional detachable flat rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer.

3.06.05 At least two adequately sized inspection openings, one at the each end of the tank for easy access to bushings and earth connections & suitable manhole shall be provided.

3.06.06 The main tank body including tap-changer compartment, radiators and coolers shall be capable of withstanding full vacuum.

`

	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **5** of **30**

3.06.07 All tank and oil filled compartment shall be tested for oil tightness by being completely filled wit h oil of visc osity n ot greater than th at of specified oi l at the ambient temperature and a pplying pre ssure eq ual to t he normal press ure pl us 35 kN/m2 measured at the base of the tank.

3.07.00 **Tank mounting**

Tank shall also be provided with lifting lugs and minimum four jacking pads. Rollers shall be provided with holding clamp plates (04 nos), required hardware and foundation bolts etc. for each transformer.

3.08.00 **Oil preservation**

Conservator tank of adequate capacity for expansion of oil from minimum ambient to 100 deg. C sha ll be p rovided. Th e tra nsformers ra ted 6. 3MVA and above s hall b e provided with air ba g bre athing through s ilica gel br eather. For lo wer rating transformers with conventional con servator with dry air filling of the space above oil and connected to silica gel breather shall be provided.

3.09.00 **Radiators**

The radiators shall be detachable type, mounted on the tank. Each radiator shall be provided with a drain plug/valve at the bottom, an air release plug at the top, shut off valve at each point of connection to the tank.

3.10.00 **Insulating Oil**

As per IS: 335. No external inhibitors are permitted.

3.11.00 All transformers shall be suitable for cable/ busduct termination as indicated in data sheet-A of section-I, volume-II.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 6 of 30

3.12.00 **Bushings/ Insulators**

3.12.01 The bushings shall conform to the requirements of IS: 2099 and IS: 3347 and shall be of porcelain and above 3150A for the LV bushing Epoxy bushing shall also be acceptable.

3.12.02 For 33kV windings 36kV bushing shall be provided. For 3.3kV, 6.6kV and 11 kV windings, 17.5kV bushing shall be provided. For 415V windings, 1.1kV bushings shall be provided.

3.12.03 The porcelain shall not engage directly with hard metal and, wherever necessary, gaskets shall be interposed between the porcelain and the fitting.

3.12.04 Clamps and fittings of steel or malleable cast iron shall be galvanised.

3.12.05 Where bushing current transformer is provided, the bushing shall be mounted so that it can be removed and replaced without disturbing the current transformers. CTs shall be cast resin type & suitable for operation at ambient temperature existing at its location on the transformer.

3.12.06 Creepage distance shall be as per data sheet-A of section-I, volume-II.

3.12.07 Minimum rated current for bushings shall be as under. However, same shall comply with IS-2099 and HV/LV system fault current mentioned in Clause No. 20.00 of Datasheet A of section-I, volume-II:

1) H V Bushing for 33kV
   7.5 MVA = 250A
   5.0 MVA = 100A
   2.0 MVA = 100A

2) H V Bushing for 11kV & 6.6kV
   10.0MVA= 1000A
   8.0MVA = 1000A
   7.5MVA = 800A
   6.3MVA = 800A
   5.0MVA = 630A
   3.5MVA = 250A
   2.5 MVA = 250A

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 7 of 30

2.0 MVA = 250A
1.6 MVA = 250A
1.0 MVA = 100A
630 kVA = 100A

2) H V Bushing for 3.3kV
2.5 MVA = 630A
2.0 MVA = 500A
1.6 MVA = 400A
1.0 MVA = 250A
630 kVA = 250A

3) L V Bushing for 11kV, 6.6kV & 3.3kV

10.0MVA= 2500A
8.0MVA = 2000A
7.5MVA = 1600A
6.3MVA = 1600A
5.0MVA = 1250A
3.5MVA= 1250A

4) L V Bushing for 433V/420V
2.5 MVA = 4000A
2.0 MVA = 4000A
1.6 MVA = 3150A
1.0 MVA = 2000A
630 kVA = 1000A

3.13.00 **Cable Box**

3.13.01 A dust tight air insulated type cable box with D.O.P. of IP: 55 shall be provided for terminating the cables directly of size and type specified in Data sheet-A of section-I, volume-II. The cable box shall also be provided with a suitable canopy. Suitable cable glands (double compression type) and lugs shall be provided for cable termination.

3.13.02 Dimensions of cable box shall be subject to purchaser's approval.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 8 of 30

3.13.03 Inspection cover for fixed portion of cable box shall be provided. Handles for lifting cable box shall be provided.

3.13.04 Creepage distance shall be as per data sheet-A of section-I, volume-II.

3.13.05 Provision shall be made for earthing the body of each cable box. Separate earthing pads shall be provided for this purpose, suitable for bolted connection to galvanised mild steel flat of size to be specified during contract engineering stage.

3.13.06 Gland plate for single core cable termination shall be of Aluminium.

3.13.07 Cable box(es) shall be provided with suitable air-insulated disconnecting chamber so that if required, transformer can be removed from its position without disconnecting the cables in the cable box(es). Independent supporting arrangement shall be provided for cable box(es) for this purpose. Supporting arrangement shall be supplied along with required hardware & foundation bolts etc.

3.14.00 **Busduct Termination**

If LV terminals are specified to be connected by means of a busduct, a flanged throat or equivalent connection shall be provided to suit purchaser's busducts. The winding termination shall be on outdoor type of bushing. Necessary flexibles shall be provided by purchaser to connect the bushing terminals to the busbars of the busduct. Details of bus duct shall be furnished during detail engineering stage. Degree of protection of LV busduct flange enclosure shall be IP:55.

3.15.00 **Neutral Terminals**

~~Two (2) nos. neutral terminals shall be provided on LV side. One neutral terminal shall be part of phase connection arrangement busduct throat/ LV cable box (as applicable). Other neutral terminal shall be in a separate box and brought to tank bottom by means of earthing bar of 50x6 mm of copper, supported on porcelain insulators mounted on transformer tank. The neutral earthing bar brought to the tank bottom for connection to station earth shall be provided with holes and suitable connecting hardware. This earthing bar shall have fork type arrangement at the end. However neutral may be connected to NGR as per system requirement.~~

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 9 of 30

3.16.00 **Neutral CT**

Bidder to provide neutral bushing CT as per details given in data sheet – A of section-I, volume-II for restricted earth fault protection or standby earth fault protection. In case neutral CT is tank mounted, CT box shall be weather proof having D.O.P. IP: 55. The Neutral CT box shall also be provided with a suitable canopy. CTs shall be cast resin type.
All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.

