TELANGANA STATE POWER GENERATION CORPORATION LIMITED
1X800MW KOTHAGUDEM, TPS, STAGE-VII, UNIT#12

VOLUME – IIB

TECHNICAL SPECIFICATION
FOR
OIL FILLED SERVICE TRANSFORMER

SPECIFICATION NO: ***PE-TS-410-302-E001, R01***

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UP (INDIA) – 201301

CONTENTS

TOTAL NO. OF SHEETS = 90 (INCLUDING COVER/ SEPARATOR SHEETS)

IT IS CONFIRMED THAT OUR TECHNICAL OFFER COMPLIES WITH THE SPECIFICATION IN TOTO, & THAT THERE ARE NO TECHNICAL DEVIATIONS.

BIDDER'S STAMP & SIGNATURE
(REFER INSTRUCTION NO. 1 OF INSTRUCTION TO BIDDERS)

PREAMBLE

1.0 The tender document contains two (2) volumes. The bidder shall meet the requirements of all the two volumes.

1.1 Volume-I (CONDITIONS OF CONTRACT)

This consists of four parts as below:-

Volume-IA	:	This part contains instructions to bidders for making bids to BHEL.
Volume-IB	:	This part contains general commercial conditions of the tender & includes provision that vendor is responsible for the quality of item supplied by their sub-vendors.
Volume-IC	:	This part contains special conditions of contract.
Volume-ID	:	This part contains commercial conditions for erection & commissioning site work, as applicable.

1.2 Volume-II (TECHNICAL SPECIFICATIONS)

Technical requirements are stipulated in Volume-II which comprises of:-

Volume-IIA	:	General Technical Conditions
Volume-IIB	:	Technical Specification including Drawings, if any.

1.2.1 Volume-IIB

This volume is sub-divided into following sections:-

Section-A	:	This section outlines the scope of enquiry.
Section-B	:	This section provides “Project Information”.
Section-C	:	This section indicates technical requirements specific to the contract, not covered in Section-D.
Section-D	:	This section comprises of technical specifications of equipments complete with data sheet A.

Data Sheet – A: - specifies data and other requirements pertaining to the Equipment.

Data sheet – C: - Indicates data / documents to be furnished after the award of Contract as per agreed schedule by the vendor (as applicable)

2.0 This requirements mentioned in Section – C / Data Sheet – A shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section – D(General Technical Requirements).

INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFER

1. Two signed and stamped copies of the following shall be furnished by all bidders as technical offer :

    a. Unpriced Price Schedule with "QUOTED" words against each item (Annexure-A, Annexure-C and Annexure-D : Main BOQ-Cum-Price Schedule, Mandatory Spares and Type test conduction as enclosed with the specification)
    b. Annexure-E
    c. A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer").
    d. A copy of previous sheet ("Contents").
    e. Datasheet-B duly filled, with bidder's signature and company stamp
    f. GA & Foundation Plan of Each Rating Transformer
    g. ("Deviation Schedule"), with "NO DEVIATION" and bidder's signature and company stamp

2. No other technical submittal such as copies of type test certificates, data sheets, write-up, drawing, technical literature, etc. is required during tender stage. Any such submission, even if made, shall not be considered as part of offer.

3. No comments/ additions/ deletions shall be made by the bidder on the signed & stamped copy of the specification. Any such changes made by the bidder shall not be considered.

4. Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference in the technical offer / covering letter shall not be considered by BHEL.

5. 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.

6. Any changes made by the bidder in the price schedule with respect to the item description/ quantities, notes etc. from those given in Annexure-A of specification [Bill Of Quantities] shall not be considered (i.e., technical description, quantities, notes etc. as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE

SECTION – A

SCOPE OF ENQUIRY

SCOPE OF ENQUIRY

1.0 This specification covers the Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of Oil Filled Service Transformer as mentioned in different sections of this specification for 1x800 MW KOTHAGUDEM TPS, STAGE-VII, UNIT#12

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

3.0 The general terms and conditions, instructions to bidders and other attachment referred to elsewhere are hereby made part of the tender specification.

4.0 The bidder shall be responsible for and governed by all requirements stipulated hereinafter.

5.0 Bidder shall confirm total compliance to the specification without any deviations from technical/quality assurance requirements stipulated.

6.0 Deviations, if any should be brought at very clearly on deviation sheet enclosed with specification only, Otherwise it will be presumed that the bidder's offer is in line with what has been stated/ asked for in this specification.

7.0 The documents shall be in English Language and MKS system of units.

SECTION - B

PROJECT INFORMATION

VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.

5.00.00 **SOURCE OF WATER**

Source of water (total quantity of water is 2192 m^3/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 **ASH DISPOSAL AREA**

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 **SALIENT DESIGN DATA**

7.01.00 Meteorological data of site is given below:-

Elevation above MSL		:	89 m
Monthly highest temperature		:	44.9 ºC
Monthly lowest temperature.		:	12.9 ºC
Rainfall			
	Average.	:	1031 mm
	Max.	:	100 mm/ hr
Mean Wind speed		:	5.8 kmph
Relative Humidity			
	Max	:	82%
	Min	:	35%
Seismic Zone		:	Zone-III as per IS- 1893 (Part-IV)

[Climatological data of Khammam is attached for reference].

SEC-C
PROJECT SPECIFIC TECHNICAL REQUIREMENTS

SECTION-VI

TECHNICAL SPECIFICATION
FOR
AUXILIARY POWER TRANSFORMER

1.00.00 **SCOPE OF SUPPLY**

1.01.00 The requirement of major 11/3.6KV Auxiliary Power transformers are indicated in BOQ-CUM-PRICE SCHEDULE. ~~Additional transformers, if required, shall be decided by Bidder based on system design and power supply arrangement.~~

~~1.02.00 Transformer offered by the bidder shall be sized according to the maximum demand at most stringent condition plus minimum 10 % margin~~

1.03.00 Each transformer shall be furnished complete with :-

a) Fittings and accessories -As per Ann-B of Sec-C. Items mentioned in Sec-D, cl. 7.0 also to be referred for balnce (but not duplicating with Sec-C) for total fitting and accessories required for each transformer.

~~b) Auxiliary equipment~~

c) First filling of oil including 10% extra -As per BOQ-Cum-Price Schedule.

1.04.00 One set of special tools and tackles -As per BOQ-Cum-Price Schedule.

1.05.00 Mandatory Spare parts -As per BOQ-Cum-Price Schedule.

1.06.00 All relevant drawings, data and instruction manuals.

2.00.00 **CODES AND STANDARDS**

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

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

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 **DESIGN CRITERIA**

3.01.00 The transformer will be used to supply power for Units & Station auxiliaries. The high voltage winding will be connected to the HV switchgear. The low voltage winding feeds the 3.3KV switchgear.

3.02.00 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.

3.03.00 The transformer shall be capable of continuous operation at rated output under the following condition :

a)	Voltage variation	:	± 10%
b)	Frequency variation	:	+3% to -5%
c)	Combined voltage and frequency variation absolute sum)	:	10%

3.04.00 The transformer shall be so designed that it is capable of operation at 125% rated voltage for a period of one minute and 140% rated voltage for a period of five seconds due to sudden load throw off.

3.05.00 The transformer shall be capable of withstanding the short circuit stresses due to a terminal fault on one winding with full voltage maintained on the other winding for minimum period of two (2) seconds.

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

3.07.00 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/IS13964/CBIP publication.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Tanks**

4.01.01 The tank shall be fabricated from good commercial grade low carbon steel of adequate thickness.

4.01.02 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) full vacuum of 760mm, (c) Short circuit forces and (d) continuous internal pressure of 35 kN/m^2 over normal hydrostatic pressure of oil.

4.01.03 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.

4.01.04 The tank shall be provided with one set of bi-directional flanged wheels for rolling the transformer parallel to either canter line over 1676 mm rail gauge. In case more than two rails are required to be provided the rail gauge of 1676 mm shall be maintained between two adjacent rails.

4.01.05 Jacking pads, lifting eyes and pulling lugs shall be provided to facilitate movement of the transformer. All heavy removal parts shall be provided with eye bolt for ease of handling.

4.01.06 Manholes/hand-holes of sufficient size shall be provided for access to leads, windings, bottom terminals of bushings and taps.

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

4.02.00 **Core & Coils**

4.02.01 The core shall be built up with high grade, non-aging, low loss, high permeability, grain oriented, cold-rolled silicon steel laminations especially suitable for core material.

4.02.02 The coils shall be manufactured from electrolytic copper conductor and fully insulated for rated voltage. Insulation shall be of Class A.

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

4.02.04 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.

4.02.05 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.

4.02.06 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.

4.03.00 **Tapping**

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

4.03.02 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.

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

4.04.00 **Off-Circuit Tap Changer (OCTC)**

4.04.01 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.

4.04.02 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.

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

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

4.05.00 **Insulating oil**

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

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

4.05.03 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, buchholz 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.

4.06.00 **Bushing**

4.06.01 Bushing rated below 52KV voltage class shall be solid porcelain or oil communicating type.

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

4.06.03 Bushing location shall provide adequate phase and ground clearances.

4.07.00 **Terminal Arrangements**

4.07.01 The physical position of the terminals and the markings shall be as per relevant IS/IEC unless otherwise required to suit the layout.

4.07.02 High voltage terminals shall be brought out thru' top cover mounted bushings with matching flanges around each bushing for connection to XLPE cables. The contractor shall furnish all necessary details in this connection for co-ordination with the bus duct/Cable and shall guarantee the matching dimensions within close tolerance.

4.07.03 Low voltage terminals shall be brought out thru' side wall mounted bushings. For bus duct connection, bushings shall have matching flange around. For cable connection, a detachable type cable end-box with disconnect links shall be furnished.

4.07.04 Low voltage winding neutral shall be brought out thru' side wall mounted bushing to a detachable cable end-box with disconnect link.

4.07.05 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.

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

4.08.00 **Cooling System**

4.08.01 The transformer cooling system (ONAN/~~ONAF~~) and number of cooling banks and capacity of each bank shall be as specified in the annex-B . The cooling system shall comprise number of cooling units each complete with its radiator banks, ~~pumps, fans~~ and other accessories

4.08.02 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 degree centigrade under following conditions:

~~a) for 20 minutes after failure of the blowers of one unit~~

b) for 10 minutes in the event of failure of the cooler units

4.08.03 The radiators shall be detachable type with top and bottom isolation valves to permit the removal of the same without drainage of oil from the tank.

~~4.08.04 All fans shall have safety guard. Pumps shall be provided with flow indicators for visual indication of oil flow.~~

~~4.08.05 Convenient means shall be provided to remove or replace any pump or fan with the transformer in service.~~

~~4.08.06 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.~~

~~4.08.07 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.~~

4.09.00 **Cooler Control panel** (NOT APPLICABLE FOR ONAN TRANSFORMER)

4.09.01 The transformer cooler control panel shall be used for control, interlocking, metering and indication of cooler control system of transformer and shall be installed outdoor near the transformer coolers.

4.09.02 Control panels shall be of CRCA sheet steel construction with protection class of IP-52 for indoor and IP-55 for outdoor installation.

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

4.09.05 The operating height shall be limited from 750mm to 1800mm. The total height of the panel and its depth shall be matched with adjacent panel.

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

4.09.07 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.

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

4.09.09 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.

4.09.10 The control panels shall be fully wired up at factory. All spare contacts of relays and switches shall be wires upto the terminal blocks.

4.09.11 The panel shall have provision of cable entry from bottom. Bottom gland plate shall be 3mm thick.

4.09.12 50 x 6 mm GI 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 GI bolts and nuts at each end to receive ground connection of 75x10 mm G.I. flat.

4.09.13 Wiring shall be done with flexible, 1100V grade PVC fire resistance wires in GI conduit or FRLS type PVC armored (round GI Wire) cable within transformer and also from transformer to Cooler Control Cabinet. Minimum wire size shall be 2.5 mm^2 stranded copper. Not more than two wires shall be connected to a terminal. 10% spare terminals shall be provided.

4.10.00 **Marshalling Box**

4.10.01 A sheet steel, weatherproof, IPW55, marshalling box shall be provided for the transformer. The box shall contain all auxiliary devices except those which must be located directly on the transformer.

4.10.02 All terminal blocks for cable connection shall be located in this box.

4.10.03 The marshalling box shall be provided with cubicle lamp with door switch, space heater with thermostat and removable cable gland plate.

4.11.00 **Wiring**

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

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

4.11.03 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.

4.11.04 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.

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

4.12.00 **Grounding**

4.12.01 The grounding pads, located on the opposite sides of the tank, cooling units, marshalling cabinet shall be provided for connection to station ground mat.

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

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

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

4.13.00 **Auxiliary Supply**

4.13.01 415V A.C. supply will be made available to each transformer by two separate feeders one normal and the other standby.

4.13.02 MCCB shall be provided for each of the incoming supply along with automatic changeover scheme to switch on to the standby source in case of failure of the normal supply.

4.14.00 **Auxiliary Equipment**

4.14.01 Neutral bushing current transformers shall be furnished when specified in the DATA SHEET-A

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

4.14.03 CT secondary leads shall be wired upto the terminal blocks. The terminals for CT secondary leads shall be provision fro shorting.

4.15.00 **Painting**

4.15.01 All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents as required, to produce a smooth surface free of scales, grease and rust.

