NTPC
3 x 660 MW NORTH KARANPURA STPP

TECHNICAL SPECIFICATION
FOR
OIL FILLED SERVICE TRANSFORMERS

SPECIFICATION NO.: PE-TS-405-302-E001, (REV. 00)

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

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TOTAL NO. OF SHEETS = 92 (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)

INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFERS

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

    a. Unpriced Price Schedule (BOQ & price schedule, as enclosed with the specification) with "Quoted" word against each item, bidder's signature and company stamp.
    b. Datasheet-B duly filled, with bidder's signature and company stamp
    c. A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer"), with bidder's signature and company stamp.
    d. A copy of previous sheet ("List Of Contents"), with bidder's signature and company stamp.
    e. Signed and stamped copy of "No Deviation" statement.
    f. List of Sub Vendors.

2. No technical submittal such as copies of type test certificates, 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. Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference elsewhere/ covering letter of technical offer shall not be considered by BHEL.

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

5. Any change made by the bidder in the price schedule with respect to the description / quantities, notes etc. from those given in Price schedule of specification (Schedule of prices) shall not be considered (i.e., technical description, quantities, notes etc. as per price schedule furnished by BHEL as part of specification shall prevail)

BIDDER'S STAMP & SIGNATURE

PREAMBLE

1.0 The Tender documents contains three (3) volumes. The bidder shall meet the requirements of all three 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 vender shall be 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 SPECIFICATION**

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

Volume – IIA General Technical Conditions.

Volume – IIB Technical Specification including Drawings, if any.

1.3 **VOLUME – IIB**

This volume is sub-divided in to following sections:-

Section – A This section outlines the Intent of Specification

Section – B This section provides "Project Information".

Section – C This section indicates Technical Requirements specific to Contract.

Data sheet - A :- Specific data and other requirements pertaining to the equipments.

Data sheet - B :- Indicate data/document to be furnished along with offer.

Data sheet – C :- Indicates data / documents to be furnished after the award of Contract.

SECTION-A

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 3 X 660 MW NORTH KARANPURA STPP.

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 up to bidder's guarantee.

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

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

5.0 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.

6.0 The offer should be complete with technical data, catalogue, brochures and drawings as applicable.

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

SECTION-B

PROJECT INFORMATION

1.00.00 **BACKGROUND**

North Karanpura Super Thermal Power Project (3x660 MW), a pit head coal based thermal power project, is located in Hazaribagh and Chatra districts of Jharkhand State. Basic inputs i.e. coal, water and land have already been tied up. The project is proposed for the States & Union Territories of Northern, Western and Eastern Regions and the State of Jharkhand.

The capacity of the project is 1980 MW comprising of three (3) units of 660 MW each.

1.01.00 **Location and Approach**

The power project is proposed to be located near Tandwa town in Chatra districts in the state of Jharkhand on Hazaribagh-Chatra State highway at a distance of about 50 kms from Hazaribagh city. The nearest commercial airport is Ranchi at a distance of 150 kms from project site. The nearest railhead Khalari Railway Station on Ranchi-Garhwa section of Eastern Railways is about 40 kms from project site.
Major rail/road distances from the project site are as under:

City		Distance Approx. (kms)
Ranchi	:	150
Khalari	:	40

The site is located near Tandwa town having latitude and longitude of about 23^0 50' N to 23º 52' N and 84^0 59' E to 85º 2' E respectively. The Vicinity Plan of the project is placed at **Annexure-I.**

Further to the information given in this sub-section, Bidders are also advised to visit the project site and collect data on local site conditions.

1.02.00 **Land**

About 2245 acres of land is being acquired for the project. About 1500 acres of land is under possession/legal possession and out of 1500 acres, about 890 acres of land is to be used for plant, ash dyke and initial enabling township. No additional land is envisaged to be acquired in plant area. About 15 acres of land is envisaged to be acquired in Hazaribagh city for Township.
Commissioner, Chatra vide dated 25.05.1999 and 14.06.2000 has given in-principle clearance for NKSTPP.

1.03.00 **Water**

Make up water available for this project would be about 22 cusec and will be arranged by constructing a dam/reservoir across river Garhi.