3.17.00 **Valves**

3.17.01 All valves upto and including 50 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings.

3.17.02 Sampling & drain valves should have zero leakage rate.

3.18.00 **Gaskets**

3.18.01 Gasket shall be fitted with weather proof, hot oil resistant, rubberized cork.

3.18.02 If gasket is compressible, metallic stops shall be provided to prevent over compression.

3.18.03 The gaskets shall not deteriorate during the life of transformer/shunt reactor if not opened for maintenance at site. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer.

3.19.00 **Voltage control (off circuit type)**

3.19.01 Off circuit tap-changing switch shall be three phase, hand operated, for simultaneous switching of similar taps on all the three phases by operating an external handle/ hand wheel. The position of off-circuit tap switch handle/hand wheel provided outside the transformer tank should be such as to enable an operator standing on ground to operate the same with ease. A caution plate indicating that switch shall be operated only when the transformer is de-energised shall be fitted near tap switch.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 10 of 30

3.19.02 Operating mechanism of tap changer shall be suitably labelled to show the direction of operation for raising secondary voltage & vice versa. Position markings shall be provided.

3.19.03 Arrangement shall be made for securing and padlocking the tap-changing switch at any working position. It shall not be possible to set and padlock in any intermediate position.

3.19.04 Tap position indicator and mechanical stops to prevent over-cranking of the mechanism shall be provided.

3.20.00 **Marshalling box**

3.20.01 Tank mounted vermin and dust proof marshalling box shall be provided to accommodate indication circuits and temperature indicators etc. and provided with proper lighting and thermostatically controlled space heaters.

3.20.02 The marshalling box shall be fabricated using sheet steel of at least 2.5mm thickness. The marshalling box shall have domed or sloping roof.

3.20.03 Marshalling box shall be complete with all internal wiring and identification ferrules, cables, conduits required for wiring between marshalling box and instruments on transformer. Wiring shall be by 1100 V grade, copper cable of size 2.5mm^2.

3.20.04 The terminal blocks shall be complete with insulating barriers and clip-on type terminals suitable for 2.5mm^2 stranded copper wire. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber.

3.20.05 The marshalling box shall have IP: 55 degree of protection.

3.20.06 CT terminals shall be with shorting and disconnecting facility. TB shall be stud type for all CT & power connection.

3.20.07 Wiring scheme shall be engraved in a stainless steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door. Refer annexure-C for standard terminal block numbering.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 11 of 30

3.21.00 **Flux density**

Flux density in any part of the core & yoke on any tap position with ±10% voltage variation from voltage corresponding to the tap shall not exceed 1.9 Wb/m^2. Transformer shall also withstand following conditions due to combined voltage and frequency variations:

Continuous operation for 110% flux density
At least 1 minute operation for 125% flux density
At least 5 sec. operation for 140% flux density

3.22.00 **Winding**

For 33kV, 11kV & 3.3kVwinding, type of winding shall be continuous disc & for 433V/ 420V winding, type of winding shall be spiral type. The conductors shall be of Electrolytic grade copper.

3.23.00 **Noise & Vibration**

The design and manufacture of transformer, fittings and accessories shall be such as to reduce noise & vibration. Noise level shall not be more than as specified in NEMA Standard Publication TR-1, when measured with transformer energised at normal voltage and frequency.

3.24.00 All transformers and their accessories shall be capable of withstanding without damage any external short circuit at the terminals for duration of two seconds.

3.25.00 Maximum Transformer losses including tolerances shall be as per annexure – B, of section-I, volume-II.

3.26.00 **LOADING CAPABILITY**

Transformer shall be suitable for continuous operation at rated kVA on any tap with voltage variation of $\pm$ 10 % corresponding to voltage of the tap. Short duration overloading shall be in accordance with IS:6600 / IEC60076-7.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 12 of 30

4.00.00 **Fittings & accessories**

4.01.00 Transformer shall be provided with, but not restricted to following minimum fittings and accessories for satisfactory operation:

4.01.01 Conventional type conservator with drain valve and oil filling hole.

4.01.02 Magnetic oil level gauge with low-level alarm contact.

4.01.03 Prismatic & toughened glass oil level gauge.

4.01.04 Gaskets

4.01.05 Gasket protection covers.

4.01.06 Silica gel breather with oil seal.

4.01.07 Double float type Buchholz relay with alarm and trip contacts with suitable gas collecting device with two shut-off valve on both side.

4.01.08 Diaphragm type explosion vent for transformers of rating less than 2MVA

4.01.09 Pocket on tank cover for thermometer.

4.01.10 Protected type mercury in glass thermometer.

4.01.11 Dial type (150 mm) Oil temperature indicator (OTI) with two sets of electrical potential- free contact rated for 2A, 220V DC, for alarm and trip purpose. The OTI shall be provided with anti-vibration mounting. OTI shall have maximum reading pointer along with resetting device. For remote oil temperature metering, an independent 4-20 mA should be made available.

4.01.12 Dial type (150 mm) Winding temperature indicator (WTI) with two sets of electrical potential- free contact rated for 2A, 220V DC, for alarm and trip purpose. The WTI shall be provided with anti-vibration mounting. WTI shall have maximum reading position along with resetting devices. For remote winding temperature metering, an independent 4-20 mA should be made available.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 13 of 30

4.01.13 Drain Valves.

4.01.14 Sampling devices.

4.01.15 Filter valves.

4.01.16 Earthing terminals – 2 Nos.

4.01.17 Rating & Diagram plates.

4.01.18 Valve schedule plate.

4.01.19 Two sets of lifting lugs (one for transformer with oil and other for tank cover).

4.01.20 Jacking pads.

4.01.21 Skids and pulling eyes on both sides.

4.01.22 Air release devices.

4.01.23 Inspection cover.

4.01.24 Oil filling hole and cap.

4.01.25 Tank mounted marshalling box.

4.01.26 Detachable, flat, bidirectional rollers with 90 deg. swivel mechanism.

4.01.27 Clamping arrangement for rollers.

4.01.28 Ground support for cable box.

4.01.29 Neutral CT secondary box.

4.01.30 Haulage facilities.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 14 of 30

4.01.31 Two nos. spring operated pressure relief devices with extension pipe to bring oil to plinth level along with electrically insulated contact for alarm and tripping for transformer rating 2 MVA and above.