4.15.02 The internal surfaces in contact with insulating oil shall be painted with heat resistant insulating varnish which shall not react with and be soluble in the insulating liquid used.

4.15.03 The external surfaces, after cleaning, shall be given a coat of high quality red oxide or yellow chromate primer followed by filler coats.

4.15.04 Paint Finish coat shall be Epoxy based with suitable additives. The thickness of finish coat shall be minimum 80 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 80 microns shall be acceptable for finish coat. Paint shade shall be semi glossy finish of shade Light Grey. Refer Painting Schedule (Vol-IIA, Sec-X, Painting Attached) for detailed painting procedure.

4.15.05 The paints shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

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

4.15.07 If it is considered necessary, the transformer may be given a further coating at site by the Owner/Purchaser. The Bidder shall therefore indicate the type and quality of the paint with full specification for this purpose.

4.15.08 All supporting structures and hardware shall be hot dip galvanized.

4.16.00 **Transportation**

4.16.01 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 36^{o}C 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.

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.

4.16.02 **Impact Recorder**

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

5.00.00 **TESTS**

5.01.00 **Routine Tests**

During manufacture and on completion, all transformers shall be subjected to the routine tests in accordance with latest IEC 60076 and its different parts.

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

5.01.01 Transformer tank with coolers shall be tested for leaks with normal head of oil plus 35 KN/m^2 for a period of 8 hours. If any leak occurs, the test shall be conducted again after all leaks have been repaired.

5.01.02 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/m^2 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/m^2 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.

5.01.03 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.

5.01.04 The wiring for auxiliary power and control circuitry shall be subjected to withstand one minute power frequency test with 2.0KV (r.m.s.) to earth.

5.01.05 Dielectric special tests as per IEC60076-3.

5.01.06 Determination of capacitances windings-to-earth and between windings.

5.01.07 Frequency Response Analysis test (This test shall also be undertaken by the manufacturer at site after transformer is installed.).

5.01.08 Measurement of acoustic sound level.

~~5.01.09 Measurement of power consumption of fans.~~

5.01.10 Measurement of zero sequence impedance(s) on three-phase unit.

5.01.11 Measurement of dissipation factor (tan delta) of insulation system capacitances.

5.01.11 All test on transformer oil as per IS 335 shall be conducted.

Note: Routine tests mentioned above are part of QAP and its Annexure.

5.02.00 **Type Tests** **

Following type tests shall be performed on one* transformer in accordance with relevant standard:

a) Dielectric type test (IEC60076-3) d) Other Type tests as per Quality Plan and Ann-1 to QAP

b) Temperature rise test.

c) Short circuit test

* Note:- . Type test mentioned at a) , b) c) & d) to be performed on one transformer of each rating. For Short Circuit test, charges for carrying out the test on one Transformer of each rating shall be payable based on actual invoice from designated laboratories(CPRI Bhopal/ CPRI Bangalore/ ERDA, Vadodara)

5.03.00 **Miscellaneous**

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

**Type test reports of a similar transformer (as per the guidance for identification of a similar transformer as defined in Annexure-B of IEC 60076-5) to be furnished after award of contract by successful bidder. However, conduction of type tests shall prevail as mentioned at *note above.

6.00.00 **SPECIAL TOOLS & TACKLES**

6.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

6.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

7.00.00 PROVEN MAKE CRITERIA

7.00.01. Vendor should have manufactured & supplied at least two numbers (one each at two different project sites) of at least highest offered rating (i.e. 6.3MVA) oil filled transformers, which must be in successful operation for a period of at least two (2) years as on 24 December, 2014. Performance certificate for the above mentioned criteria to be furnished along with the Bid.

7.00.02. Along with Bid, bidder to furnish short circuit test report of at least highest offered rating (i.e. 6.3MVA) oil filled transformers.

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Note:- The performance certificate and short circuit test reports should be of Transformer with
(a) Rating 6.3MVA or higher, and
(b) HV Winding rated voltage 11kV or Higher.

Please also refer Technical PQR(Part of NIT) for completeness of Pre-Qualification Requirement.

ANNEXURE-B

FITTINGS AND ACCESSORIES

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

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

2. Oil preservation system complete with accessories.

3. Air release plugs.

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

5. 150 mm dial magnetic oil level gauge with low level alarm contacts

6. 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).

7. 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).

8. Remote winding temperature indicator for mounting on Owner/Purchaser's panel with a separate detector element.

9. Thermometer pockets.

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

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

12. Drain valve with threaded adopter.

13. Sampling valve.

14. Necessary valves for detachable cooler units.

15. Jacking pads, handling and lifting lugs.

16. Cover lifting eyes.

17. Bi-directional flanged wheels and skids.

18. Clamping device with bolts & nuts.

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

20. Two-grounding pads.

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

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

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

24. Rating and terminal marking plates.

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

26. Tap-changing gear complete with tap position indicator, operation counter etc. ~~For OLTC gear(where specified), oil surge relay(OSL) with shut-off valve, Local control cabinet and Remote (RTCC) panel~~

Note : All indication, alarm, trip contacts provided shall be rated for 2.0A at 220 V D.C. and 5A at 240 V A.C.

Note:- Fitting and Accessories mentioned in Sec-D, Cl. no. 7.0 also to be referred and any additional items to be included as accessories for each transformer which are not mentioned above.

ANNEXURE-A
BOQ CUM PRICE SCHEDULE FOR OIL FILLED SERVICE TRANSFORMER (MAIN ITEMS)

Sr. No.	Item code	Item description	Unit	ORDERED QUANTITY	UNIT PRICE (EX-WORKS) Rs	TOTAL PRICE (EX-WORKS) Rs	REMARKS
1.0	302-11014-A	6300KVA, 11KV/3.6KV, 3 PHASE, 2 WINDING, OUTDOOR, ONAN, Z=7.0%, DYN11, OFF CIRCUIT TAPS. 5% IN STEPS OF 2.5% (WITH CABLE BOX TYPE HV AND WITH BUS-DUCT TYPE LV TERMINATION)	NOS.	2			REFER NOTE-2
2.0	302-11012-A	3500KVA, 11KV/3.6KV, 3 PHASE, 2 WINDING, OUTDOOR, ONAN, Z=6.0%, DYN11, OFF CIRCUIT TAPS. 5% IN STEPS OF 2.5% (WITH CABLE BOX TYPE HV AND WITH BUS-DUCT TYPE LV TERMINATION)	NOS.	2			REFER NOTE-2
3.0	302-11045-A	10 % EXTRA TRANSFORMER OIL IN SEALED NON RETURNABLE STANDARD DRUMS FOR 6300KVA, 11KV/3.6KV, 3 PHASE, 2 WINDING, OUTDOOR, ONAN, Z=7.0%, DYN11	NOS.	2			REFER NOTE-1
4.0	302-11045-A	10 % EXTRA TRANSFORMER OIL IN SEALED NON RETURNABLE STANDARD DRUMS FOR 3500KVA, 11KV/3.6KV, 3 PHASE, 2 WINDING, OUTDOOR, ONAN, Z=6.0%, DYN11	NOS.	2			REFER NOTE-1
5.0	302-11055-A	**MISCELLANEOUS ITEMS**					
5.0(a)		SPECIAL TOOLS AND TACKLES	LOT	1			BIDDER TO FURNISH THE LIST
5.0(b)		SUPERVISION OF COMMISSIONING					
5.0(b.1)		CHARGES PER VISIT	VISIT	2			REFER NOTE 3, 4 & 5
5.0(b.2)		MANDAYS CHARGES	NOS.	4			REFER NOTE 3, 4 & 5

Notes:

1 BIDDER SHALL SUPPLY 10% EXTRA OIL AS PER THE QUOTED PRICE. QUANTITY OF EXTRA OIL SHALL BE SUBJECT TO APPROVAL DURING DETAIL ENGINEERING.

2 BIDDER TO NOTE THAT THE COST OF TRANSFORMER SHALL INCLUDE THE COST OF SPECIAL TESTS (MENTIONED IN ANN-1 TO QAP) AS ROUTINE TEST. THESE SPECIAL TEST SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. BIDDER SHALL QUOTE ACCORDINGLY.

3 BIDDER TO QUOTE CHARGES PER VISIT AND MANDAYS CHARGES. THE VISIT CHAGRES SHALL BE INCLUSIVE OF CHARGES OF AIR FARE/TRAIN FARE , BOARDING/LODGING, MEDICAL , INSURANCE ETC.

4 FREQUNCY RESPONSE ANALYSIS TEST (MENTIONED IN SEC-C, CL. NO. 5.01.07) SHALL BE CONDUCTED AT SITE. CHARGES FOR THIS TEST SHALL BE GOVERN BY PRICES MENTIONED AT 5.0(b.1) & 5.0(b.2). TOOLS & TACKLES INCLUDING FREQUENCY RESPONSE ANALYSER FOR TESTING AT SITE SHALL BE ARRANGED BY BIDDER. NO OTHER CHARGES SHALL BE PAYABLE BY BHEL.

5 AMOUNT PAYABLE PER VISIT = UNIT VISIT CHARGES AS PER SL. NO. 5.0(b.1) ABOVE (+) UNIT MANDAYS CHARGES AS PER SL. NO. 5.0(b.2) ABOVE (x) NO. OF DAYS AT SITE(TO BE CERTIFIED BY BHEL SITE)

6 BOQ-CUM-PRICES SCHEDULE (ANNEXURE-A & ANNEXURE-C) AND TYPE TEST CONDCTION SCHEDULE (ANNEXURE-D) WILL BE CONSIDERED FOR PRICE EVALUATION PURPOSE.

ANNEXURE-C
BOQ CUM PRICE SCHEDULE FOR OIL FILLED SERVICE TRANSFORMER (MANDATORY SPARES)

Sr. No.	Item code	Item description	Unit	ORDERED QUANTITY	UNIT PRICE (EX-WORKS) Rs	TOTAL PRICE (EX-WORKS) Rs	REMARKS
	302-11000-B	**MANDATORY SPARES FOR 6300KVA TRANSFOMER**					
1.0		**BUSHING**					
1.0(a)		HV BUSHING	NO.	1			
1.0(b)		LV BUSHING	NO.	1			
1.0(d)		LV NEUTRAL BUSHING	NO.	1			
2.0		WINDING TEMPERATURE INDICATOR WITH ALL ACCESSORIES	NO.	1			
3.0		OIL TEMPERATURE INDICATOR	NO.	1			
4.0		PRESSURE RELIEF DEVICE OR DIAPHRAGM FOR EXPLOSION RELIEF VENT	NO.	1			
5.0		MAGNETIC OIL LEVEL GAUGE	NO.	1			
6.0		BUCHHOLZ RELAY	NO.	1			
7.0		SILICA GEL BREATHER	NO.	1			
8.0		OIL SURGE RELAY FOR OLTC	NO.	1			
9.0		COMPLETE CABLE CUM BUSDUCT LV TERMINALS	NO.	1			
10.0		VALVE OF EACH TYPE INSTALLED	NO.	1			
	302-11000-B	**MANDATORY SPARES FOR 3500KVA TRANSFOMER**					
1.0		**BUSHING**					
1.0(a)		HV BUSHING	NO.	1			
1.0(b)		LV BUSHING	NO.	1			
1.0(d)		LV NEUTRAL BUSHING	NO.	1			
2.0		WINDING TEMPERATURE INDICATOR WITH ALL ACCESSORIES	NO.	1			
3.0		OIL TEMPERATURE INDICATOR	NO.	1			
4.0		PRESSURE RELIEF DEVICE OR DIAPHRAGM FOR EXPLOSION RELIEF VENT	NO.	1			
5.0		MAGNETIC OIL LEVEL GAUGE	NO.	1			
6.0		BUCHHOLZ RELAY	NO.	1			
7.0		SILICA GEL BREATHER	NO.	1			
8.0		OIL SURGE RELAY FOR OLTC	NO.	1			
9.0		COMPLETE CABLE CUM BUSDUCT LV TERMINALS	NO.	1			
10.0		VALVE OF EACH TYPE INSTALLED	NO.	1			

ANNEXURE-D
(TYPE TESTS TO BE CONDUCTED)

Sr. No.	Item code	Item description	UNIT PRICE (EX-WORKS) FOR 6300KVA Rs.	UNIT PRICE (EX-WORKS) FOR 3500KVA Rs.	REMARKS
	302-11051-A	**TYPE TESTS ON ONE NUMBER OF EACH TYPE AND RATING OF TRANSFORMER**			
1.0		TEMPERATURE RISE TEST			
2.0		DIELECTRIC TYPE TESTS (FULL WAVE LIGHTNING IMPLUSE TEST FOR THE LINE TERMINALS(LI)			
3.0		SHORT CIRCUIT TEST**	** REFER NOTE- 2		

Notes:

1 BIDDER TO QUOTE UNIT PRICES FOR TYPE TESTS AT SL. NO. 1.0 & 2.0 ONLY. CONDUCTION OF SHORT CIRCUIT TEST WILL ALSO BE IN THE SCOPE OF BIDDER, BUT ACTUAL CHARGE FOR THE SAME WILL BE BORNE BY BHEL AS PER NOTE NO. 2 BELOW.