1.04.00 **Fuel (Coal)**

1.04.01 **Coal Requirement, Availability and Linkage**

Coal requirement for the project is estimated as 10.6 Million Tonne/Annum (MTPA), considering a GCV of 3800 kcal/kg. Ministry of Coal vide letter dated 21.10.99 accorded in-principle coal linkage of 10.00 MTPA subject to ratification by Standing Linkage Committee-Long Term (SLC (LT)), of MOC. SLC (LT) in its meeting held on 15.12.2000 firmed up the coal linkage of 10.24 MTPA for the project. Subsequently, the coal linkage was withdrawn by SLC (LT) in its meeting held on 22/23.10.08.

Cabinet Committee on Investment (GOI) in its meeting on 20.02.13 decided in-principle to restore the original coal linkage granted to NKSTPP (i.e. from Magadh Coal Block) with the stipulation that the coal supply will commence during the 13th Five Year Plan. MOC vide letter dated 09.05.2013 restored the coal linkage with the stipulation that the coal supply will commence during the 13th five year plan.

1.04.02 **Coal Transportation**

Coal from Magadh block of North Karanpura Coalfields is proposed to be transported to the project site through conveyor belt system. One external coal handling plant and one internal coal handling plant are envisaged.

1.05.00 **Meteorological Data**

Important meteorological data from nearest observatory at Hazaribag is placed at Annexure-II**.**

1.06.00 **Plant Water Scheme**

The Plant water scheme is described below.

1.06.01 **Condenser Cooling System**

It is proposed to adopt Air Cooled Condenser for the project.

1.06.02 **Equipment Cooling Water (ECW) System (Unit Auxiliaries)**

All plant auxiliaries shall be cooled by De-mineralized water (DM) in a closed circuit. The primary circuit DM water shall be cooled through heat exchangers by auxiliary cooling water system. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system.

1.06.03 **Ash Water System**

It is proposed to have HCSD (High concentration Slurry Disposal) system for combined fly ash and bottom ash. No recirculation of ash water from ash disposal area is envisaged.

1.06.04 **Other Miscellaneous Water Systems**

(a) Raw water shall be used for meeting the Fly ash and bottom ash system requirement etc.

(b) The service water shall be taken from clarified water tank of Pretreatment plant. Service water (wash water) collected from various areas shall be treated using oil water separators, tube settlers, coal settling pits etc. as per requirement and treated water from liquid effluent treatment plant shall be recycled back to the service water system for re-use.

(c) The drinking water requirement of the plant shall be provided from water treatment plant.

(d) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water and makeup to the hydrogen generation plant shall be provided from Demineralising plant.

(e) The quality of Raw water is enclosed with this sub-section as Annexure-III.