4.01.32 Gas collection device along with all accessories**.**

4.02.00 Breather shall be fitted at a height not exceeding 1.5 M.

4.03.00 Rating and diagram plate shall be fitted at a height of about 1.75 M above the ground level.

4.04.00 The WTI and OTI shall have accuracy class of $\pm$ 2 deg. C or better.

4.05.00 Rating/ Name/ Valve schedule plates shall be of white non-hygroscopic material with engraved black lettering . Su ch plates sh all b e b i- lingu al (requ irement will be finalised d uring de tailed e ngineering) w ith Hindi inscription first, followed b y English. Alternatively, two separate plates with Hindi & English inscription shall be provided.

5.00.00 **PAINTING**

Paint s hade shal l be informed to su ccessful bi dder during det ail e ngineering as applicable for s pecific pr oject. Adequate q uantity of touch u p pa int shall also be supplied. There shall be no commercial or delivery implication to BHEL on account of paint shade, paint specification/ procedure.

6.00.00 **QUALITY ASSURANCE, TESTING & INSPECTION**

6.01.00 BHEL's Standard QP (PE-QP-999-302-E001 Rev. 0) is enclosed as per Annexure-A of section-II, volume-II for reference. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ ultimate customer's approval. There shall be no commercial or delivery implication to BHEL on account of QP approval.

6.02.00 All m aterials, com ponents a nd accessories of th e tra nsformers shall be p rocured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 15 of 30

6.03.00 Tests shall be performed in presence of Purchaser's representative. The bidder shall give at least fifteen (15) days advance notice of date when the tests are to be carried out.

6.04.00 All routine and acceptance tests as per relevant standards and specification shall be carried out by the vendor/ sub-vendor on all transformers.

6.05.00 Successful bidder shall furnish List of sub-vendors/ makes of items for BHEL/ customer approval at contract stage. This shall not have any commercial implication to BHEL.

6.06.00 For acceptance of short circuit reports for tests carried out earlier on similar transformers, successful bidder shall furnish the following documents for BHEL/ BHEL's customer acceptance without any commercial/ delivery implication to BHEL

6.06.01 Calculations and design considerations to prove ability to withstand the dynamic effects of short circuit.

6.06.02 Short circuit test report of previously tested similar transformer for validation by comparison. Criteria for similarity of transformer for acceptance of Short circuit test report shall be as given in the Annexure-B of IEC-60076-5.

7.00.00 COMMISSIONING SPARES, SPECIAL TOOLS & TACKLES AND O & M SPARES

7.01.00 Commissioning spares are those, which may be required during commissioning of the equipment. Bidder to furnish list of commissioning spares along with technical offer as per annexure-IV of section-I, volume-II.

7.02.00 The bidder shall supply with the equipment, one unused complete set of all special tools & tackles required for the erection, assembly, disassembly and proper maintenance of the equipment. A list of such tools & tackles (price deemed to be included in the total bid price) shall be submitted by the bidder along with the offer as per annexure-V of section-I, volume-II.

7.03.00 O & M spares are those which are required for satisfactory & trouble free operation of equipment. List of O & M spares is enclosed as per Annexure-D of section-II, volume-II. O & M spares shall be quoted (if applicable) as per BOQ-cum-price schedule as part of NIT.

`

	TITLE :	SPECIFICATION NO.
BHEL	STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 16 of 30

8.00.00 O & M MANUALS

8.01.00 O & M manuals for the installation, operation and maintenance of transformers shall be furnished at least three months before despatch of equipment.

8.02.00 Draft manual should first be submitted for purchaser's approval. The manual should contain minimum following details:

8.02.01 General description of equipment.

8.02.02 Approved Technical Data Sheet

8.02.03 All drawings

8.02.04 Salient constructional features.

8.02.05 Technical leaflets of fittings/ important parts.

8.02.06 Type and routine test certificates.

8.02.07 Instructions to be followed on receipt of equipment at site & for storage.

8.02.08 Instructions for foundation arrangement.

8.02.09 Erection procedures and checks.

8.02.10 P re-commissioning checks.

8.02.11 Co mmissioning procedures.

8.02.12 Withdrawal arrangement/ material handling instructions.

8.02.13 O peration instructions.

8.02.14 Main tenance instructions.

8.02.15 Tro uble-shooting.

8.02.16 Safety instructions.

`

	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR** **OIL FILLED SERVICE TRANSFORMERS**	**PE-SS-999-302-E001** VOLUME NO. : **II** SECTION : II REV NO. : **00** DATE : 30/06/2016 SHEET : **17** of **30**