2 ** CHARGES FOR CARRYING OUT SHORT CIRCUIT TEST SHALL BE PAYABLE BASED ON ACTUAL INVOICE FROM DESIGNATED LABORATORIES (CPRI, BHOPAL/ CPRI, BANGLORE / ERDA, VADODARA) WITH AN ADDITIONAL LUMP SUM AMOUNT OF 5% OF EX-WORKS PRICE OF TRANSFORMER BEING TESTED TO COVER HANDLING COSTS (TRANSPORTATION, INSURANCE ETC.).

3 TYPE TEST REPORTS (CONDUCTED FOR THIS CONTRACT) SHALL BE SUBMITTED FOR APPROVAL DURING DETAILED ENGINEERING.

ANNEXURE-E
LIST OF TYPE TESTS/SPECIAL TESTS (VALID REPORTS TO BE SUBMITTED)

Sr. No.	Item code	Item description	11/3.6KV, 6300KVA	11/3.6KV, 3500KVA	REMARKS
1.0		DEGREE OF PROTECTION (IP 55) TESTS ON MARSHALLING BOX	APPLICABLE	APPLICABLE	
2.0		DEGREE OF PROTECTION (IP 55) TESTS ON CABLE BOX	APPLICABLE	APPLICABLE	
3.0		PRD OPERATION TEST(APPLICABLE FOR 2000kVA & ABOVE RATING TRANSFORMER)	APPLICABLE	APPLICABLE	
4.0		MEASUREMENT OF HARMONICS CURRENT IN NO LOAD CURRENT	APPLICABLE	APPLICABLE	

Notes:

1 TYPE TEST REPORTS OF A SIMILAR TRANSFORMER (AS PER THE GUIDANCE FOR IDENTIFICATION OF A SIMILAR TRANSFORMER AS DEFINED IN ANNEXURE-B OF IEC 60076-5) TO BE FURNISHED AFTER AWARD OF CONTRACT.

2 THE TYPE TEST SHOULD HAVE BEEN EITHER CONDUCTED AT AN INDEPENDENT LABORATORY OR SHOULD HAVE BEEN WITNESSED BY A CLIENT.

3 IF VALID TYPE TEST REPORTS ARE NOT AVAILABLE OR REPORTS ARE NOT ACCEPTABLE OR REPORTS ARE NOT MEETING THE CONTRACT SPECIFICATION REQUIREMENT DURING DETAILED ENGINEERING THEN ALL TYPE TESTS LISTED ABOVE SHALL BE CONDUCTED FREE OF COST ON ONE TRANSFORMER OF EACH TYPE AND RATING .

Annex B
(informative)

Definition of similar transformer

A transformer is considered similar to another transformer taken as a reference if it has the following characteristics in common with the latter:

– same type of operation, for example generator step-up unit, distribution, interconnection transformer;

– same conceptual design, for example dry type, oil-immersed type, core type with concentric windings, sandwich type, shell type, circular coils, non-circular coils;

– same arrangement and geometrical sequence of the main windings;

– same type of winding conductors, for example aluminium, aluminium alloy, annealed or work-hardened copper, metal foil, wire, flat conductor, continuously transposed conductors and epoxy bonding, if used;

– same type of main windings, for example helical-, disc-, layer-type, pancake coils;

– absorbed power at short circuit (rated power/per unit short-circuit impedance) between 30 % and 130 % of that relating to the reference transformer;

– axial forces and winding stresses occurring at short circuit not exceeding 120 % of those relating to the reference transformer;

– same manufacturing processes;

– same clamping and winding support arrangement.

TECHNICAL SPECIFICATION

FOR

OIL FILLED SERVICE TRANSFORMERS

SPECIFICATION NO.: PE - TS - 999 - 302 - E001

REV. NO. 00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA

CONTENTS

SECTION 'A'
SCOPE OF ENQUIRY

SCOPE OF ENQUIRY

1.0 This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **OIL FILLED SERVICE TRANSFORMERS.**

2.0 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.

3.0 The general terms and conditions, instructions to bidders and other attachment referred to elsewhere are hereby made part of the tender specification.

4.0 The bidders shall be responsible for and governed by all requirements stipulated hereinafter.

5.0 Bidders shall confirm total compliance to the specification without any deviation from the technical/ quality assurance requirements stipulated

GENERAL TECHNICAL REQUIREMENTS

1.00 INTENT OF SPECIFICATION

1.01 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 The intent of specification is not to specify all details of design & construction of equipment. The equipment shall, however, conform in all aspects to high standard of design, engineering and workmanship and be capable of performing in continuous operation upto & after bidder's guarantee period in manner acceptable to purchaser who will interpret the drawings & specification and shall have power to reject any work or material which in his judgement is not in full accordance with this specification.

2.00 CODES AND STANDARDS

2.01 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.

2.02 The design, material, construction, manufacture, inspection, testing and performance of LT Service Transformers shall conform to the currently applicable standards and codes of practices as per Annexure-VIII. General design, electrical & constructional features and various fittings & accessories shall be as per CBIP manual on Transformers Publication No. 275 (latest edition).

2.03 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

3.00 SCOPE OF ENQUIRY

3.01 Bidder shall quote for mineral oil filled LT Service Transformers including 10% spare oil in accordance with various sections of this specification. The transformer shall be provided with all fittings & accessories (including foundation hardware) & shall be complete in all aspects, for satisfactory operation, in accordance with this specification & technical particulars. Design ambient temperature shall be 50 deg. C. Project information shall be given separately for the specific project.

3.02. Bidder shall quote for following equipment & services:

1. Transformers (Rating & quantity of transformers shall be as per specific project requirement-Sec-C).

2.	Special Tools & Tackles required for erection, commissioning and proper maintenance of equipment. (Bidder to furnish list along with offer)	One Lot
3.	Commissioning spares for each transformer. (Bidder to furnish list along with offer)	One Lot
4.	O & M spares	As specified in Annexure-I
5.	Type Tests	As specified in Annexure-II

Note:
Extra 10% of total oil quantity shall be supplied along with the first lot of transformers in sealed non-returnable drums.

4.00 SERVICES & EQUIPMENT TO BE EXCLUDED

4.01 Civil work such as transformer foundation, cable trenches etc.
4.02 Erection, testing, commissioning of transformer at site.
4.03 External power connection for HV & LV side of transformer by means of busduct/ cables, as applicable.
4.04 HV termination kits.
4.05 Connection to Station Earth.

5.00 TERMINAL POINTS

I. HV bushings with terminal connector for bus duct/ cable glands & lugs in case of cable connection.
II. LV bushings with terminal connector (3 Phase + 1 Neutral) for bus duct/ cable glands & lugs in case of cable connection.
III. 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
IV. For LV Earthing : - neutral earth busbar brought near the base of transformer/ Cable glands & lugs in case of cable connection
V. Transformer earthing pads.
VI. Terminals of marshalling box for external connection to equipment supplied by the purchaser.

6.00 TECHNICAL REQUIREMENTS

6.01 Technical particulars of transformers are specified in Data Sheet –A

6.02 Equipment shall give continuous service under specified site conditions.

6.03 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.

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

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

6.06 Under base of tank shall be fixed type.

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

6.08 Specific technical requirements are as follows:

6.08.01 **Tank: -** Fabricated from tested quality steel and designed to withstand continuous internal pressure of 35 kN per sq. m. over normal pressure as well as short circuit forces. The main tank body including tap-changer compartment, radiators and coolers shall be capable of withstanding full vacuum. All steel surfaces in contact with insulating oil shall be painted with two coats of heat resistant oil in soluble insulating varnish. Tank shields, if provided, shall not resonate at natural frequency of equipment.

6.08.02 **Tank mounting** Transformer tank shall be mounted on bi-directional rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer. 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.

6.08.03 **Tank openings** At least two adequately sized inspection openings, one at each end of the tank for easy access to bushings and earth connections.

6.08.04 **Oil preservation** Conservator tank of adequate capacity for expansion of oil from minimum ambient to 100 deg. C shall be provided. The transformers rated 6.3MVA and above shall be provided with air bag breathing through silica gel breather. For lower rating transformers with conventional conservator with dry air filling of the space above oil and connected to silica gel breather shall be provided.

6.08.05 **Radiators** Tank mounted with shut off valves.

6.08.06 **Insulating Oil** As per IS: 335. No external inhibitors are permitted.

6.08.07 All transformers shall be suitable for cable/ Busduct termination as indicated in data sheet-A.

6.08.09 **Bushings/ Insulators**

a) 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 can be acceptable.

b) For 3.3kV, 6.6kV and 11 kV windings, 17.5kV bushing shall be provided. For 415V windings, 1.1kV bushings shall be provided.

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

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

e) 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.

f) Creepage distance shall be as per data sheet-A.

g) 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:

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

6.08.10 **Cable Box**

a) 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. 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.

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

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

d) Creepage distance and clearances in air shall be as per CBIP manual.

e) 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.

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

g) 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.

6.08.11 **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 busduct shall be furnished during detail engineering stage. Degree of protection of LV busduct flange enclosure shall be IP: 55.

6.08.12 **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.

6.09 **Neutral CT**

Bidder to provide neutral bushing CT as per details given in data sheet - A 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. CT mounted inside the tank shall not be acceptable.

6.10 Voltage control (off circuit type)

a) 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.

b) 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.

c) 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.

d) 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.

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

6.11 Marshalling box

a) Tank mounted vermin and dust proof marshalling box shall be provided.

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

c) 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$^{2.}$

d) The terminal blocks shall be complete with insulating barriers and clip-on type terminals suitable for 2.5mm^2 stranded copper wire. At least 20% spare terminals shall be provided.

e) The marshalling box shall be provided with thermostatically controlled space heaters and shall have IP: 55 degree of protection. The marshalling box shall also be provided with a suitable canopy.

f) CT terminals shall be with shorting and disconnecting facility.

6.12 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

6.13 Winding

For 11KV & 3.5KVwinding, type of winding shall be continuous disc & for 433V winding, type of winding shall be spiral type.

6.14 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.

6.15 All transformers and their accessories shall be capable of withstanding without damage any external short circuit at the terminals for duration of two seconds. Calculation shall be furnished by the bidder during contract engineering stage to substantiate the adequacy of support system to withstand short circuit forces.

6.16 Maximum Transformer losses including tolerances shall be as per annexure – III.

6.17 LOADING CAPABILITY

Transformer shall be suitable for continuous operation at rated kVA on any tap with voltage variation of ± 10 % corresponding to voltage of the tap. Short duration overloading shall be in accordance with IEC 354/IS: 6600.

7.0 Fittings & accessories

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

a) Conventional type conservator with drain valve and oil filling hole.
b) Magnetic oil level gauge with low-level alarm contact.
c) Prismatic & toughened glass oil level gauge.
d) Gaskets
e) Gasket protection covers.
f) Silica gel breather with oil seal.
g) Double float type Buchholz relay with alarm and trip contacts with suitable gas collecting device with two shut-off valve on both side.
h) Diaphragm type explosion vent for transformers of rating less than 2MVA
i) Pocket on tank cover for thermometer.
j) Protected type mercury in glass thermometer.
k) 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 dual output 4-20 mA should be made available.
l) 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 dual output 4-20 mA should be made available.
m) Drain Valves.

n) Sampling devices.
o) Filter valves.
p) Earthing terminals – 2 Nos.
q) Rating & Diagram plates.
s) Valve schedule plate.
t) Two sets of lifting lugs (one for transformer with oil and other for tank cover).
u) Jacking pads.
v) Skids and pulling eyes on both sides.
w) Air release devices.
x) Inspection cover.
y) Oil filling hole and cap.
z) Tank mounted marshalling box.
aa) Detachable, flat, bidirectional rollers with 90 deg. swivel mechanism.
bb) Clamping arrangement for rollers.
cc) Ground support for cable box.
dd) Neutral CT secondary box.
ee) Haulage facilities.
ff) 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.
gg) Gas collection device along with all accessories**.**

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

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

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

7.05 Rating/ Name/ Valve schedule plates shall be of white non-hygroscopic material with engraved black lettering. Such plates shall be bi- lingual with Hindi inscription first, followed by English. Alternatively, two separate plates with Hindi & English inscription shall be provided.

8.00 PAINTING

Paint shade shall be informed to successful bidder during detail engineering as applicable for specific project.
Successful bidder shall furnish painting specification/ procedure to be used for BHEL/ CUSTOMER approval during detailed engineering. Adequate quantity of touch up paint shall also be supplied. There shall be no commercial or delivery implication to BHEL on account of paint shade, paint specification/ procedure.

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

9.01 Commissioning spares are those, which may be required during commissioning of the equipment. Bidder to furnish list of commissioning spares along with technical offer

9.02 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-I.

9.03 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.

10.00 QUALITY ASSURANCE, TESTING & INSPECTION

10.01 BHEL's Standard QP (PED-302-00-Q-001 Rev. 03) is enclosed as per Annexure-V for reference. However, at contract stage, the successful bidder shall submit the QP for BHEL/ ultimate customer's approval. 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 implication to BHEL on account of QP approval.

10.02 All materials, components and accessories of the transformers shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.

10.03 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.

10.04 All routine and acceptance tests as per relevant standards and specification shall be carried out by the vendor/ sub-vendor on all transformers. Charges for all these routine and acceptance tests for all the equipments & components shall be deemed to be included in the bid price.