1.07.00 **Criteria for Earthquake Resistant Design of Structures and Equipment**

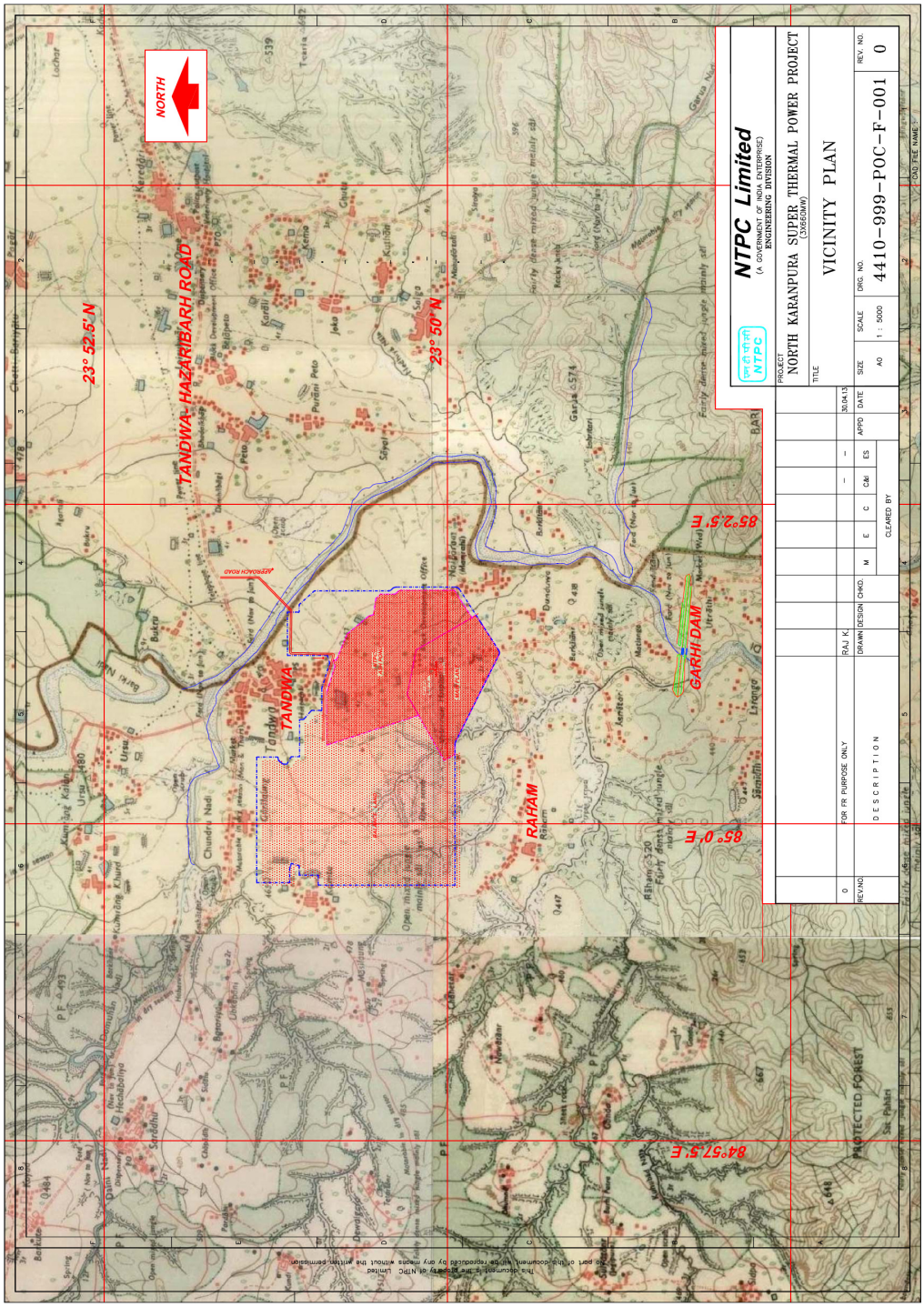
All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in the Part - B of this section.

1.08.00 **Criteria for Wind Resistant Design of Structures and Equipment**

All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in Part B of this section.

Annexure-I

VICINITY PLAN



CLIMATOLOGICAL TABLE

Annexure-II

CLIMATOLOGICAL TABLE

स्टेशन : हजारीबाग
STATION : Hazaribagh

अक्षांश LAT 23°59′ N देशांतर LONG 85°22′ E समुद्री तल माध्य से ऊँचाई HEIGHT ABOVE M. S. L 611 METRES