ANNEXURE - A

STANDARD QUALITY PLAN

एनटीपीसी NTPC Transforming lives	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers** (Up to 5 MVA, 33 kV Class)	**STANDARD QUALITY PLAN** **CONFORMING TO CODE :** **NTPC TECHNICAL SPECIFICATION / IEC:60076**	QP No: 0000-999-QOE-S-036, Rev No: 0 Date: 20.02.2013 Page: 1 of 8 VALID UPTO: 19.02.2016	REVIEWED BY Banish K. Jha H Shekhar B D Prasad	APPROVED BY Approved I Gowrishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	**	10		11
1.00	**RAW MATERIAL**													
1.01	Steel Plate & Pipe	a) Thickness	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:2062 /IS:1239	Mfr Plant Std./ IS:2062 /IS:1239	QC Record		P	V	V	*A) Supplier's TC for all BOIs shall be maintained by Mfr for NTPC verification.*
		b) Surafce defects	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	*B) Make of all BOIs & Raw Material shall be subject to NTPC acceptance and Vendor list for the same sall be submitted as annexure to project/package specific endorsement sheet.*
		c) Chemical Composition	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Mechanical Properties	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) Hydraulic Test of Pipes	-do-	-do-	-do-	-	-do-	-do-	-do-		V	V	V	
1.02	CRGO Steel	a) Make,Thickness,Finish & Gr	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:3024/IS:649	Mfr Plant Std./ IS:3024/IS:649	QC Record		P	V	V	
		b) Cutting & edge burr	-do-	Test	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Waviness & edge camber	-do-	-do-	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		d) Specific core loss	-do-	-do-	-do-	As per IS/ Plant Std	-do-	-do-	-do-		V	V	V	
		e) Surface resistivity/Insulation resistance of surface coating	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Stacking factor	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Permeability at 800A/m	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		h) Bend Test / Ductility	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
1.03	Paper Insulated Copper Conductor	a) Dimensions & tolerances (Bare & Insulated)	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:13730/IEC 60554	Plant Std./ IS:13730/IEC 60554	QC Record		P	V	V	
		b) Resistivity/Conductivity	-do-	Test	-do-	-do-	-do-	-do-	Supplier's TC	√	V	V	V	
		c) Paper Covering	-do-	Measure	-do-	-	-do-	-do-	-do-		P	-	-	
		d) Voltage Test betn Strands for bundled conductor	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	For CTC only
		e) Cu Purity	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Elongation	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Tensile Strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
1.04	Insulating Paper	a) Make,Dimensions & Type	M ajor	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:1060/IS:9335 IEC 60554	Mfr Plant Std./ IS:1060/IS:9335 IEC 60554	QC Record		P	V	V	
		b) Density & substance	-do-	-do-	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Tensile Strength	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Elongation	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) Water Absorption	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Moisture Content	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) pH Value & conductivity aqueous extract	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		h) Ash Content	-do-	Test	-do-		-do-	-do-	-do-		V	-	-	
		i) Electrical Strength in Air	-do-	-do-	-do-	As per IS/Plant Std	-do-	-do-	-do-		V	V	V	
		j) Air Permeability	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		k) Tear Index	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		l) Heat Stability	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: Mfrr / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

एनटीपीसी NTPC Transforming lives

ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers (Up to 5 MVA, 33 kV Class)**

STANDARD QUALITY PLAN

CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION / IEC:60076

QP No: 0000-999-QOE-S-036, Rev No: 0
Date: 20.02.2013
Page: 2 of 8
VALID UPTO: 19.02.2016

REVIEWED BY: Banish K. Jha, H Shekhar, B D Prasad
APPROVED BY: Approved, Dt....., T Gowrishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		**	10		11
1.05	Press-Board	a) Make, Type, Dimensions	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS-1576	Plant Std./ IS-1576	QC Record		P	V	V	
		b) Compressibility	-do-	Test	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Density	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Tensile strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) pH Value/Conductivity of Water extract	-do-	-do-	-do-	As per IS/ Plant Std	-do-	-do-	-do-		P	V	V	
		f) Electrical Strength in air and oil	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	
		g) Shrinkage in air & oil	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		h) Flexibility/ Elongination	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		i) Ash content	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		j) Moisture content	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		j) Oil absorption	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		k) Cohesion between plies	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
1.06	Densified Wood	a) Dimensions & Type	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:3513/IS3400- P-II	Mfr Plant Std./ IS:3513	QC Record		P	-	-	
		b) Surface finish	-do-	Visual	-do-	-do-	-do-	-do-	-do-		P	-	-	
		c) Electrical Strength in air and oil	-do-	Test	-do-	-do-	-do-	-do-	Supplier's TC		V	V	V	
		d) Oil absorption	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) Shrinkage in air & oil	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Moisture content	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Compression strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		h) Crossbreaking strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		i) Tensile strength	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		j) Density	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		k) Specific gravity	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
1.07	Gasket Syntheic Rubber or Acryo Nitrile Butadine Rubber for Gasket	a) Dimensions, Grade & Type	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	Mfr Plant Std./ IS:4253-P-I/II	Plant Std./ IS:4253-P-I/II	QC Record		P	-	-	
		b) Hardness	-do-	-do-	-do-	-do-	-do-	-do-	Supplier's TC		V	V	V	
		c) Tensile strength	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Compressibility	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	
		e) Recovery	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Compression set	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Flexibility	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Ageing in air & oil	-do-	-do-	-do-	-	-do-	-do-	-do-		V	V	-	
		e) Accelerated ageing	-do-	-do-	-do-	-	-do-	-do-	-do-		V	V	-	
		f) Chloride/Sulphate conte- nt of water extract	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		g) Density	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
** M: Mfrr / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE,
CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

एनटीपीसी NTPC Transforming lives	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers** (Up to 5 MVA, 33 kV Class)	**STANDARD QUALITY PLAN** **CONFORMING TO CODE :** **NTPC TECHNICAL SPECIFICATION / IEC:60076**	QP No: 0000-999-QOE-S-036, Rev No: 0 Date: 20.02.2013 Page: 3 of 8 VALID UPTO: 19.02.2016	REVIEWED BY Banish K. Jha H Shekhar B D Prasad	APPROVED BY Approved T.G.V.Ishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	QUANTUM OF CHECK C/N	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6		7	8	9		**	10		11
1.08	Insulating Oil	a) Make, Appearance of oil	Major	Visual	As per IEC/IS	As per IEC/IS	NTPC Specification/ IEC-296/IS-335	NTPC Specification	Supplier's TC	√	V	V	V	
		b) Density,Resistivity	-do-	Test	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		c) Kinematic Viscosity	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		d) Interfacial Tension	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		e) Flash & pour point	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		f) Neutralisation value	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		g) Corrosive Sulfer Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		h) Water contnet	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		i) Anti Oxidants Additives	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		j) Oxidation Stability, Neuralisation Value in mgKOH/g and Sludge %	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		k) Breakdown Voltage (As delivered and after treatment)	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		l) Dissipation factor	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		m) PCA Content	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		n) Impulse withstand Level	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		o) Gassing tendency	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
		q) Ageing characteristics at 115^0 C for 96 hours	-do-	-do-	-do-	-do-	IS-335-1993	IS-335-1993	-do-	√	V	V	V	For reference only
		r) S.K.Value	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
2.00	**FITTING AND ACCESSORIES**													
2.01	Porcelain Busings	a) Make , Rating,Dimensions	Major	Measure	As per IS/ Plant Std	As per IS/ Plant Std	IS:2099/IS:3347/ IS:12676/NTPC Spec.	IS:2099/IS:3347/ IS:12676/NTPC Spec.	QC Record		P	-	-	
		b) Visual Defects	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Routine testing	-do-	Testing	-do-	-do-	-do-	-do-	Supplier's TC	√	V	V	V	
2.02	Bucholz Relay	a) Type, Size & Make	Major	Visual	As per IS/ Plant Std	As per IS/ Plant Std	Plant Std./ IS:3637	Plant Std./ IS:3637	QC Record		P	V	V	
		b) Continuity for alarm & trip (Performance)	-do-	Test	-do-	-do-	-do-	-do-	Supplier's TC		V	V	-	
		c) Porosity Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	-	
		d) High Voltage & IR Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	-	
		e) Element Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	-	
		f) Gas Voulme Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	
		g) Loss of Oil & Surge Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	-	
2.03	Pressure Relief Device (if applicable)	a) Type, Size & Make	Major	Visual	10%	As per IS/ Plant Std	Mfr Plant Std./ IS:3637	Plant Std./ IS:3637	QC Record		P	V	-	
		b) Operation (Pressure & flag indication)	-do-	Test	-	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Switch Contact Operation	-do-	-do-	-	-	-do-	-do-	-do-		V	-	-	
		d) HV Test	-do-	-do-	-do-	-	-do-	-do-	-do-		V	V	-	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: Mfrr / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE,

CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

NTPC Transforming lives

ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers** (Up to 5 MVA, 33 kV Class)

STANDARD QUALITY PLAN

CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION / IEC:60076

QP No: 0000-999-QOE-S-036, Rev No: 0
Date: 20.02.2013
Page: 4 of 8
VALID UPTO: 19.02.2016

REVIEWED BY: Banish K. Jha, H Shekhar, B D Prasad
APPROVED BY: Approved, T Gowrishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	QUANTUM OF CHECK C/N	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M**	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6		7	8	9		10			11
2.04	Magnetic Oil Level Gauge	a) Type, Size & Make	Major	Visual	10%	-	NTPC Spec/ Plant Std/Mfrr Drg	NTPC Spec/ Plant Std/Mfrr Drg	QC Record		P	-	-	
		b) Dial Marking	-do-	-do-	-do-		-do-	-do-	Supplier's TC		V	-	-	
		c) Switch Continuity	-do-	Test	-do-	-	-do-	-do-	-do-		V	-	-	
		d) Leak Test	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		e) HV Test	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
		f) Operational test	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
2.05	Off-Circuit Tap Changer (if applicable)	a) Dimensions, Alignment of padlocking arrangement	Major	Measure	10%	As per IS / Plant Std	Mfrr Drg. /Mfr Plant Std	Mfrr Drg. /Mfr Plant Std	QC Record		P	V	-	
		b) Physical condition	-do-	Visual	100%	-	-do-	-do-	-do-		P	-	-	
		c) Operation of Switch	-do-	Test	-do-	-	-do-	-do-	-do-		P	-	-	
		d) Insulation Resistance Test	-do-	-do-	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		e) Leak Test of Handle Stuffing Box	-do-	-do-	-do-	100%	-do-	-do-	-do-		V	V	V	
2.06	On Load Tap (if applicable)	a) Visual Check,make,type	Major	Visual	100%	-	IS: 2026/IS:8468	IS: 2026/IS:8468	QC Record		P	V	-	
		b) Dimensional check	-do-	Measure	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Mechanical operation on Diverter & selector switch	-do-	verify	-do-	100%	-do-	-do-	Supplier's TC		P	V	-	
		d) HV test on auxiliary circuit	-do-	Test	-do-	-do-	-do-	-do-	-do-	√	V	V	V	
2.07	Valves (Gate/Globe/ Butterfly)	a) Dimensional check	Major	Measre	10%	-	Mfr Drg/Plant Std/ IS:778-P-I	Mfr Drg/Plant Std/ IS:778-P-I	QC Record		P	-	-	Drain and Sample Vlave should have zero leakage rate
		b) Type, Size & Make	-do-	Visual	-do-	-	-do-	-do-	-do-		P	V	-	
		c) Hydraulic/Leakage Test (for Body & Seat)	-do-	Test	As per IS/ Plant Std	As per IS/ Plant Std	IS:778-P-I	IS:778-P-I	Supplier's TC		V	V	V	
									-do-		V	-	-	
		d) Operational Test (Smooth Close & Open)	-do-	-do-	-do-	-	-do-	-do-	-do-		V	-	-	
2.08	Marshalling Kiosk & Remote Tap Control (RTCC)	a) Dimensional/Visual checks, makes of MB & mountings	Major	Visual	100%	100%	NTPC Appd Drgs	NTPC Appd Drgs	QC Record		W	W	V	At Marshalling Kiosk's mnaufactuer's works.
		b) 2 kV insulation test on auxiliary wiring	-do-	Test	-do-	-do-	-do-	Should withstand for one minute	Test Report	√	W	W	V	
		c) IP-55 Degree of protection by thin paper insertion	Major	Test	-do-	-do-	IS:13947-1993	IS:13947-1993	-do-		P	W	V	
		d) Check for paint, shade & thickness	-do-	Measure/ Test	On random basis	On random basis	NTPC Specn./ IS:101-P-IV-Sec-2	NTPC Specn./ IS:101-P-IV-Sec-2	-do-		W	W	V	
2.09	OTI & WTI	a) Type, Size & Make	Major	Visual	As per IS/ Plant Std	As per IS/ Plant Std	NTPC Specs/Apvd drgs/ Mfr Std/ IS:11222/IS:2848	NTPC Specs/Apvd drgs/ Mfr Std/ IS:11222/IS:2848	QC Record		P	V	V	
		b) HV Test	-do-	Test	-do-	-do-	-do-	-do-	Supplier's TC		V	V	-	
		c) Temperature Calibration	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	
		d) Switch setting & switch deferential	-do-	-do-	-do-	-do-	Mfr Std / IS 2848	Mfr Std / IS 2848	-do-		V	V	V	
		e) Calibration & operation of Switch	-do-	-do-	-do-	-do-	-do-	-do-	-do-		V	V	V	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
** M: Mfrr / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE,
CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

एनटीपीसी NTPC Transforming lives

ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers (Up to 5 MVA, 33 kV Class)**

STANDARD QUALITY PLAN

CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION / IEC:60076

QP No: 0000-999-QOE-S-036, Rev No: 0
Date: 20.02.2013
Page: 5 of 8
VALID UPTO: 19.02.2016