10.05 Additionally, the bidder shall include in his equipment price the cost of carrying out the following special tests as routine tests on all the transformers:

1) Oil Leakage test for 24 hours
2) Jacking test on transformer's load bearing members.
3) Repeat no load loss tests after electrical tests.
4) Measurement of capacitance & tan delta to determine capacitance between winding & earth.

10.06 Type tests & special tests shall be conducted on one transformer of each rating and type as per Annexure-II. The charges for each of the type test & special test shall be quoted in "Schedule of Prices –Type/special Tests on Transformers". These charges shall also be applicable in case of waival of any type test/special test by the purchaser at a later date.

10.07 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.

10.08 Charges for all type tests and special test as per Annexure-II except Short circuit test shall be considered for price comparisons purpose.

10.09 Charges for carrying out Short circuit test shall be payable based on actual invoice from the designated laboratories (CPRI, Bhopal / CPRI, Bangalore / ERDA, Vadodara) with an additional lump sum amount of 5% of ex-works price of transformer being tested to cover handling costs (transportation, insurance etc.).

10.10 In case any of the type and special tests are required to be repeated the same shall be carried out by the vendor without any commercial / delivery implication to BHEL.

10.11 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

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

b) 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.

11.00 DRAWINGS, DATA & DOCUMENTS TO BE SUBMITTED

11.01 Following shall be submitted along with the offer:

a) The enclosed Data Sheet-B filled up completely for each rating/ type of transformers.
b) Clause – wise deviation, if any.

11.02 Following documents shall be submitted after placement of order for BHEL & customer's approval:

a) The enclosed Data Sheet – C duly filled up.
b) Vendor drawing submission schedule.
c) Design calculations for short circuit withstand capability (refer cl.6.15 & cl 10.11)

d) Overall General Arrangement Drawing clearly showing all fittings, accessories, termination details, foundation details with roller locking arrangement.
e) General Arrangement of Marshalling Box.
f) Rating & Diagram Plate Drawing.
g) Valve Schedule Plate Drawing.
h) Cable Box Arrangement Drawing.
i) Bushing/ Insulator Drawings.
j) Busduct Trunking Drawings.
k) Quality Plan.
l) Type test procedure
m) Wiring Diagrams.
n) Type/ Special Test certificates for tests already carried out on similar transformers.
n) Painting procedure of vendor for approval of customer.
o) Recommended Field Quality Plan
q) Routine test reports
r) O & M Manuals

The documents listed at sl. no. a),b) & c) shall be submitted by successful bidder within 2 weeks from L.O.I while documents sl. no. d) through o) shall be submitted by successful bidder within 4 weeks from L.O.I.

No. of documents/ drawings required shall be as per "Documents/ Drawings Distribution Schedule" enclosed as per Annexure-IV.

12.00 O & M MANUALS

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

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

a) General description of equipment.
b) Approved Technical Data Sheet
c) Salient constructional features.
d) Technical leaflets of fittings/ important parts.
e) All drawings.
f) Type and routine test certificates.
g) Instructions to be followed on receipt of equipment at site & for storage.
h) Instructions for foundation arrangement.
i) Erection procedures and checks.
j) Pre-commissioning checks.
k) Commissioning procedures.
l) Withdrawal arrangement/ material handling instructions.

m) Operation instructions.
n) Maintenance instructions.
o) Trouble-shooting.
p) Safety instructions.

13.00 All drawings/ documents indicated at clause no. 11 & 12 above shall be computer generated. Drgs. / documents shall be required in soft form (PDF format) also. All drawings shall be prepared in AUTOCAD latest version. Drawings & documents shall be submitted in CD also. The number of copies of various drawings/ documents shall be as per Annexure -IV.

ANNEXURE-I

LIST OF O & M SPARES

S. NO.	DESCRIPTION	QTY
1	HV bushing with metal parts & gaskets	1 no. for each rating
2	LV bushing with metal parts & gaskets	1 no. for each rating
3	WTI with alarm & trip contacts	1 no.
4	OTI with alarm & trip contacts	1 no.
5	Magnetic oil level gauge	1 no.
6	Diaphragm of explosion vent	1 no.
7	Buchholz relay	1 no.
8	Silica gel charge	Three charge
9	Floats with contacts for Buchholz relay	1 set
10	Set of gaskets	2 sets
11	Set of valves (1 no. of each size & Type)	1 set
12	Set of windings for one limb in a suitable oil container (container shall be completely filled with transformer oil)	1 no. of each rating & type of transformer.
13	Contact for tap changer	1 set
14	Pressure relief device for 2MVA & above transformers	1 no.
15	Hydraulic/screw Jacks	4 no.
16	Any other item considered essential by the bidder	

Note:

1) Wherever set is indicated above, it means the total parts/ accessories required to replace the particular item for a given equipment

2) O & M spares shall be supplied along with transformers and packed separately with proper inscription.

ANNEXURE-II

TYPE/SPECIAL TESTS FOR OIL FILLED SERVICE TRANSFORMERS

a) Tank Pressure test
b) Tank Vacuum test
c) Capacitance & tan delta of windings
d) Noise level
e) Measurement of harmonic current in no load current
f) PRD operation test (applicable for 2000kVA & 2500kVA transformer)
g) Short circuit test
h) Degree of protection (IP55) test on marshalling box.
i) Degree of protection (IP55) test on cable box.
j) Degree of protection (IP55) test on LV busduct flange enclosure.
k) Zero sequence impedance.
l) Temp rise test.
m) Dielectric type test (including chopped wave impulse test)
n) DGA test on oil before and after temperature test.

ANNEXURE III

TRANSFORMER LOSSES

1. The No-Load and Load losses for transformers are given below:

11KV/433V, 6.6KV/433V & 3.3KV/433V TRANSFORMERS

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
3.5kVA	4.5kW	32.0kW
2.5 MVA	2.8kW	30.0kW
2.0MVA	2.4 kW	24.0kW
1.6MVA	2.1kW	19.0kW
1.25 MVA	1.7kW	15.0kW
1.0MVA	1.5kW	12.0kW
630 kVA	1.0kW	7.5kW

2. 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.

3. In case measured losses of transformers during testing exceeds the above mentioned values, BHEL may accept the transformer with penalty. The rate of penalty shall be Rs. 1.95 lacs per kW. The penalty shall be calculated for each transformer as given below:

   PENALTY =Penalty Rate x [measured No-Load losses - maximum No-Load losses) + (measured Load losses – maximum Load losses)]

ANNEXURE- IV

DOCUMENTS/ DRAWINGS DISTRIBUTION SCHEDULE

S. NO.	DESCRIPTION	No. hard prints/Soft copies	No. of CD-ROMs	REMARKS
1.	Docs. /drgs. for approval (First submission)	1 Hard copies + Soft Copy	Nil	
2.	Drgs. / docs. for approval (Second & subsequent submission till approval)	Soft Copy	Nil	
3.	Final approval drgs. / docs. for Distribution	14 Hard Copies + Soft Copy	3 CD-ROMS	
4.	As Built Drg.	6 Hard copies + Soft Copy	3 CD-ROMS	
5.	Operation & Maintenance manual for approval	Soft Copy		
6.	Approved Operation & Maintenance Manual for distribution	6 Hard copies + Soft Copy	3 CD-ROMS	
7.	Erection/ Installation Manual	6 Hard copies	3 CD-ROMS	
8.	Type Test Certificates/ Reports	1 Hard copies + Soft Copy		

ANNEXURE - V

STANDARD QUALITY PLAN

	QUALITY PLAN	CUSTOMER : TSGENCO	PROJECT TITLE : 1X800MW KOTHAGUDEM	SPECIFICATION NO. : PE-TS-410-302-E001
		BIDDER/ VENDOR :	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE:
	SHEET 1 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. :

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**											
1.1	Mild Steel plate, MS Pipe, Channels, MS Angles	a) Thickness	Major	MEASURE	10%			QC Record.	3/2		1	
		b) Surface defects	Major	VISUAL	100%			QC Record.	3/2		2	
		c) Chemical composition	Major	TEST	-			Supplier's TC	3/2		-	
		d) Mechanical Properties	Major	TEST	-	'MANFUF. STD /	'MANFUF. STD /	Supplier's TC	3/2		2	
		e) Hydraulic test of pipes	Major	TEST	-	IS:2062 / IS:1239	IS:2062 / IS:1239	Supplier's TC	3/2		2	
1.2	CRGO Steel	a) Thickness Dimension & Finish	Major	MEASURE	10%	DRG/DATA SHEET/	DRG/DATA SHEET/	QC Record.	2		1	
		b) Grade of CRGO	Major	MEASURE	-	'MANFUF. STD /	'MANFUF. STD /	TC	3/2		2	
		c) Cutting & burr	Major	MEASURE	10%	IS:3024 / IS:649	IS:3024 / IS:649	QC Record.	2		-	
		d) Scratches, surface finish	Major	VISUAL	10%			QC Record.	3/2		-	
		e) Waviness & edge camber	Major	MEASURE	10%			QC Record.	2		1	
		f) Specific core loss	Major	TEST	-			Supplier's TC	3/2		2	
		g) Surface resistivity	Major	TEST	-			Supplier's TC	3/2		2	
		h) Stacking factor	Major	TEST	-			Supplier's TC	3/2		2	
		i) Permeability	Major	TEST	-			Supplier's TC	3/2		2	
		j) Bend test/ Ductility	Major	MEASURE	-			Supplier's TC	3/2		2	
1.3	Paper Insulated Copper Conductor	a) Dimensions	Major	MEASURE	100%	'MANFUF. STD /	'MANFUF. STD /	QC Record.	2		1	
		b) Resistivity/Conductivity	Major	TEST	10%	IS:13730-P-27/IEC	IS:13730-P-27/IEC	Supplier's TC	3/2		1	
		c) Elongation	Major	TEST	-	60554	60554	Supplier's TC	3/2		2	
		d) Tensile Strength	Major	TEST	-			Supplier's TC	3/2		2	
		e) Proof stress if applicable	Major	TEST	-			Supplier's TC	3/2		2	
		f) Insulation test between strands for bunched conductors	Major	TEST	-			Supplier's TC	3/2		2	
		g) Cu purity of CC rod	Major	TEST	-			Supplier's TC	3/2		2	
		h) Chemical composition	Major	TEST	-			Supplier's TC	3/2		2	
		i) Surface Finish	Major	VISUAL	100%	Free from sharp edge,burr,scretch, cuts etc.	Free from sharp edge,burr,scretch, cuts etc.	QC Record.	2		2	
1.4	Insulating Paper	a) Dimensions	Major	MEASURE	10%	'MANFUF. STD /	'MANFUF. STD /	QC Record.	2		1	
		b) Density & substance	Major	TEST	-	IS:9335-P-2/IS:9335-	IS:9335-P-2/IS:9335-	Supplier's TC	3/2		2	
		c) Tensile Strength	Major	TEST	-	P-III/IEC 60554	P-III/IEC 60554	Supplier's TC	3/2		2	
		d) Elongation	Major	TEST	-			Supplier's TC	3/2		2	
		e) Water absorption	Major	TEST	-			Supplier's TC	3/2		2	
		f) Moisture content	Major	TEST	-			Supplier's TC	3/2		2	
		g) pH value & conductivity aqueous extract	Major	TEST	-			Supplier's TC	3/2		2	
		h) Ash content	Major	TEST	-			Supplier's TC	3/2		2	
		i) Electrical strength	Major	TEST	-			Supplier's TC	3/2		2	
		j) Air permeability	Major	TEST	-			Supplier's TC	3/2		2	
		k)Tear index	Major	TEST	-			Supplier's TC	3/2		2	
		l) Heat stability	Major	TEST	-			Supplier's TC	3/2		2	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER : TSGENCO			PROJECT TITLE : 1X800MW KOTHAGUDEM			SPECIFICATION NO. : PE-TS-410-302-E001					
		BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:					
	SHEET 2 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
1.5	Insulation & Press-Board moulding (stock items)	a) Dimension	Major	Measure	10%	'MANFUF. STD / IS:1576	'MANFUF. STD / IS:1576	QC Record.	2		1		
		b) Compressibility	Major	Test	-			Supplier's TC	3/2		2		
		c) Density	Major	Test	-			Supplier's TC	3/2		2		
		d) Tensile strength	Major	Test	-			Supplier's TC	3/2		2		
		e) pH value/Conductivity of water extract	Major	Test	-			Supplier's TC	3/2		2		
		f) Electrical strength in air & oil	Major	Test	-			Supplier's TC	3/2		2		
		g) Shrinkage in air	Major	Test	-			Supplier's TC	3/2		2		
		h) Flexibility	Major	Test	-			Supplier's TC	3/2		2		
		i) Ash content	Major	Test	-			Supplier's TC	3/2		2		
		j) Moisture content	Major	Test	-			Supplier's TC	3/2		2		
		k) Cohesion between plies	Major	Test	-			Supplier's TC	3/2		2		
		l) Elongation	Major	Test	-			Supplier's TC	3/2		2		
		m) Oil absorption	Major	Test	-			Supplier's TC	3/2		2		
1.6	Densified wood	a) Dimension	Major	Measure	10%	'MANFUF. STD / IS:3513	'MANFUF. STD / IS:3513	QC Record.	2		1		
		b) Surface finish	Major	Visual	10%			QC Record.	2		-		
		c) Electrical strength in oil	Major	Test	-			Supplier's TC	3/2		1		
		d) Oil absorption	Major	Test	-			Supplier's TC	3/2		-		
		e) Moisture content	Major	Test	-			Supplier's TC	3/2		-		
		f) Compression strength	Major	Test	-			Supplier's TC	3/2		-		
		g) Crossbreaking strength	Major	Test	-			Supplier's TC	3/2		-		
		h) Tensile strength	Major	Test	-			Supplier's TC	3/2		-		
		i) Specific gravity/ Density	Major	Test	-			Supplier's TC	3/2		-		
1.7	Gasket(Rubber Bonded Cork sheet (if applicable)	a) Dimension	Major	Measure	10%	'MANFUF. STD / IS:4253	'MANFUF. STD / IS:4253	QC Record.	2		-		
		b) Hardness	Major	Test	-			Supplier's TC	3/2		1		
		c) Tensile strength	Major	Test	-			Supplier's TC	3/2		-		
		d) Compressibility	Major	Test	-			Supplier's TC	3/2		1		
		e) Recovery	Major	Test	-			Supplier's TC	3/2		-		
		f) Compression set	Major	Test	-			Supplier's TC	3/2		-		
		g) Flexibility	Major	Test	-			Supplier's TC	3/2		-		
		h) Fluid resistence test	Major	Test	-			Supplier's TC	3/2		-		
		i) Chloride/Sulphate content of water extract	Major	Test	-			Supplier's TC	3/2		-		
		j) Density	Major	Test	-			Supplier's TC	3/2		-		
1.8	Nitrile Rubber Cord and "0" Ring (if applicable)	a) Dimension	Major	MEASURE	10%	'MANFUF. STD / IS:4253	'MANFUF. STD / IS:4253	Supplier's TC	2		-		
		b) Shore Hardness	Major	Test	-			Supplier's TC	3/2		-		
		c) Tensile strength	Major	Test	-			Supplier's TC	3/2		-		
		d) Elongation at break	Major	Test	-			Supplier's TC	3/2		-		
		e) Compression set	Major	Test	-			Supplier's TC	3/2		-		
		f) Accelerated Ageing in oil	Major	Test	-			Supplier's TC	3/2		-		