1951 से 1980 तक के प्रेक्षणों पर आधारित
BASED ON OBSERVATIONS FROM 1951 TO 1980

माह / MONTH	स्टेशन का सतह दाब / STATION LEVEL PRESSURE (एच. पी. ए. / hPa)	वायु तापमान / AIR TEMPERATURE — माध्य / MEAN: शुष्क बल्ब / DRY BULB (डि.सें. / °C)	नम बल्ब / WET BULB (डि.सें. / °C)	दैनिक अधिकतम / DAILY MAX (डि.सें. / °C)	दैनिक न्यूनतम / DAILY MIN (डि.सें. / °C)	माह में उच्चतम / HIGHEST IN THE MONTH (डि.सें. / °C)	माह में निम्नतम / LOWEST IN THE MONTH (डि.सें. / °C)	चरम / EXTREMES: उच्चतम / HIGHEST (डि.सें. / °C)	दिनांक और वर्ष / DATE AND YEAR	निम्नतम / LOWEST (डि.सें. / °C)	दिनांक और वर्ष / DATE AND YEAR	आर्द्रता / HUMIDITY: सापेक्ष आर्द्रता / RELATIVE HUMIDITY (प्रतिशत / %)	वाष्प दाब / VAPOUR PRESSURE (एच.पी.ए. / hPa)	मेघ की मात्रा / CLOUD AMOUNT: समस्त मेघ / ALL CLOUDS (आकाश के अष्टमांश / Oktas of sky)	निम्न मेघ / LOW CLOUDS (आकाश के अष्टमांश / Oktas of sky)	वर्षा / RAINFALL: मासिक योग / MONTHLY TOTAL (मि.मि. / mm)	वर्षा के दिनोंकी संख्या / NO. OF RAINY DAYS	वर्षसहित सबसे नम महीने का योग / TOTAL IN WETTEST MONTH WITH YEAR (मि.मि. / mm)	वर्षसहित शुष्कतम महीने का योग / TOTAL IN DRIEST MONTH WITH YEAR (मि.मि. / mm)	24 घंटोंकी सबसे भारी वर्षा / HEAVIEST FALL IN 24 HOURS (मि.मि. / mm)	दिनांक और वर्ष / DATE AND YEAR	माध्य पवन गति / MEAN WIND SPEED (कि.मी. प्र. घं. / Kmph)
जनवरी JAN I	947.6	14.7	10.9	22.6	9.3	26.7	4.6	30.6	31 1881	0.9	07 1980	62	10.4	1.4	0.5	23.5	1.7	113.0 1919	0.0	68.1	06 1945	6.2
II	944.5	18.9	12.8									49	10.4	1.6	0.5							
फरवरी FEB I	945.7	17.9	12.3	25.7	12.0	30.5	6.9	33.6	22 1967	1.7	08 1974	52	10.3	1.3	0.4	16.2	1.4	117.3 1907	0.0	63.5	23 1927	7.3
II	942.6	22.6	14.4									39	10.4	1.4	0.6							
मार्च MAR I	944.0	23.4	15.0	30.8	16.6	35.6	11.4	38.9	27 1892	6.7	04 1898	39	10.8	1.5	0.3	18.4	1.7	164.3 1905	0.0	44.2	20 1946	7.9
II	940.6	27.8	16.3									29	10.2	1.9	0.5							
अप्रैल APR I	941.0	28.6	18.2	35.7	21.3	39.3	16.4	41.7	22 1956	10.6	01 1968	36	13.3	1.8	0.3	17.0	1.4	81.6 1952	0.0	60.5	22 1925	8.6
II	937.1	32.4	18.8									26	11.8	2.2	0.7							
मई MAY I	937.0	30.7	21.1	37.8	24.0	41.5	19.3	43.9	18 1897	15.6	22 1977	43	18.1	2.5	0.3	43.4	2.9	187.2 1936	0.0	84.1	27 1887	9.1
II	933.4	34.3	21.2									32	15.7	2.9	0.7							
जून JUN I	933.4	28.4	23.3	34.1	24.1	40.1	21.0	46.6	14 1975	18.3	02 1975	67	25.0	5.3	1.8	177.1	9.2	774.5 1911	0.5 1905	249.2	24 1911	8.7
II	930.4	30.4	23.5									60	23.8	5.8	2.5							
जुलाई JUL I	933.1	25.6	23.8	29.5	23.0	33.2	21.4	39.6	08 1975	19.3	18 1975	86	28.2	6.5	3.8	310.0	16.2	693.2 1930	99.8 1911	221.7	06 1953	7.9
II	930.5	26.8	24.1									80	28.1	6.4	3.7							
अगस्त AUG I	934.5	25.2	23.7	29.1	22.7	31.5	21.3	34.2	03 1972	20.0	29 1967	88	28.3	6.4	3.8	320.1	16.2	706.1 1943	83.8 1928	180.1	17 1888	7.6
II	931.6	26.4	24.3									84	28.7	6.4	3.5							
सितम्बर SEP I	936.2	25.1	23.1	29.0	22.2	31.5	20.4	33.3	24 1960	17.8	29 1950	85	26.8	5.1	2.9	260.9	11.6	530.9 1893	40.7 1966	167.4	28 1963	7.3
II	935.1	26.0	23.5									81	27.2	5.6	2.9							
अक्तूबर OCT I	943.6	23.9	20.4	28.5	18.9	31.3	14.3	34.0	04 1966	9.7	12 1972	73	21.4	2.4	1.2	80.6	4.1	378.6 1963	0.0	149.4	24 1963	5.2
II	940.6	24.9	20.7									68	21.3	2.9	1.3							
नवम्बर NOV I	947.0	20.2	15.5	25.8	13.3	28.3	9.0	31.7	01 1896	4.4	25 1879	60	14.3	1.2	0.4	5.5	0.4	160.0 1924	0.0	95.0	08 1924	4.8
II	943.9	21.4	16.0									56	14.2	1.6	0.5							
दिसम्बर DEC I	948.2	15.7	11.8	23.1	9.3	26.2	5.1	29.4	20 1950	0.5	24 1961	62	11.1	1.1	0.2	5.2	0.4	81.3 1885	0.0	39.4	13 1885	5.3
II	945.1	18.7	13.1									52	11.1	1.2	0.2							
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN I	941.1	23.3	18.3	29.3	18.1	41.9	3.8	46.6		0.5		63	18.2	3.0	1.3	1277.9	67.2	2146.0	739.6	249.2		7.2
II	938.0	25.9	19.1									55	17.7	3.3	1.5			1893	1966			
वर्षोंकी सं NUMBER OF YEARS I	28	27	27	27	28	27	28	83		83		27	27	29	23	29	29	99	99	99		23
II	28	28	28									28	27	30	22							