REVIEWED BY	APPROVED BY
Banish K. Jha	Verified
H Shekhar	Approved
B D Prasad	I Gowrishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	QUANTUM OF CHECK C/N	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6		7	8	9		**	10		11
2.10	Bushing CT	a) Make & rating	Major	Visual	100%	10%	Mfr Drg/IS:2705	Mfr Drg/IS:2705	QC Record		V	V	V	
		b) Dimensions/Visual check	Major	Measure	As per IS	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Routine Test	-do-	Test	100%	100%	-do-	-do-	-do-		V	V	V	
2.11	Radiator	a) Type, Model, Rating, make	Major	Visual	100%	100%	NTPC Specs/Apvd drgs/ Mfr Std	NTPC Specs/Apvd drgs/ Mfr Std	QC Record		P	V	V	
		b) Dimensions & No. of elements	-do-	Measure	-do-	-do-	-do-	-do-	-do-		W	V	-	
		c) Paint, Shade, Finish & thickness	-do-	Visual / Measure	-do-	-do-	-do-	-do-	-do-		W	V	V	
		d) Pressure test	-do-	Test	-do-	1samp/des./lot	-do-	-do-	Supplier's TC	√	W	V	V	
		e) Adhesion Test on paint	-do-	-do-	-do-	As per IS	IS:101	IS:101	-do-		W	V	V	
2.12	Terminal Connector	a) Dimensional check	Major	Measure	10%	-	Mfrs Drg'/IS:5561	Mfrs Drg'/IS:5561	QC Record		P	-	-	
		b) Surface Finish	-do-	Visual	As per IS	-	-do-	-do-	-do-		V	-	-	
		c) Acceptance Test	-do-	Test	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
2.13	Silicagel Breather	a) Type, Size, Model	Major	Visual	10%	-	Mfr Plant Std.	Mfr Plant Std.	QC Record		P	-	-	
		b) Pressure/Breathing Leakage Test	-do-	Test	-do-	-	-do-	-do-	Supplier's TC		V	-	-	
		c) Colour of Silica gel	-do-	Viusal	-do-	-	-do-	-do-	-do-		V	-	-	
3.00	**IN-PROCESS**													
3.01	Fabrication of Tank, Cover, Conservator and welding requirement	a) Welding Procedure Spececification	Major	Verify	100%	100%	ASME-Sec-IX	Approved WPS/ ASME-Sec-IX	QW-482		V	V	V	
		b) Process Qualification Records	-do-	Test	-do-	-do-	-do-	-do-	QW-483		W	V/W†	V/W†	†-WPS approval, Welders & PQR qualification shall be done as per following :-
		c) Welders Qualification	-do-	-do-	-do-	-do-	-do-	-do-	QW-484		W	V/W†	V/W†	A) Upto 2 MVA - by Transformer Mfrr
		d) Welding Electrodes	-do-	-do-	As per IS	-	As per WPS/IS:814	As per WPS/IS:814	Supplier's TC		V	-	-	B) 2-5 MVA - by Main Contractor
		e) Fitup for Butt weld joints of tank and cover	-do-	Visual	-do-	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		V	-	-	
		f) Visual check on weldment	-do-	Visual	100%	-	-do-	-do-	-do-		V	-	-	
		g) Dimensional check after welding	-do-	Measure	-do-	-	-do-	-do-	-do-		V	-	-	
		h) DP Test on welded joints of load bearing member	-do-	Test	-do-	100%	Mfr Drg/Plant Std/ IS:3658	Mfr Drg/Plant Std/ IS:3658	-do-		W	V	V	
		i) Check for flatness of gasket surface	-do-	Visual	-do-	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	-do-		W	-	-	
		j) Rim flatness	-do-	Measure	10%	-	-do-	-do-	-do-		W	-	-	
		k) Surface cleaning by sand/ shot blasting	-do-	Visual	100%	100%	-do-	-do-	-do-		V	V	-	
		l) Primer coating, Paint shade, thickness inside and outside	Major	Measure	100%	10%	IS:101/ NTPC Specification	IS:101/ NTPC Specification	-do-		W	V	V	
		m) Paint adhesion test	-do-	Test	-do-	5%	IS:101	IS:101	-do-		W	V	V	
3.02	Core Stamping	a) Burr & Bow	Major	Visual	Plant Std	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Dimensional check	-do-	Measure	-do-	-	-do-	-do-	-do-		P	-	-	
3.03	Core Building	a) Dimensional check	Major	Measure	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Assembly of limb insulation and limb plates	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Rectangularity of core assembly	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
** M: Mfrr / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE,
CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

एनटीपीसी NTPC Transforming lives

ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers (Up to 5 MVA, 33 kV Class)**

STANDARD QUALITY PLAN

CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION / IEC:60076

QP No: 0000-999-QOE-S-036, Rev No: 0
Date: 20.02.2013
Page: 6 of 8
VALID UPTO: 19.02.2016

REVIEWED BY: Banish K. Jha, H Shekhar, B D Prasad
APPROVED BY: T Gowrishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	QUANTUM OF CHECK C/N	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6		7	8	9		**	10		11
		d) Freedom from overlaps & air gap at joints.	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		e) Core verticality	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		f) Limb & stack thikcness	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		g) Limb clamping & binding	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		h) Core Diameter	-do-	-do-	-do-	100%	-do-	-do-	-do-		P	V	V	
		i) Earthing of Core	-do-	-do-	-do-	-do-	-do-	-do-	-do-		P	V	V	
3.04	Test on core	a) Dimensional check	Major	Measure	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Pre-core Loss measurement	-do-	-do-	Plant Std.	-	-do-	-do-	-do-		P	-	-	
3.05	Winding	a) Brazing procedure , PQR & Brazer qualification	Major	Review	100%	100%	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	V	V	
		b) Conductor size	-do-	Measure	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Radial Depth of winding	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		d) Anchoring & Binding	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	At start & finish
		e) No of turns.	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		f) Transposition & cross overs	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		g) Dimensional checks	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	OD, ID & axial length
		h) Insulation arrangement & alignment	Major	Measure	100%	-	-do-	-do-	-do-		P	-	-	
		i) Winding length	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		j) Brazed joints	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	
		e) Lead & Coil identification and marking	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		f) Free from damages	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		g) Continuity test for leads	-do-	Test	-do-	100%	-do-	-do-	-do-		P	V	V	
		h) IR Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-		P	V	V	
3.06	Core coil assembly	a) Cleanliness of core	Major	Visual	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Alignment of spacers /blocks	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Cleaning of Core before Core Coil Assembly	-do-	-do-	-do-	-	-do-	-do-	-do-		P			
		d) Arrangement of Top & Bottom Insulation and Pressure rings.	-do-	-do-	-do-	-	-do-	-do-	-do-		P			
		e) Resting of Common Blocks on Active Part	-do-	-do-	-do-	-	-do-	-do-	-do-		P			
		f) Isoaltion Test of Core, if applicable	-do-	-do-	-do-	100%	-do-	NTPC Spec.	-do-		P	V	V	
		g) Earthing of core	-do-	-do-	-do-	100%	-do-	Mfr Drg/Plant Std	-do-		P	V	V	
3.07	Connection and tap switch assembly	a) Ratio Test on all taps	Major	Test	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Lead disposition	-do-	Visual	-do-	-	-do-	-do-	-do-		P	-	-	
		c) Brazing of joints	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		d) Crimping of joints	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		e) Insulation over joints	-do-	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		f) Vector group	-do-	Test	-do-	-	-do-	-do-	-do-		P	-	-	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
** M: Mfrr / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE,
CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