	PARTICULARS	**BIDDER/VENDOR**
BHEL	**NAME**	
	SIGNATURE	
	DATE	BIDDER'S/VENDORS COMPANY SEAL

LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER : TSGENCO			PROJECT TITLE : 1X800MW KOTHAGUDEM			SPECIFICATION NO. : PE-TS-410-302-E001				
		BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:				
	SHEET 3 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :				

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.9	Insulating Oil	a) Appearance of oil	Major	Visual				Supplier's TC	3/2		2,1	
		b) Density at 29.5 deg C	Major	Test				Supplier's TC			2,1	
		c) Kinematic viscosity at 27 & 40 deg C	Major	Test				Supplier's TC			2,1	
		d) Interfacial tension at 27 deg C	Major	Test				Supplier's TC			2,1	
		e) Flash point	Major	Test				Supplier's TC			2,1	
		f) Pour point	Major	Test				Supplier's TC			2,1	
		g) Neutralization value	Major	Test				Supplier's TC			2,1	
		h) Corrosive sulphur	Major	Test				Supplier's TC			2,1	
		i) Dielectric dissipation factor	Major	Test				Supplier's TC			2,1	
		j) Specific resistance (resistivity)	Major	Test	One sample	MANFUF. STD / IS:335	MANFUF. STD / IS:335	Supplier's TC			2,1	
		k) Ageing characteristics after accelerated ageing	Major	Test				Supplier's TC			2,1	
		l) Oxidation stability	Major	Test				Supplier's TC			2,1	
		m) Presence of oxidation inhibitor	Major	Test				Supplier's TC			2,1	
		n) Electric strength(BDV, Tan-delta) i) As delivered ii) After treatment	Major	Test				Supplier's TC			2,1	
		o) Water content	Major	Test				Supplier's TC			2,1	
		p) S.K.value	Major	Test				Supplier's TC			2,1	
1.10	Paint &Varnish	Shelf Life	Major	VISUAL	100%	MANF.STD	MANF.STD	Supplier's TC	3/2		2,1	
2	**FITTING AND ACCESSORIES**											
2.1	Porcelain Bushing (if applicable)	a) Dimension	Major	MEASURE	100%	IS:2099/IS:8603	IS:2099/IS:8603	QC records	2		-	
		b) Visual defects	Major	Visual	100%			QC records	2		-	
		c) routine testing	Major	Test	100%			Supplier's TC	3/2		2,1	
2.2	Condenser Bushing (if applicable)	a) Type, size & model	Major	Visual	100%	IS:2099 / IS:8603 / IEC 60137	IS:2099 / IS:8603 / IEC 60137	QC records	2		1	
		b) Dimensional check	Major	Measure	100%			QC records	2		1	
		c) Dry power frequency voltage withstand test	Major	Test	-			Supplier's TC	3/2		2,1	
			Major	Test	-							
		d) HV Test for test tap	Major	Test	-			Supplier's TC	3/2		2,1	
		e) Tan delta & capacitance test	Major	Test	-			Supplier's TC	3/2		2,1	
		f) Nitrogen Pressure Test	Major	Test	-			Supplier's TC	3/2		2,1	
		g) Routine Test	Major	Test	-			Supplier's TC	3/2		2,1	

	PARTICULARS	BIDDER/VENDOR	
BHEL	**NAME**		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER : TSGENCO			PROJECT TITLE : 1X800MW KOTHAGUDEM			SPECIFICATION NO. : PE-TS-410-302-E001					
		BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:					
	SHEET 4 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
2.3	Bucholz Relay	a) Type, size & make	Major	Visual	100%	MANFUF. STD./'	MANFUF. STD./'	QC records	2		1		
		b) Continuity for alarm &	Major	Test	-	IS:3637	IS:3637	Supplier's TC	3/2		2		
		trip (Performance)	Major	Test	-								
		c) Porosity test	Major	Test	-			Supplier's TC	3/2		2		
		d) High voltage & IR test	Major	Test	-			Supplier's TC	3/2		2		
		e) Element test	Major	Test	-			Supplier's TC	3/2		2		
		f) Gas volume test	Major	Test	-			Supplier's TC	3/2		2,1		
		g) Loss of oil & surge test	Major	Test	-			Supplier's TC	3/2		2,1		
2.4	Pressure	a) Type, size & make	Major	Visual	100%	MANFUF. STD./'	MANFUF. STD./'	QC records	2		1		
	Relief Device	b) Operation (Pressure &	Major	Test	-	IS:3637	IS:3637	Supplier's TC	3/2		2,1		
		flag indication)	Major	Test	-								
		c) HV Test	Major	Test	-			Supplier's TC	3/2		2,1		
		d) Switch contact operation	Major	Test	-			Supplier's TC	3/2		2		
2.5	Magnetic Oil	a) Type, size & make	Major	Visual	100%	MANFUF. STD'	MANFUF. STD.'	QC records	2		1		
	Lavel Gauge	b) Dial marking	Major	Visual	-			Supplier's TC	3/2		2		
	(MOG)	c) Switch continuity	Major	Test	-			Supplier's TC	3/2		2		
		d) HV test	Major	Test	-			Supplier's TC	3/2		2		
		e) Operation test	Major	Test	-			Supplier's TC	3/2		2		
2.6	Off-Circuit Tap	a) Dimensions	Major	Measure	100%	MANFUF. STD'	MANFUF. STD'	QC records	2		-		
	Changer/Switch	b) Physical condition	Major	Visual	100%			QC records	2		-		
	(if applicable)	c) operation of switch	Major	Test	-			QC records	2		-		
		d) Insulation resistance test	Major	Test	-			Supplier's TC	3/2		2		
		e) Leak test of handle stuffing box	Major	Test	-			Supplier's TC	3/2		2		
		f) Milli volt drop test	Major	Test	-			Supplier's TC	3/2		2		
2.7	On load Tap	a) Visual check	Major	Visual	100%	IS:8468/IEC 60214	IS:8468/IEC 60214	QC records	2		-		
	Changer	b) Dimensional check	Major	Measure	100%			Supplier's TC	2		-		
	(if applicable)	c) Mechanical operation on	Major	Verify	-			Supplier's TC	3/2		2		
		Diverter & Selector switch,											
		4000 switching oper. (Min)											
		d) HV test on Auxiliary circuit	Major	Test	-			Supplier's TC	3/2		2,1		
		e) Sequence test	Major	Test	-			Supplier's TC	3/2		2,1		
		f) Pressuure test of diverter	Major	Test	-			Supplier's TC	3/2		2,1		
		switch compartment with oil											
		g) Mechanical test of Tap	Major	Test	-			Supplier's TC	3/2		2,1		
		selector with motor drive											
		500 satisfactory opm(in all)											
		from one extreme position											
		to the other in air											
		h) Opm test of complete	Major	Test	-			Supplier's TC	3/2		2,1		
		tapchanger											
		i) Aux. ckt. HV test at 2 KV for 1 min.	Major	Test	-			Supplier's TC	3/2		2,1		

	PARTICULARS	**BIDDER/VENDOR**
BHEL	**NAME**	
	SIGNATURE	
	DATE	BIDDER'S/VENDORS COMPANY SEAL

LEGEND : **1 - BHEL/ CUSTOMER** **2 - VENDOR** **3 - SUB- VENDOR** **P - PERFORM** **W - WITNESS** **V - VERIFICATION**

	QUALITY PLAN	CUSTOMER : TSGENCO			PROJECT TITLE : 1X800MW KOTHAGUDEM			SPECIFICATION NO. : PE-TS-410-302-E001					
		BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:					
	SHEET 5 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
2.8	Gun Metal / Cast Iron Valves Gate/globe/ Butterfly)	a) Dimensional check	Major	Measure	100%	Manf. Std./IS:778 Class 1	Manf. Std./IS:778 Class 1	QC Record	2		-		
		b) Type, size & make	Major	Visual	100%			QC Record	2		-		
		c) Leakage test(Hydraulic test for Body & Seat)	Major	Test	-			Supplier's TC	3/2		2,1		
			Major	Test	-								
		d) Operational test (close & open)	Major	Test	-			Supplier's TC	3/2		2		
2.9	Bushing CT	a) Visual check/Dimensional check	Major	Measure/Visual test	100%	Manf. Std./IS:2705	Manf. Std./IS:2705	Supplier's TC	2		-		
		b) Routin test	Major	Test	-	Manf. Std./IS:2705	Manf. Std./IS:2705	Supplier's TC	3/2		2,1		
2.10	Marshaling box/RTCC	a) Visual check for wiring	Major	Test	100%	Drg./Manf. Std./IS:5/IS:13947	Drg./Manf. Std./IS:5/IS:13947	Supplier's TC	3/2	2	-		
		b) Dimensional check	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
		c) Check for make of components	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
		d) 2 kV insulation test on auxiliary wiring	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
		e) Check for paint, shade & thickness	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
		f) Degree of Prot. By paper insertion	Major	Measure/Test	100%			Supplier's TC	3/2	2	-		
2.11	OTI&WTI	a)Type size & make	Major	Visual	100%	Manf. Std.	Manf. Std.	QC records	2		1		
		b) HV test	Major	Test	-			Supplier's TC	3/2		2,1		
		C) Temperature calibration	Major	Test	-			Supplier's TC	3/2		2,1		
		d) Switch setting & switch deferential	Major	Test	-			Supplier's TC	3/2		2,1		
		e) Calibration & operation of switch	Major	Test	-			Supplier's TC	3/2		2,1		
2.12	Radiator	a) Type, Model, Rating	Major	Visual	100%	Drg./Manf. Std./IS:101	Drg./Manf. Std./IS:101	QC records	3/2	2	1		
		b) Dimensions & No. of elements	Major	Measure	100%			QC records	3/2	2	-		
		c) Paint shade, Finish & film thickness	Major	Measure/test	100%			QC records	3/2	2	-		
		d) Pressure test	Major	Test	100%			Supplier's TC	3/2	2	1		
		e) Adhesion test on paint	Major	Test	100%								
		f) Welding quality	Major	Visual/ DPTest	100%	Relevant code	Relevant code	Supplier's TC	3/2	2	1		
2.13	Hardware	a) Dimensional check	Major	Measure	100%	Manf. Std.	Manf. Std.	QC records	2		-		
		b) Tensile strength	Major	Test	-			Supplier's TC	3/2		-		
			PARTICULARS		**BIDDER/VENDOR**								
	BHEL		**NAME**										
			SIGNATURE										
			DATE									BIDDER'S/VENDORS COMPANY SEAL	