1.00.00 **General Requirements**

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment. However, for equipment in air conditioned areas, design ambient temperature shall be 35 deg.C, if 2x100% air conditioning system is provided.

1.02.00 All equipments shall be suitable for rated frequency of 50Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification. The step-up voltage level for the project shall be 400 KV. The turbo generator unit will be connected to its own step-up transformers for feeding power into the EHV grid. The overall system shall be designed considering voltage variation of +/- 5% and fault level of 50kA for 400KV and 40kA for 220 KV system. Under black start condition the minimum fault level of 1000 MVA shall be considered at 400KV voltage level and voltage variation at 400kV may be considered as +/-10% till system stabilization.

1.03.00 Contractor shall provide fully compatible electrical system, equipments, accessories and services for the entire station/plant in his scope as well as those specifically required by the Employer.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and International Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 The auxiliary AC voltage supply arrangement shall have 33 kV, 11 kV, 3.3KV and 415V systems. It shall be designed to limit voltage variations as given below under worst operating condition:

a)	33KV/11KV/3.3KV (MV)	+/- 6%
b)	415 V/240 V	+/- 10%
c)	220V DC	-15% to +10% However the nominal continuous DC power supply shall be 240V.

1.06.00 The voltage level for motors shall be as follows:

a)	Upto 0.2 KW	:	Single phase 240V AC / 3 phase 415V AC
b)	Above 0.2 KW and upto 200 KW	:	3 phase, 415V AC
c)	Above 200 KW and upto 1500 KW	:	3 phase, 3.3 kV AC
d)	Above 1500 KW	:	11 kV

The bidder may adopt 415V/3.3 KV for the drives rated in the range of 160-210 KW.

For CHP conveyor motor's rating above 160 kW, 3.3 KV, three phase AC supply is to be used.

The voltage rating of the drives indicated above is for basic guideline. Minor variations in above can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.

Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.

1.07.00	The preferred AC control supply voltage shall be 110V for all 415 V non breaker controlled feeders. Control supply voltages other than above may be offered by bidder based on the bidder's standard proven practice.
1.08.00	The designed fault levels for 11 KV & 3.3 KV systems shall be restricted to 40 kA rms for 1 second and 50 kA rms for 1 second for 415 V systems. The 33 KV system equipments shall have a minimum short circuit fault withstand rating of 12.5 kA for 1 second.
1.09.00	The nominal voltage of main DC system shall be 220V. DC batteries shall be designed for continuous float operation with trickle charge, hence all the associated components like batteries, battery chargers, DC motors, relays, contactors, timers etc shall be suitable for continuous operation at the maximum continuous battery float voltage including suitable temperature correction factors. The operational limits of variation of DC voltage is (+)10 % to (-)15%. In addition, the bidder may propose 110V, 48V or 24V systems as per requirements of control and instrumentation of his equipment and design.
1.10.00	The Contractor shall furnish calculations of maximum loading and fault levels under the most onerous conditions for the various equipment/systems as defined else where in the specification to prove adequacy of their parameters. In case any equipment or system is found to be inadequate, it shall be changed/ modified without any additional liability to the Employer.