एनटीपीसी NTPC Transforming lives	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers** (Up to 5 MVA, 33 kV Class)	**STANDARD QUALITY PLAN** **CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION / IEC:60076**	QP No: 0000-999-QOE-S-036, Rev No: 0 **Date: 20.02.2013** **Page:** 7 of 8 **VALID UPTO: 19.02.2016**	REVIEWED BY Banish K. Jha, H Shekhar, B D Prasad	APPROVED BY Approved, T.G.Krishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	QUANTUM OF CHECK C/N	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6		7	8	9		**	10		11
3.08	Ovening and	a) Cleanliness of tank	Major	Visual	100%	-	Mfr Drg/Plant Std	Mfr Drg/Plant Std	QC Record		P	-	-	
		b) Drying	-do-	Physical	-do-	-	-do-	-do-			P	-	-	
		c) Check tightness of clamped blocks and measurments of winding height	-do-	Measure	-do-	-	-do-	-do-	-do-	√	P	-	-	
		d) Electrical Clearances	-do-	-do-	-do-	100%	-do-	-do-	-do-	√	P	V	V	
		e) Tightning of Coil & Spacers; Locking of tie rods & fastners	-do-	-do-	-do-	-	-do-	-do-	-do-	√	P			
		g) Check Paint shade,thickness & Adhesion	-do-	Visual/ Phys.	-do-	-	-do-	-do-	-do-	√	P	-	-	
		h) Oil filling and air release	-do-	Physical	-do-	-	-do-	-do-	-do-		P	-	-	
4.00	Type & Special Test	a) Review of Type test & Special test report												NTPC RIO to verify type test clearance from NTPC Engg for complete transformer including bushings, MB, transformer tank (eg: Pressure & Vacuum tests), terminal connector, OLTC, etc, as per specs. / LOA.
		b) Review of all previous stage of inspection as per QP	Major	Verify	100%	100%	NTPC Specs/Apvd Drg/DS	CHP Reports/ Protocols	TC / TR		V	V	V	
5.00	Routine Test	a) Dimensional check	Critical	Measure	100%	1Sample /Lot/Rating	NTPC Spec/Apvd Drgs/ DS/IS:2026 / IEC-60076	NTPC Spec/Apvd Drgs/ DS/IS:2026 / IEC-60076	QC Record	√	P	W	W	Each transformer shall be assembled with all fittings and accessories meant for the particular transformer before offering for inspection and testing by NTPC.
		b) Measurement of winding resistance of HV at normal, extreme taps & LV winding	-do-	-do-	-do-	100%	-do-	-do-	-do-	√	P	W	W	
		c) Measurement of voltage ratio at all taps, polarity & vector group	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		d) Magnetic balance test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		e) Measurement of No-Load Losses & magnetising current at 90%, 100% & 110% voltage at 50 Hz.	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		f) Measurement of No Load Current with 415 Volt/50 Hz AC Supply	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		g) Measurement of impedance & short circuit impedance at normal & extreme taps	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		h) Measurement of load loss	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		i) Measurement of insulation resistance of winding	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: Mfrr / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

एनटीपीसी NTPC Transforming lives	ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : **Oil Filled Transformers (Up to 5 MVA, 33 kV Class)**	**STANDARD QUALITY PLAN** CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION / IEC:60076	QP No: 0000-999-QOE-S-036, Rev No: 0 Date: 20.02.2013 Page: 8 of 8 VALID UPTO: 19.02.2016	REVIEWED BY Banish K. Jha, H Shekhar, B D Prasad	APPROVED BY Approved J Gowrishankar

Sl No	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK M	QUANTUM OF CHECK C/N	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D*	AGENCY M	AGENCY C	AGENCY N	REMARKS
1	2	3	4	5	6		7	8	9		**	10		11
		j) Dielectric Test												
		1) Separate source AC withstand voltage test of HV & LV	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		2) Induced over voltage test on HV & LV terminals	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		k) Repeat no load current/loss measurement & IR measurement after completion of dielectric tests	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		l) Measurement of Capacitance & tan delta for winding to earth	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		m) BDV of oil before and after dielectric test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		n) Jacking test on oil filled transformer followed by DP Test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		o) Oil Leakage test	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		p) IP-55 Degree of protection by thin paper insertion on MB	Major	Test	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		q) Functional/Continuity checking of wiring, IR, & HV on MB	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		r) Functional / Continuity checking of WTI, OTI, PRV, Buchholtz Relay	-do-	-do-	-do-	-do-	-do-	-do-	-do-	√	P	W	W	
		s) Paint, Shade, Thickness, Adhesion	Critical	-do-	Random basis	Random basis	-do-	-do-	-do-	√	P	W	W	
6.00	**PRE-DESPATCH**	a) Packing of loose items and main unit	Major	Physical	100%	-	Mfr Std/Packing List /Chalan	Mfr Std/Packing List /Chalan	QC Record	√	P	-	-	Accessories to be segregated unitwise
		b) Blanking of openings & valves after adjustment/drainage of oil	-do-	-do-	-do-	-	-do-	-do-		√	P	-	-	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: Mfrr / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE,

CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

`

	TITLE : STANDARD TECHNICAL SPECIFICATION FOR OIL FILLED SERVICE TRANSFORMERS	SPECIFICATION NO. PE-SS-999-302-E001
		VOLUME NO. : II
		SECTION : II
		REV NO. : 00 DATE : 30/06/2016
		SHEET : 28 of 30