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER : TSGENCO			PROJECT TITLE : 1X800MW KOTHAGUDEM			SPECIFICATION NO. : PE-TS-410-302-E001				
		BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:				
	SHEET 6 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.14	Oil Pump Motor set (if applicable)	a) Type, Model, Rating	Major	Visual	100%	Manf. Std.	Manf. Std.	QC records	2		-	
		b) Dimensional check	Major	Measure	100%			QC records	2		-	
		c) Hv test at 2 kV for one minute	Major	Test	-			Supplier's TC	3/2		2,1	
		d) Input power taken by pump	Major	Test	-			Supplier's TC	3/2		2,1	
		e) Performance test (I/P,O/P,DISCH, NO LOAD, Locked Rotor te)	Major	Test	-			Supplier's TC	3/2		2,1	
2.15	Cooling Fan (if applicable)	a) Type, Model, Rating	Major	Visual	100%	Approved drgs/docs/spec./ IS:2312	Approved drgs/docs/spec./ IS:2312	QC records	2		-	
		b) Dimensional check	Major	Measure	-			QC records	2		-	
		c) HV test at 2 KV for	Major	Test	-			Supplier's TC	3/2		2,1	
		one minute	Major	Test	-						-	
		d) IR test	Major	Test	-			Supplier's TC	3/2		-	
		e) Power consumption & RPM	Major	Test	-			Supplier's TC	3/2		2,1	
2.16	Roller Assembly	a)Dimensions	Major	Measure	100%	Manf. Drg./docs	Manf. Drg./docs	QC records	2		-	
		b) Mechanical & Chemical properties of Raw material used for Shaft & Roller	Major	Measure	-			Supplier's TC	3/2		2	
2.17	Terminal Connector (if applicable)	a) Dimensional check	Major	Measure	100%	Manf. Drg./docs/IS:5561	Manf. Drg./docs/IS:5561	QC records	2		-	
		b) Surface finish	Major	Visual	-			Supplier's TC	3/2		2	
		c) Acceptance test	Major	Test	-			Supplier's TC	3/2		2,1	
2.18	Air Cell for Conservator (if applicable)	a) Dimensional check	Major	Measure	100%	Manf. Drg./docs/PO	Manf. Drg./docs/PO	QC records	2		-	
		b) Surface finish	Major	Visual	100%			Supplier's TC	3/2		2	
		c) Acceptance test	Major	Test	100%			Supplier's TC	3/2		2,1	
2.19	Oil Flow Indicator (if applicable)	a) Type, Model, Rating	Major	Visual	100%	Manf. Drg./docs/Spec.	Manf. Drg./docs/Spec.	QC records	2		-	
		b) Dimensional check	Major	Measure	100%			QC records	2		-	
		c) Functional test	Major	Test	-			Supplier's TC	3/2		2,1	
2.20	Silicagel Breather	a) Type, Size, Model	Major	Visual	100%	Manf. Drg./docs/Spec.	Manf. Drg./docs/Spec.	QC records	2		-	
		b) Pressure/ Leakage test	Major	Test	-			Supplier's TC	3/2		2	
		c) Colour of silica gel	Major	Visual	-			Supplier's TC	3/2		2,1	

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LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER : TSGENCO	PROJECT TITLE : 1X800MW KOTHAGUDEM	SPECIFICATION NO. : PE-TS-410-302-E001
		BIDDER/ VENDOR :	STANDARD QP NO. : PE-QP-999-302-E001, REV. 0	SPECIFICATION TITLE:
	SHEET 7 OF 10	SYSTEM	ITEM :OIL FILLED TRANSFORMER	DOC. NO. :

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3	**IN-PROCESS**											
3.1	Fabrication of Tank, Conservator,Radiator, HV&LV CABLE BOX and welding requirement	a) Welding procedure specification	Major	Verify/Review	100%			QC Records	3/2		2	
		b) Process qualification record	Major	Verify/Review	100%			QC Records	3/2		2	
		c) Weider qualification	Major	Verify/Review	100%			QC Records	3/2		2	
		d) Welding electrodes-Me-chanical Properties	Major	Verify/Review	100%			QC Records	3/2		2	
		e) Fitup for butt weld joints of tank and cover	Major	Visual	100%			QC Records	3/2		2	
		f) Visual check on weldment & any foregin particle in the entire tank with conservator, pipes etc.and blanking of ends with bolted plates	Major	Visual	100%			QC Records	3/2		2	
		g) Dimensional check after final welding incl.foundation dimension-HV & LV cable box/ Radiator/ Cooler/ Pipes	Major	Measure	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	3/2		2	
		h) DP test on welded joints	Major	Test	100%			QC Records	3/2		2,1	
		i) Check for flatness gasket surface	Major	Visual	100%			QC Records	3/2		2,1	
		J) Rim flatness	Major	Measure	100%			QC Records	3/2		2,1	
		k) Surface cleaning by sand/ shot blasting	Major	Visual	100%			QC Records	3/2		2,1	
		l) Primer coating, paint shade thickness inside & outside	Major	Measure	100%			QC Records	3/2		2,1	
		m) Paint film adhesion test	Major	Test	100%			QC Records	3/2		2,1	
		n) Vacuum Test (Tank)	CR	Vacuum test	100%	Appd. Doc./BHEL	Appd. Doc./BHEL	QC formate	3/2	1		
		o) Pressure test (Tank)	CR	Pressure test	100%	SPEC./CBIP	SPEC./CBIP	QC formate	3/2	1		
3.2	Core Stamping	a) Burr & Bow	Major	Visual	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2		-	
		b) Dimensional check	Major	Measure	100%			QC Records	2		-	
3.3	Core Building	a) Dimensional check	Major	Measure	100%			QC Records	2		-	
		b) Assembly of limb insulation and limb plates.	Major	Visual	100%			QC Records	2		-	
		c) Rectangularity of core assembly	Major	Visual	100%			QC Records	2		-	
		d) Freedom from overlaps & air gap at joints	Major	Visual	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2		-	
		e) Leaning of cor(i.e core verticality)	Major	Visual	100%			QC Records	2		-	
		f) Limb & stack thickness	Major	Visual	100%			QC Records	2		-	
		g) Limb clamping & binding	Major	Visual	100%			QC Records	2		-	
		h) Core diameter	Major	Visual	100%			QC Records	2		1	
		i) Earthing of core	Major	Visual	100%			QC Records	2		1	

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LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER : TSGENCO			PROJECT TITLE : 1X800MW KOTHAGUDEM			SPECIFICATION NO. : PE-TS-410-302-E001			
		BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:			
	SHEET 8 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :			

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.4	Test on Core	a) Dimensional check	Major	Measure	100%			QC Records	2		-	
		b) Flux density measurement	Major	Measure	100%			QC Records	2		-	
		c) Isolation test between(core to core clamps)	Major	Test	100%			QC Records	2		-	
		d)Torque Tightness	Major	Measure	100%			QC Records	2		-	
		e) Core Insulation	Major	Electrical	100%	Manf. Drg./stand.	Manf. Drg./stand.	QC Records	2		-	
		f) Core Loss	Major	Electrical with dummy coil	100%			QC Records	2		1	
		g)Visual checks of core verticality	Major	Visual	100%			QC Records	2		-	
		h) Core pressure Test at 2kV AC for one minute between all bolts, side plates, structure steel works and core	Major	Electrical	100%			QC Records	2	1	-	
3.5	Winding	a) Brazing procedure & Brazer qualification	Major	Review	100%			QC Records	2		-	
		b) Conductor size.	Major	Measure	100%			QC Records	2		-	
		c) Redial depth of winding	Major	Measure	100%			QC Records	2		-	
		d) Anchoring & binding at start & finish	Major	Measure	100%			QC Records	2		-	
		e) No. of turns	Major	Measure	100%			QC Records	2		-	
		f) Transposition of cross-overs	Major	Measure	100%			QC Records	2		-	
		g) Dimensional check (0D,ID & axial length)	Major	Measure	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		-	
		h) Insulation arrangement & alignmt.	Major	Measure	100%			QC Records	2		-	
		i) Winding length	Major	Measure	100%			QC Records	2		-	
		j) Brazed joints	Major	Measure	100%			QC Records	2		-	
		k) Lead & coil identification and marking	Major	Measure	100%			QC Records	2		-	
		l) Free from damages	Major	Measure	100%			QC Records	2		-	
		m) Continuity test for leads	Major	Measure	100%			QC Records	2		-	
		n) Turn to Turn Insulation	Major	Measure	100%			QC Records	2		1	
		o) Measure. Of Resistance	Major	Measure	100%			QC Records	2		1	
3.6	Core coil assembly	a) Cleanliness of core	Major	Visual	100%			QC Records	2		-	
		b) Alignment of spacers/blocks	Major	Visual	100%			QC Records	2		-	
		c) Elect. Clearance & Insp. Of core & coil assly after completion of terminal gear	Major	Visual/measure	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		-	
		d) Check provision of core frame earthing	Major	Visual	100%			QC Records	2		-	
3.7	Connection and Tap switch assembly	a) Ratio test on all taps	Major	Test	100%			QC Records	2		1	
		b) Lead disposition.	Major	Visual	100%			QC Records	2		-	
		c) Brazing of joints	Major	Visual	100%	Manf. Drg./Relevant	Manf. Drg./Relevant	QC Records	2		-	
		d) Crimping of joints	Major	Visual	100%	stand.	stand.	QC Records	2		-	
		e) Insulation over joints	Major	Visual	100%			QC Records	2		-	
		f) Vector group	Major	Test	100%			QC Records	2		1	
3.8	Ovening and Tanking	a) Cleanliness of tank	Major	Visual	100%			QC Records	2		-	
		b) Drawing	Major	Physical	100%			QC Records	2		1	
		c) Check tightness of clamped blocks and measurements of winding height	Major	Measure	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		1	
		d) Electrical clearances	Major	Measure	100%			QC Records	2		1	
		e) Oil filling and air release	Major	Physical	100%			QC Records	2		-	
		f) Dryness (Tan-delta & I.R)	Major	Measure	100%			QC Records	2		-	

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	SIGNATURE		
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LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN	CUSTOMER : TSGENCO			PROJECT TITLE : 1X800MW KOTHAGUDEM			SPECIFICATION NO. : PE-TS-410-302-E001					
		BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:					
	SHEET 9 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
4	Type & Special Test on Transformer	a)Review of type test & special test report b) Review of all previous stage of insp. As per QR prior to final testing	Major	Verify	100%	Reports			2	1	-	**Type Test and Special Test as per enclosed annexure-1 to be conducted.**	
5	ROUTINE TEST Each Transformer Shall be completely assembled with all fittings and accessoriesmeant for particular transformerbefore offering for inspection & Test	a) Verification of completeness / Dimensional check	Major	Measure	100%				2	1			
		b) Measurement of Voltage Ratio at all taps,polarity & vector group verification	Major	Measure	100%				2	1			
		c) Measurement of winding resistance on HV & LV on all the Taps.	Major	Measure	100%				2	1			
		d) Vector group and polarity check	Major	Measure	100%				2	1			
		e) Magnetic balance Test	Major	Measure	100%				2	1			
		f) Induced overvoltage	Major	Measure	100%				2	1			
		g) Sepatate Source Voltage Withstand test(Applied Voltage Test)	Major	Measure	100%				2	1			
		h)Measurement of capacitance & Tan delta to determine capacitance between winding & earth,	Major	Measure	100%	As per APPROVED DATA SHEET/IS:2026/ IEC-60076	As per APPROVED DATA SHEET/IS:2026/ IEC-60076	Manf. Test Records/QC Formats	2	1			
		i) Measurement of No-load losses & current at 90)%, 100% & 110% rated voltage.	Major	Measure	100%				2	1			
		j) 0.2 kV core Isolation (If Applicable)	Major	Measure	100%				2	1			
		k) Measurement of no load current with 415 V, 50 hZ AC supply.	Major	Measure	100%				2	1			
		l) IR & measurement of Insulation power factor & capacitance between winding and earth	Major	Measure	100%				2	1			
		m) Load loss & short circuit Impedence measurement on principal & extreme taps.	Major	Measure	100%				2	1			
		n) Repeat no load currents/loss measurement after completion of all dielectric test.	Major	Measure	100%				2	1			
		o) Test on OLTC/OCTC.	Major	Measure	100%				2	1			

	PARTICULARS	BIDDER/VENDOR	
BHEL	**NAME**		
	SIGNATURE		
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LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

	QUALITY PLAN		CUSTOMER : TSGENCO			PROJECT TITLE : 1X800MW KOTHAGUDEM			SPECIFICATION NO. : PE-TS-410-302-E001				
			BIDDER/ VENDOR :			STANDARD QP NO. : PE-QP-999-302-E001, REV. 0			SPECIFICATION TITLE:				
		SHEET 10 OF 10	SYSTEM			ITEM :OIL FILLED TRANSFORMER			DOC. NO. :				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS	
1	2	3	4	5	6	7	8	9	10			11	
		p) Verification of oil leakage test with all fitting & accessories at normal head of oil plus 35KPA for 8 hours.	Major	Measure	100%	As per APPROVED DATA SHEET/IS:2026/ IEC-60076/ MANF. STD.	As per APPROVED DATA SHEET/IS:2026/ IEC-60076/ MANF. STD.	Manf. Test Records/QC Formats	2	1			
		q) Frequency Response Analysis Test	Major	Measure	100%				2	1		**This test shall also to be performed at site by bidder after transformer Installation**	
		r) Jacking Test followed by D.P. Test	Major	Measure	100%				2	1			
		s) Paint shade & adhession test	Major	Measure	100%				2	1			
		t) Protection on M. Box by paper insertion	Major	Measure	100%				2	1			
		u) 2 KV test on M.Box wiring & functional check for component of MB	Major	Measure	100%				2	1			
		v) Slope and alignment of Buchhoz relay	Major	visual	100%				2	1			
		w) DFT of paint	Major	Measure	100%				2	1			
		x) Test on Transformer Oil	Major	Measure	100%				2	1		As Per IS-335	
6	Pre **Shipment** check &Despatch	a) Transformer- verification of final transportion.							2				
		b) Dew points measurement of N2/Dry gas tightness/ Pr reading (Only applicable for transformers dispatched with Gas Filling)							2				
		c) Packing of loose items							2				
			PARTICULARS		**BIDDER/VENDOR**								
	BHEL		**NAME**										
			SIGNATURE										
			DATE									BIDDER'S/VENDORS COMPANY SEAL	