SECTION - C

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)

3 X 660 MW NORTH KARANPURA STPP

1. SCOPE OF SUPPLY & SERVICES:

The scope includes the design, manufacture, inspection and testing , proper packing and delivery to site of following transformers along with fitting & accessories and 10% extra oil.

2. MAIN ITEMS:

S. No.	DESCRIPTION	TOTAL (Nos)
1	1000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.25%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	2
2	1600kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=8.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	2
3	2000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=10.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	26
4	2000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=10.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination) - Low loss transformers	4
5	1000kVA, 3.3kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.25%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and with solidly grounded LVN termination)	2
6	5000kVA, 33kV/11.5kV, 3 phase, 2 winding, outdoor, ONAN, Z=8%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and with solidly grounded LVN termination)	2

7	2000kVA, 33kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=6%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and LVN termination)	2
8	7500kVA, 33kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=7%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and LVN termination)	2
9	5000kVA, 11kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=7%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with cable box type LVN termination)	2
10	10000kVA, 11kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=9%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with cable box type LVN termination)	2

a) ABOVE QUANTITY OF TRANSFORMERS SHALL BE FOR ORDERING. VARIATION IN RATING AND QUANTITY MAY BE TO THE EXTENT OF ±30% OF THE TOTAL ORDER VALUE.

b) BIDDER TO NOTE THAT IN ADDITION TO THOSE SPECIFIED IN IS:2026 / IEC 60076, ALL SPECIAL TESTS AS ROUTINE TESTS AS INDICATED IN CLAUSE NO. 10.15 (ROUTINE TESTS) OF TECHNICAL SPECIFICATION NO. PE-TS-405-302-E001 SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. BIDDER SHALL QUOTE ACCORDINGLY.

c) NOS. OF DRAWINGS / DOCUMENTS REQUIRED FROM VENDOR SHALL BE AS PER ANNEXURE-I

d) STANDARD QUALITY PLAN SHALL BE AS PER ANNEXURE-II.

e) TRANSFORMER LOSSES SHALL BE AS PER ANNEXURE-III.

f) SCHEDULE OF PRICES IS ENCLOSED (ANNEXURE-A, B, C & D).

g) SCHEDULE OF PRICES – TRANSFORMERS (ANNEXURE-A), EXTRA OIL (ANNEXURE-B), TYPE TESTS / SPECIAL TESTS ON TRANSFORMERS (ANNEXURE-C) & MANDATORY SPARES (ANNEXURE-D) SHALL BE CONSIDERED FOR PRICE EVALUATION PURPOSE.

3.00 CODES AND STANDARDS

Transformers IS:2026, IS:6600, IEC:60076
Bushings IS:2099, IEC:60137
Insulating oil IEC:60296
Bushing CTs IS:2705, IEC 60185
Indian Electricity Act 2003, BEE Guideline & CEA notification

3.01 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.

3.02 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).

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

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 Core shall be high grade non-ageing cold rolled super grain oriented silicon steel laminations of M4 grade or better quality. The core isolation shall be able to withstand a voltage of 2 kV (rms.) for 1 minute in air.

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**

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

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

c) The main tank body including tap changer, shall be capable of withstanding full vacuum.

d) Transformers shall be mounted on detachable type bi-directional rollers for rail gauge of 1676mm. Auxiliary transformers shall have suitable bi-directional skids, however auxiliary transformers above 2 MVA shall be provided with four no. of bi-directional detachable flat rollers. Suitable locking arrangement shall be provided to prevent accidental movement of transformer.

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

f) Oil leakage test on assembled transformer

All tank and oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature and applying pressure equal to the normal pressure plus 35 kN/m2 measured at the base of the tank. The pressure shall be maintained for a period of not less than 6(six) hours during which time no sweating shall occur.