ANNEXURE - B

TRANSFORMER LOSSES

1. The No-Load and Load losses for transformers 2.0MVA & above and voltage ratio 33kV/6.9kV, 33kV/3.5kV, 11kV/6.9kV, 11kV/3.5kV, 6.6kV/3.5kV are given below:

Ratings	Maximum No-Load losses at rated frequency and 100%voltage	Maximum Load losses at normal ratio, rated current and 75 deg. C
10.0 MVA	9.0kW	72 .0kW
8.0MVA	7.5 kW	57.0kW
7.5 MVA	7.2 kW	50.0kW
6.3MVA	6.5kW	45 .0kW
5.0MVA	5.5kW	36.0kW
3.5MVA	4.5kW	32 .0kW
2.5 MVA	2.8kW	30.0kW
2.0MVA	2.4 kW	24.0kW

The above indicated maximum No-Load and Load losses are inclusive of permissible tolerance as per IS-2026. Further tolerance on maximum losses is not permissible.

2. ~~Transformers of rating 2.5MVA & below and voltage ratio 33kV/433V, 11kV/433V, 6.6kV/433V, 3 .3kV/433V shall have Energy Efficien cy Lev el 1 as per I S-1180. However, percent impedance shall be as per Data Sheet A of s ection I, v olume II of technical specification.~~

`

	TITLE :	SPECIFICATION NO.
BHEL	**STANDARD TECHNICAL SPECIFICATION FOR**	**PE-SS-999-302-E001**
	OIL FILLED SERVICE TRANSFORMERS	VOLUME NO. : **II**
		SECTION : II
		REV NO. : **00** DATE : 30/06/2016
		SHEET : **29** of **30**

ANNEXURE – C

Terminal No.	Description	Remarks
T-01 T-02	230V, Single Phase, 50Hz, AC Supply	
T-03 T-04	MOG (Oil Level) Alarm	
T-05 T-06	Buchholz Relay Alarm	
T-07 Dummy T-08	Buchholz Relay Trip	
T-09 T-10	PRV-1 Alarm	If applicable
T-11 Dummy T-12	PRV-1 Trip	
T-13 T-14	PRV-2 Alarm	
T-15 Dummy T-16	PRV-2 Trip	
T-17 T-18	OTI Alarm	
T-19 Dummy T-20	OTI Trip	
T-21 T-22	WTI-1 Alarm	
T-23 Dummy T-24	WTI -1 Trip	
T-25 to T-28	SPARE	If applicable
T-29 T-30	4-20 mA for OTI (DDCMIS)	If applicable
T-31 T-32	4-20 mA for OTI (SCADA)	
T-33 T-34	4-20 mA for WTI-HV (DDCMIS)	
T-35 T-36	4-20 mA for WTI-HV (SCADA)	
T-37 to T-50	SPARE	
T-51 T-52	WTI 1-CT	If applicable
T-53	CT Shorting Terminal	
T-54 T-55	WTI 2-CT	
T-56	CT Shorting Terminal	
T-57 T-58	LV Neutral CT (REF Protection)	
T-59	CT Shorting Terminal	
T-60 T-61	LV Neutral CT (E/F Protection)	If applicable
T-62	CT Shorting Terminal	
T-63 T-64	HV Neutral CT (REF Protection)	
T-65	CT Shorting Terminal	
T-66 T-67	HV U-PHASE CT	
T-68	CT Shorting Terminal	
T-69 T-70	HV V-PHASE CT	
T-71	CT Shorting Terminal	
T-72 T-73	HV W-PHASE CT	
T-74	CT Shorting Terminal	
T-75 to T-80	SPARE TBs (for CT)	

Notes:

1). The Terminals from T-01 to T-48 shall be designated as indicated in the chart for all outdoor transformers (ONAN cooling).

2). The Terminals which are not used for a particular Transformer shall be left as spare. e.g. in case there is only one WTI alarm & trip, then terminals T-25 to T-28 & T-38 to T-40 shall be left as spare terminals.

3). Provide 20% spare TBs.

1X660 MW Panki TPS

ANNEXURE D TO SECTION II

Domestic Packing for Oil Filled Transformers Rating ≤10MVA

A. Transformer shall be despatched in open in such a manner there shall be no damage during transit.

B. Transformer Radiator Assembly, Conservator, Spares and Accessories shall be despatched in "Crate Packing" using wood.

C. Transformer Oil (Extra Oil + Spare Oil) shall be despatched in Non Returnable Sealed Drums with proper marking of Volume and Vendor details.

D. Paint for touchup shall be despatched in "Crate Packing" using wood.

E. CRATE PACKING DETAILS

1.0 PREPARATION OF PACKING CASES:

1.1 DIMENSIONS

1.1.1 Minimum number of planks shall be used for a shook.

1.1.2 Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm

1.1.3 Horizontal, vertical, diagonal planks shall be given for binding

1.1.4 Width of binding planks shall be minimum 100mm

1.1.5 Distance between any 2 binding planks shall be less than 750mm

1.1.6 Diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm

1.1.7 Distance of the outer edges of these planks from the edge of case shall be less than 250mm.

1.1.8 Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.

1.2 JOINTING OF PLANKS

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

1.3 TONGUE AND GROOVE JOINTS

Two consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12+1 mm, thickness of tongue shall be 8 +1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

1.4 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc. End splits: Longest end splits at each end shall be

measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split. Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

1.5 OTHER MATERIALS

1.5.1 NAILS

The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

1.5.2 BLUE NAILS

These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

1.5.3 HOOP IRON STRIPS

These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust. If sufficient nailing is done for bigger boxes, strapping need not be done.

1.5.4 CLIPS

These shall be used for strapping the hoop iron strips on the boxes.

1.5.5 BRACKETS

These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of "L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.

1.5.6 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM

100GSM (Colourless) Multi Layered Cross Laminated Polyethylene Film are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

1.5.7 RUBBERISED COIR

The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

1.5.8 FASTENERS

Bolts, double nuts, spring washers will have to be used to hold the job that there shall be no jerk.

1.5.8 PACKING SLIP

Packing slip kept in the polyethylene bag shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder shall be nailed to front / rear of case.

1.5.9 MARKING PLATE

Marking on the packing case shall be done as per the manufacturer standard.