LEGEND : 1 - BHEL/ CUSTOMER 2 - VENDOR 3 - SUB- VENDOR P - PERFORM W - WITNESS V - VERIFICATION

ANNEXURE-1 TO QAP

SL. NO.	TYPE TEST	APPLICABLE (YES/NO)	REMARKS
1	Measurement of winding resistance	YES	On Each Rating of Transformer. Prices to be included in Main Transformer Prices
2	Measurement of voltage ratio and check of voltage vector relationship	YES	
3	Measurement of impedance voltage/short-circuit impedance (principal tapping) and load loss	YES	
4	Measurement of no-load loss and current	YES	
5	Measurement of insulation resistance	YES	
6	DGA Test on Oil before and after Temperature Test	YES	
7	Dielectric Type Tests (As per IEC-60076-3)- Full Wave Lightning impluse Test for the Line Terminals(LI)	YES	Refer Annexure-D (Type Test Conduction Schedule)
8	Temperature-rise	YES	
9	Tests on on-load tap-changers, where appropriate	NOT APPLICABLE	
10	Short-circuit test	YES**	**Charges for carrying out short circuit test shall be payable based on actual invoice from designated laboratories (CPRI, Bhopal/ CPRI, Banglore / ERDA, Vadodara) with an additional lump sum amount of 5% of ex-works price of transformer being tested to cover handling costs (transportation, insurance etc.). Refer Annexure-D (Type Test Conduction Schedule)
	SPECIAL TEST		
1	Dielectric Special Test (As per IEC-60076-3) ##:- a. Chopped Wave Lightning impulse Test for the Line Terminals(LIC) b. Lightning impluse Test for the Neutral Terminals(LIN) c. Induced Voltage Test with PD measurement(IVPD)	YES	## These Special Test shall be conducted as Routine Test on all transformer.
2	Measurement of zero-sequence impedance(s) on three-phase Unit ##	YES	
3	Measurement of Acoustic Noise level ##	YES	
4	Oil Leakage Test for 8 Hours ##	YES	
5	Jacking Test on Transformers Load Bearing Member ##	YES	
6	Tank Pressure & Tank Vacuum Test ##	YES	
7	Measurement of Capacitance & Tan delta to determine capacitance between winding, between winding to earth and insulation system capacitance ##	YES	
8	Frequency Response Analysis Test ##	YES	
9	Test on Transformer Oil as per IS:335 ##	YES	
10	Measurement of the harmonics of the no-load current	NO	
11	f) Measurement of the power taken by the fans and oil pumps	NOT APPLICABLE	
12	g) Degree of Protection on Cable Box	NO	
13	h) Degree of Protection on Marshalling Box	NO	
14	i) PRD operation test (if PRD is applicable)	NO	

ANNEXURE - VIII

APPLICABLE STANDARDS & CODES FOR TRANSFORMERS

Specification for power transformers	IS: 2026 [ ] IS: 11171 [ ] IS:6600 [ ]	IEC: 76 [ ] IEC:354 [ ]	BS: 171 [ ]
Fittings & accessories for power transformer	IS: 3639 [ ]	IEC: [ ]	BS: [ ]
Specification for new insulation oil	IS: 335 [ ]	IEC: 296 [ ]	BS: 148 [ ]
Bushing for alternative voltage above 1000 volts	IS: 2099 [ ]	IEC: 137 [ ]	BS: 223 [ ]
Dimension for porcelain transformer bushings	IS: 3347 [ ]		
Current transformers	IS: 2705 [ ]	IEC: 185 [ ]	BS: 3938 [ ]
Gas operated relays	IS: 3637 [ ]		
Classification of insulating material for electrical machinery & apparatus in relation to their thermal stability in service	IS:1271 [ ]	IEC: 216 [ ]	
Classification of degrees of protection provided by enclosures of electrical equipment	IS: 12063 [ ]	IEC: 529 [ ]	IS: 13947 [ ]
Method of high voltage testing	IS: 2071 [ ]	IEC: 60 [ ]	
Colours for ready mixed paints & enamels	IS: 5 [ ]		
Specifications for power & distribution transformers	CBIP Publication No275(1999 edition [ ]		
Guide for loading of oil immersed transformers	IS: 6600 [ ]	IEC: 354 [ ]	BS: [ ]
Noise level	NEMA, STANDARD-TR1		

SPECIFIC TECHNICAL REQUIREMENTS
(DATA SHEET-A)

11/3.6kV

S. No.	Description	Unit		Particulars
1.0	Quantity	Nos.		3.5 MVA 6.3 MVA
2.0	Service (Unit/Station)			Unit/Station
3.0	Installation			Out Door
4.0	Type of insulating oil			Mineral
5.0	No. of phase	No(s)		03
6.0	Frequency	Hz		50
7.0	Type of cooling			ONAN
8.0	Rated output under site conditions	kVA		As indicated
9.0	Rated Voltage			
	a) HV Winding		kV	11.0
	b) LV Winding		kV	3.6
10.0	No Load transformation ratio			11/3.6
11.0	Vector group			Dyn11
12.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%		3.5 MVA: 6% 6.3 MVA: 7%
13.0	Total range of tappings and tapping steps			$\pm$ 5% in steps of 2.5%
14.0	Type of tap changing equipment			Off-Circuit
15.0	Temperature rise			
	a) Top oil by thermometer		deg. C	50 deg. C above ambient of 50 deg.C
	b) Winding by resistance		deg. C	55 deg. C above ambient of 50 deg.C
16.0	System Highest Voltage			
	a) HV Winding		kV	12.0 kV
	b) LV Winding		kV	3.6 kV + 10%
17.0	Phase Connection			
	a) HV Winding			Delta
	b) LV Winding			Star

18.0	Insulation Levels		
18.1	One minute power frequency withstand voltage (rms)		
	a) HV Winding	kV	28 (11kV)
	b) LV Winding	kV	10(3.6 kV)
18.2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV),
	b) LV Winding	kVp	40 (3.6 kV)
19.0	Terminal details		
	a) HV Line	Cable box (XLPE cables)	
	b) HV Neutral	N.A.	
	c) LV Line	Flange for Segregated Phase Busduct	
	d) LV Neutral	One neutral as part of LV busduct throat and second neutral with copper earthing bar for system earthing brought near the base of the transformer.	
20.0	System Fault Level		
	a) HV Winding	kA	50 kA RMS for 1Sec
	b) LV Winding	kA	40 kA RMS for 1Sec
21.0	Method of System Earthing		
	a) HV System	Unearthed	
	b) LV System	Low resistance earthed to limit Earth fault current to 300A for 10 Sec	
22.0	Details of Cooling Equipment	Detachable tank mounted radiators	
23.0	Provision/ accommodation of CTs		
	LV Neutral	1 Core PS CLASS and 1 Core 5P20. CT particulars shall be given to successful bidder during detail engineering. There shall be no commercial implication to BHEL on this account.	
24.0	Colour Shade:		
	a) Interior (For M. Box)	As required	
	b) Exterior	As required	
25.0	Space/ Layout Limitation if Any		

26.0	Cable details			
	a) HV side			
	i) Type			XLPE
	ii) Voltage Grade		12kV	Unearthed
	iii) Conductor material & size			Stranded Aluminium, after award of contract
	iv) No. of cores & runs		Three core/Single core, one run/Three run	
27.0	Penalty for Losses			
	a) Rates for bid evaluation			N.A.
	b) 'A' (for no load loss)			Losses not to exceed max. Losses as per annex-III of the specification
	ii) 'B' (for load losses)			- Do-
	c) Rates for penalty			
	i) 'A' (for no load loss)			Rs. 1.95 lacs per kW
	ii) 'B' (for load loss)			Rs. 1.95 Lacs per kW
28.0	Transformer Bushing		HV	LV
	a. Voltage Class	kV, rms	17.5	7.2
	b. Material	Solid porcelain or oil communicating type		
	c. Creepage distance	mm	31mm/kV	
29.0	Max. Flux density in any part of core & Yoke at 110% rated voltage			1.9 Tesla
30.0	Max. Current density of conductor coil of HV and LV winding			2.5 A/ Sq. Cm

DATA SHEET-B

(TO BE SUBMITTED ALONG WITH OFFER FOR EACH RATING)

DATA SHEET-B

FOR 11kV/3.6kV

S. No	Description	6.3MVA	3.5MVA
1.	Rating		
2.	No Load transformation ratio		
3.	Maximum No- load losses at rated frequency and 100% rated voltage		
4.	Maximum load losses at normal ratio, rated current and 75 deg. C		
5.	Overall Dimensions		
6.	Total weight		
7.	Total oil Quantity		

GUARANTEED TECHNICAL PARTICULARS
(DATA SHEET-C)

Instructions to vendor : This data sheet shall be submitted by successful bidder after award of contract

S. No.	Description	Unit	Particulars
1.0	Name of Manufacturer		
2.0	Reference Standards		
3.0	Installation		
4.0	Rated no load Voltage		
	a) HV Winding	kV	
	b) LV Winding	kV	
5.0	Type of cooling		
6.0	Rated kVA		
7.0	No. of phase	No(s)	
8.0	Rated Frequency	Hz	
9.0	Winding connections		
	a) HV Winding		
	b) LV Winding		
10.0	Vector group		
11.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	
12.0	Off-Circuit tap changer		
	a) Total range of tappings (+/-)	%	
	b) Size of tapping step	%	
	c) For HV/LV variation		
13.0	Impulse voltage withstand level		
	a) HV Winding	kVp	
	b) LV Winding	kVp	
14.0	Power frequency withstand voltage for one minute		
	a) HV Winding	kV	
	b) LV Winding	kV	
15.0	Maximum No load losses at rated frequency and		
	a) 100% rated voltage	kW	
	b) 110% rated voltage	kW	

16.0	Maximum Load losses at normal ratio, rated current and 75 deg. C	
17.0	Tolerance on losses (+/-)	
18.0	Guaranteed maximum Temperature rise of	
	a) Top oil by thermometer above ambient of 50 deg. C	deg. C
	b) Winding by resistance above ambient of 50 deg. C	deg. C
19.0	Efficiency at 75 deg. C and unity power factor for	
	a) 100% full load	%
	b) 75% full load	%
	c) 50% full load	%
20.0	Voltage regulation at full load at 75 deg. C	
	a) Unity power factor	%
	b) 0.8 Power factor (Lagging)	%
21.0	External short circuit withstand capacity & duration	MVA, sec
22.0	Max. short time (30 sec.) rating of transformer	KVA
23.0	Type of magnetic circuit	Core/ Shell
24.0	Type of core joints	
25.0	Type of winding	
	a) HV Winding	
	b) LV Winding	
26.0	Type of insulation	
	a) HV winding	
	b) LV winding	
	c) Between core & adjacent winding	
	d) Between windings	
27.0	HV terminal arrangement	
	a) Bushing with or without CTs	
	b) CT details (Ratio, ACC. Class, VA, Type)	
	c) Clearance between phases in air	mm
	d) Clearances to earth in air	mm

28.0 LV terminal arrangement
- a) Bushing with or without CTs
- b) CT details (Ratio, ACC. Class, VA, Type)
- c) Clearance between phases in air — mm
- d) Clearances to earth in air — mm

29.0 Neutral terminal arrangement
- a) No. of neutral terminals
- b) Neutral CT provided or not
- c) NCT details (Ratio, ACC. Class, VA, Type)

30.0 HV Bushing
- a) Rated voltage class — kV
- b) Rated current — A

31.0 LV Bushing
- a) Rated voltage class — kV
- b) Rated current — A

32.0 LV Neutral Bushing
- a) Rated voltage class — kV
- b) Rated current — A

33.0 Maximum flux density
- a) At rated voltage — Wb/M2
- b) At 110% rated voltage — Wb/M2

34.0 Maximum current density for
- a) HV Winding — Amp/mm2
- b) LV Winding — Amp/mm2

35.0 Magnetising current at rated voltage and frequency (% of full load current)

36.0 Rollers
- a) Type
- b) Unidirectional/ Bidirectional
- c) Quantity
- d) Gauges
  - i) Longitudinal — mm
  - ii) Transverse — mm