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

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** Main tank shall be provided with conservator tanks of adequate capacity for expansion of oil from minimum ambient to 100 deg.C. The equipment rated 7.5MVA and above shall be provided with air bag breathing through indicating type cobalt free silica gel breather with transparent enclosure. However conventional type conservator with indicating type cobalt free breather (transparent enclosure) may be offered for transformer below 7.5 MVA.

6.08.05 **Radiators** The radiators shall be detachable type, mounted on the tank.

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

6.08.06 **Insulating Oil**

As per IS: 335. No external inhibitors are permitted.
No inhibitors shall be used in the oil. The oil supplied with transformers shall be new and previously unused and must conform to following while tested at supplier's premises and shall have following parameters.

S.No	Property	Permissible values
1.	Kinematic Viscosity, mm2/s	≤ 12 at 40 ° C ≤ 1800.0 at (-)30 ° C
2.	Flash Point, ° C	≥ 140° C
3.	Pour point, ° C	≤ (-)40 ° C
4.	Appearance	Clear, free from sediment and suspended matter
5.	Density kg/dm3 at 20 ° C	≤ 0.895
6.	Interfacial Tension N/m at 25° C	≥ 0.04
7.	Interfacial Tension N/m at 25° C	≥ 0.04
8.	Neutralisation value, mgKOH/g	≤ 0.01
9.	Corrosive sulphur	Non Corrosive
10.	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply
11.	Anti oxidants additives	Not detectable
12.	Oxidation Stability -Neutralization value, mgKOH/g -Sludge, % by mass	 ≤ 1.2 ≤ 0.8
13.	Breakdown voltage As delivered, kV After treatment, kV	 ≥ 30 ≥ 70
14.	Dissipation factor, at 90° C	≤ 0.005

	And 40 Hz to 60 Hz	
15.	PCA content	≤1%
16.	Impulse withstand Level, kVp	≥ 145
17.	Gassing tendency at 50 Hz after 120 min, mm3/min	≤ 5

Subsequently oil samples shall be drawn at:

S. No	Parameters	Before filling in main tank at site & tested for	Prior to energization at site for following properties & acceptance norms:	Applicability
i)	BDV	60 kV (min)	60 kV (min)	Applicable for all Transformers
ii)	Moisture content	10 ppm (max.)	10 ppm (max.)	

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

6.08.08 **Bushings/ Insulators**

a) Bushing shall be solid porcelain/condenser/oil communicating type.

b) No arcing horns to be provided on the bushings.

c) LV bushing palms & UT-HV bushing palms shall be silver/tin plated.

d) The bushings shall conform to the requirements of IS: 2099 and IS: 3347.

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

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

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

h) 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.

i) 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
   10.0MVA= 1000A
   7.5MVA = 800A
   5.0MVA = 630A
   2.0 MVA = 250A
   1.6 MVA = 250A
   1.0 MVA = 100A

2) H V Bushing for 3.3kV
   1.0 MVA = 250A

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

4) L V Bushing for 11kV & 3.3kV
   5.0MVA = 1250A

5) L V Bushing for 3.3kV
   10.0MVA= 2500A
   7.5MVA = 2000A
   2.0MVA= 1000A

6) L V Bushing for 433V/420V
   2.0 MVA = 4000A
   1.6 MVA = 3150A
   1.0 MVA = 2000A

6.08.9 **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.

6.08.10 **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.

6.08.11 **Neutral Terminals**

Two (2) nos. neutral terminals shall be provided on LV side. One neutral terminal shall be part of phase connection arrangement busduct throat/ LV cable-box (as applicable). Other neutral terminal shall be in a separate box and brought to tank bottom by means of earthing bar of 50x6 mm of copper, supported on porcelain

insulators mounted on transformer tank. The neutral earthing bar brought to the tank bottom for connection to station earth shall be provided with holes and suitable connecting hardware. This earthing bar shall have fork type arrangement at the end. However neutral may be connected to NGR as per system requirement.

6.08.12 **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.

All CTs (except WTI) shall be mounted in the turret of bushings, mounting inside the tank is not permitted.

All CT terminals shall be provided as fixed type terminals on the M. Box/CCC/CMB to avoid any hazard due to loose connection leading to CT opening or any other loose connection in power circuit. In no circumstances Plug In type connectors shall be used for CT & Power connection.