37.0 Pressure test withstand
- a) Tank — Kg/M2
- b) Radiator and other fittings — Kg/M2

38.0	Vacuum withstand	
	a) Tank	mm of Hg
	b) Radiator and other fittings	mm of Hg
39.0	Approximate weight of	
	a) Core	Kg
	b) Windings	Kg
	c) Tank, Fittings & Coolers etc.	Kg
	d) Oil	Kg
	e) Total weight with oil	Kg
	f) Untanking weight (core & winding)	Kg
	g) Shipping weight of the heaviest package	Kg
40.0	Quantity of Insulating Oil	
	a) Oil in tank	Ltrs.
	b) Oil in cooling equipment	Ltrs.
	c) Total oil Quantity	Ltrs.
41.0	Dimensions	
42.1	Tank dimensions	
	a) Length	mm
	b) Breath	mm
	c) Height	mm
42.2	Shipping dimensions of the largest package	
	a) Length	mm
	b) Breath	mm
	c) Height	mm
42.3	Overall Dimensions (LxBxH)	(mmXmmXmm)
43.0	Details of tank and other material	
	a) Thickness of tank side plate	mm
	b) Thickness of tank bottom plate	mm
	c) Thickness of tank cover plate	mm
	d) Thickness of radiator sheets	mm
	e) Minimum clearance height for lifting core and winding from tank	mm
44.0	Positive sequence impedance at	
	a) Maximum voltage tap	%
	b) Minimum voltage tap	%
45.0	Zero-sequence impedance at principal tap	%

46.0	Paint Shade		:	
47.0	Voltage Variation		:	CFVV
48.0	Noise Level		:	
49.0	Degree of Protection			
	a) Marshalling Box		:	IP55
	b) HV Cable Box		:	IP55
	c) LV Flange Enclosure		:	IP55
50.0	Creepage Distance			
	a) HV Bushing	(mm/kV)	:	
	b) LV Bushing	(mm/kV)	:	
	c) Neutral Bushing	(mm/kV)	:	
51.0	Material of Winding			
	a) HV/LV		:	
52.0	Insulation level separate source power frequency voltage withstand			
	i) HV winding (kV RMS)		:	
	ii) LV winding (kV RMS)		:	
	iii) HV Bushing		:	
	iv) LV Bushing		:	
	v) Neutral Winding		:	
53.0	Temperature Class of Insulation		:	
54.0	Over Excitation withstand time (sec)			
	100%		:	
	110%		:	
	125%		:	
	140%		:	
55.0	Thermal Time constant		:	
56.0	Magnetizing Inrush Current		:	
57.0	Radiator Details			
	a) No. of Radiators		:	
	b) No. of Flutes		:	
	c) Overall Dimensions		:	
	d) Radiator sizing calculations furnished		:	(YES/NO)

VOLUME : IIA

SECTION-X

PAINTING

CONTENT

VOLUME : IIA

SECTION-X

PAINTING

1.00.00 **GENERAL**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

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

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall

be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35°C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35°C.

The colour scheme shall be submitted during execution of contract for approval by the Purchaser/Engineer.

2.00.00 PREPARATION

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

3.00.00 DAMAGED PAINTWORK

Any damaged paintwork shall be made good as follows:

a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.

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

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

4.00.00 PAINTING SYSTEMS

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

a) Surfaces Subject To Weathering

All surfaces shall have a minimum of four coats of paint made up as follows:

Primer coat	:	35 micron DFT
Tie coat	:	35 micron DFT

Finishing coat (2 Nos.) : 35 micron DFT per coat

The total minimum DFT shall be 140 micron.

b) Surfaces Inside Buildings

All surfaces shall have a minimum of three coats of paint made up as follows:

Primer coat : 35 micron DFT

Tie coat : 35 micron DFT

Finishing coat (2 Nos.) : 25 micron DFT per coat

The total minimum DFT shall be 120 micron.

For type and colour of primer & finish coat of the equipment refer to Annexure-I & II.

For detail painting on building & structural steel elements refer Volume VII of this specification.

5.00.00 **COLOUR CO-ORDINATION & FINISH**

5.01.00 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

5.02.00 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

5.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

5.04.00 Final colours and finishes shall be to the Approval of the Owner.

ANNEXURE-1: COLOUR SCHEME FOR POWER PLANT & EQUIPMENT

SL. No.	Name of Equipment	Colour	Remarks
	MAIN PLANT		
1.	Main turbine	Opaline Green Semi Glossy finish	
2.	Main generator	Opaline green Semi Glossy finish	
3.	Condenser	Deep Orange	
4.	Ejectors (Main, starting and priming and vacuum pumps	Aluminium Cladding	Individual equipment to be identified by name & no.
5.	Heat exchangers (Eg.: deaerator LP heaters, HP heaters, gland steam condenser,	Aluminium Cladding	-do-
6.	Turbine oil cooler stator water cooler etc.)	Golden Yellow	-do-
7.	Flash tanks (HP, LP Etc.	Aluminium	-do-
8.	Pumps e.g. :	X	
	i) Boiler feed pumps	Deep Orange	However, individual pump to be identified by name & no.
	i) Condensate extraction pumps	Deep Orange	
	iil) Lube oil Transfer	Light Grey	

Sl. No.	Name of the Equipment	Colour	Remarks
9.	Turbine oil system		
	i) Main oil tank	Brown Glow	Oil tanks to be identified by their name
	ii) Central oil tank	Al. paint	
	iii) Oil purifier & Polishing filter	Light Grey	
10.	Boiler steel supporting structure	Light Grey	
11.	Boiler coating	Al. Cladding	
12.	Super heaters (exposed portions, if any)	Light Admirality Grey	
13.	Metal structures	Light Grey	
14.	Hand rails	Mint. Green	
15.	Pipe supports	Light Grey	
16.	Gratings (non-galvanized)	Black	
17.	Air ducts	Light Admirality Grey	Primary air, secondary air, roar air, ignitor air, scanned air etc. with hot or cold indication to be identified by suitable legend
18.	FD Fan PA fan, scanner (booster) air fan, igniter air fan, seal air fan	Light Admirality Grey	-do-
19.	Flue gas ducts	Dove grey	
20	ID Fans	-do-	

Sl. No.	Name of the Equipment	Colour	Remarks
21.	Coal mills and associated feeders	Quaker Grey	
22.	Mill reject system	Air craft Grey Green	
	FUEL OIL HANDLING SYSTEM		
23.	LDO storage tank	Al. paint	
24.	Furnace oil storage	Covered with G.I. sheet cladding	
25.	Pumps, filters and valves	Light brown	
	INSTRUMENT AND SERVICE PLANT AIR SYSTEM		
26.	Compressors with inter and after coolers	Sky blue	Identifying legends to be used
27.	Heaters/Drivers	Dove Grey	
28.	Air receivers	Sky blue	
	MISCELLANEOUS EQUIPMENTS		
29.	Cranes	Smoke Grey	
	Mono rails & chain pulley systems	Smoke Grey	
30.	Hooks	Black X	
31,	Tanks	Galvanized mesh	X-same colour as for the relevant piping
32.	Fencing	Aluminium Paint	
33.	Lighting poles		

Sl. No.	Equipment	Colour	Remarks
34.	Chimney	Half white & signal Red	Entire outside shell shall be painted with alternate bands of signal red and white colour, (out of which top 50m shall be painted with heat and acid resistance paint and balance with water proof cement paint conforming tolS:5410)
	ELECTRICAL COMPONENTS		
35.	Main generator		
	Lub oil system	X	X-same colour as for the relevant piping
	Hydrogen system	X	-do-
36.	Diesel generator set		
	Diesel engine	Smoke grey	
	Generator	-do-	
37.	L.T. Transformers		
	Indoor	Opaline Green Semi Glossy finish	
38.	Outdoor 33 KV class transformers	-do-Light grey	
39.	Generator bus duct		
	Inside of main plant bldg.	Opaline Green Semi Glossy finish	
	Outside of main plant bldg.	- do -	
40.	Generator transformer	Light grey	
41.	Battery charger	Opaline Green: Semi Glossy finish	

Sl. No.	Name of the Equipment	Colour	Remarks
42.	Mimic flow diagram		
	400 KV	Dark Violet	
	220 KV	Golden Yellow	
	132 KV	Sky Blue Signal	
	33.0 KV	red Solmon Pink	
	11.0 KV	Canary Yellow	
	11.0 KV	Aircraft Blue	
	6.6 KV	Middle brown	
	415V		
43	Unit Control Board (Control Room)	Opaline Green Semi Glossy finish	
44.	Mimic Relay Panel for CHP	Smoke grey	
45.	Motors		
	Indoor	Smoke Grey	
	Outdoor	Light grey	
46.	LT Switchgear (Indoor)	Glossy White	
	LT Switchgear interior	Opaline Green Semi Glossy finish	
	LT switchgear exterior	-do-	
	MCC	-do-	
	D.C. Distribution board	-do-	
	L.T. busduct inside of enclosure	-do-	
	L.T. busduct outside of enclosures		
47.	6.6 KV SWGH	Opaline Green Semi Glossy finish	
	- 6.6 KV busduct inside of main plant bldg.		

Sl. No.	Name of the Equipment	Colour	Remarks
48.	Common system and Station aux. electrical panel (Control room)	Opaline Green Semi Glossy finish	
49.	Control modules and console inserts	Smoke Grey	
50.	Electronic system cabinets, computer system cabinets, BMS, ATRS, EHC system cabinet etc. (Control equipment room)	Opaline Green semi Glossy finish	
51.	All locally mounted C&I systems panel cabinets (Local) (External)	-do-	
52.	Internal colour for all panels and cabinets as listed above	Glossy White	
53.	Lighting Package Equipment		
	- Inside	Glossy White *	
	- Outside	Opline Green Semi Glossy finish	
	220 KV SWITCHYARD EQUIPMENTS		
54.	Control and Relay Panels (Control equipment room and switchyard control room)	Opaline Green Semi Glossy finish	
	ii) PLCC Cabinets	Opaline Green Semi Glossy finish	
55.	CTs, PTs, Lighting arrestors, and Marshalling boxes	Light Admirality Grey	

Sl. No.	Name of the Equipment	Colour	Remarks
56.	Porcelain parts like insulators	Dark Brown	
57.	Generator Protection (Control equipment room)	Opaline Green panel Semi Glossy finish	
58.	All other structures and equipments	Galvanised	

ANNEXURE-2 – PIPELINES

Sl. No.	Name of the Equipment	Colour	Legend	Remarks
1.	Water			
a)	Condensate	Satin Blue	MC	
i)	LP bypass attemperation	Opaline Green with semi glossy finish	LPBA	
ii)	Condensate make-up line to condenser from surge tank and from DM supply header	-do-	CCM	
b)	Boiler feed	Al. Cladding	BFD	
	HP bypass	Opaline Green	HPBA	
i)	attemperation	Semi glossy finish		
ii)	Super-heater attemperation	-do-	SHA	
III)	Reheater attemperation	-do-	RHA	
iv)	Aux. PRDS attemperation	Al. Cladding	APRD	
c)	Heater drips	-do-	HD	
d)	Drains back to cyde cycle	-do-	D	
e)	Drains to waste	-do-	W	
f)	Cooling/Circulating			
	- Pump Inlet	Phiroza Blue	CW	
	- Pump Outlet	Sky Blue		
g)	Aux. Clarified water			
	- Pump Inlet	Phiroza Sky Blue	ACW	
	- Pump Outlet	Sky Blue		

Sl. No.	Name of the Equipment	Colour	Legend	Remarks
h)	Demineralised water (cooling purposes)	Smoke Grey	DMCW	
i)	Drinking water	G.I. Line	PW	
j)	Blowdown	Al. Cladding	BD	
k)	Ash water piping	HP-Green	ASH-HP	
	(both HP & LP system)	LP-Sky Blue	ASH-LP	
2.	Steam			
a)	Main	Aluminium*	MS	*Aluminiurn is to be used only in cases where the pipes are not already clad with aluminium sheets.
b)	Auxiliary	-do-	AS 1EX	
c)	Bled (extraction)	-do--	2 EX	
d)	Hot reheat	-do-	HR	
e)	Cold reheat	-do-	CR	
f)	HP Bypass	-do-	HPB	
g)	LP Bypass	-do-	LPB	
h)	Exhaust/vent (open to atmosphere) and safety valve	Al. Paint	V/SVE	Hazard mark may be given
3.	Air			
a)	Instrument	Dark Blue		
b)	Service/ Plant	Light Blue		
c)	Vacuum			

Sl. No.	Name of the Equipment		Colour Legend		Remarks
4.	Air-steam Mixture				* Aluminium is to be used only in cases where the pipes are not already clad with aluminium sheets
	a)	From turbine glands to gland steam condenser	Aluminium		
	b)	From Condenser to ejectors	-do-		
	c)	From Heater Shells to Condenser	Aluminium		
5.	Gas				
	a)	Hydrogen	Signal Red	H_2	
	b)	Chlorine	Greenish Yellow	CL	
	c)	Carbon dioxide	Black	$C0_2$	
6.	Oils				
			1. Before Filter -Dark Yellow	CRO	
			2. After Filter -Light Yellow	CRO	
	b)	Furnace oil	Aluminium Cladding	FO	
	c)	Trip Oil	Red	TRP-0	
	d)	Auxiliary Trip Oil	Red & While Bands	ATRO	
	e)	Primary Oil	Greenish Yellow	PRO	
	f)	Secondary Oil	Blue	SERO	
	g)	Auxiliary Secondary oil	Red & Blue Bands	Aux. SE-0	
	h)	Transformer oil	Smoke Grey	TRO	
7.	Pulverized fuel		Grey	PF	
8.	Fire Installation		Fire red	FIRE	
	a)	Control Fluid			

Sl.No.	Name of the Equipment	Colour	Legend	Remarks
9.	Chemical Feed			
a)	HP dosing to boiler (Phosphate)	Light Grey	HPDO	
b)	LP dosing to Condensate (Hydrazine)	S.S. Tube (No Paint)	LPDO	