6.08.13 **Valves**

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

(b) Sampling & drain valves should have zero leakage rate.

6.08.14 **Gaskets**

a) Gasket shall be fitted with weather proof, hot oil resistant, rubberized cork gasket.

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

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

6.08.15 **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. 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.

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

6.08.16 **Marshalling box**

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

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. One dummy terminal block in between each trip wire terminal shall be provided. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber.

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. TB shall be stud type for all CT & power connection.

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

6.08.17 **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

6.08.18 **Winding**

For 33KV, 11KV & 3.3KVwinding, type of winding shall be continuous disc & for 433V winding, type of winding shall be spiral type.
The conductors shall be of Electrolytic grade copper. All Windings of 66kV and below shall have uniform insulation. The contractor shall ensure that windings are made in dust proof & conditioned atmosphere.

6.08.19 **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.

6.08.20 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.

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

6.08.22 **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. Transformer shall be capable of being loaded in accordance with IS:6600 / IEC60076-7.

7.0 Fittings & accessories

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

a) Conservator for main tank with MOG (with low oil level alarm contact), drain valve & indicating type free Cobalt free breather with transparent enclosure (maximum height 1400 mm above rail level) etc. Aircell (for 7.5 MVA & above).

b) Buccholz relay, double float type with alarm and trip contacts, alongwith suitable gas collecting device.

c) For 2 MVA & above rating transformer/reactor, minimum two numbers of spring operated PRD (with trip contacts) with suitable discharge arrangement for oil shall be provided.
For transformers below 2 MVA, diaphragm type explosion vent shall be provided.

d) OTI & WTI shall be 150 mm dial type with alarm and trip contacts with max. reading pointer & resetting device. (maximum height 1500 mm above rail level)

e) Top & bottom filter valves with threaded male adapters, bottom sampling valve, drain valve/sludge removal valve at the bottom most point of the tank.

f) Air release plug, bushing with metal parts & gaskets, terminal connectors on bushings (as applicable) & surge arrestor (as applicable).

g) Prismatic/toughened glass oil gauge for transformers.

h) Bi-directional wheel & skids, M. Box, OCTC, Bushing CTs, Insulating Oil, Cooling equipment, Valve Schedule Plate.

i) Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs, additional 4 nos. lifting lugs for bell tank cover, inspection cover, manhole, Bilingual R&D Plate, Terminal marking plates, two earthing terminals etc.

j) Bolts & nuts (exposed to atmosphere) shall be galvanized steel/SS.

k) Rain hoods to be provided on Buchholz, MOG & PRD. Entry points of wires shall be suitably sealed.

The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the Transformers & Shunt Reactor are deemed to be included.

7.02 Breather shall be fitted at a height not exceeding 1.4 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 ± 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

PARTS NAME	TYPE OF PAINT	NO.OF COATS	TOTAL DFT
Inside of tank and accessories (except CCC, CMB & M Box)	Oil & heat resistant fully glossy white	One coat	Atleast 30 micron
External surface of transformer/reactor and accessories including CCC, CMB, M Box (except coolers & radiators)	Chemical resistant epoxy zinc phosphate primer, MIO (Micaceious iron oxide) as intermediate paint followed by polyurethane finish paint (RAL 5012 Blue)	One coat each	Atleast 100 micron
External Cooler, Radiator surface	Anticorrosive primary paint followed by high quality full glossy outer finish paint (RAL 5012 Blue)	Two coats each	Atleast 100 micron
Internal Radiator surface	Hot oil proof, low viscosity varnish and subsequent flushing with transformer oil	------	-----
Internal surface of CCC,CMB & M Box	Chemical resistant epoxy zinc phosphate primer followed by chemical and heat resistant epoxy enamel white paint	Two coats each	Not less than 100 micron

9.00 COMMISSIONING 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 (price deemed to be included in the total bid price) along with technical offer.

9.02 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 QP (PE-QP-999-302-E001 Rev. 00) is enclosed as per Annexure-II for reference. However, at contract stage, the successful bidder shall submit the QP for BHEL/ NTPC approval. In case bidder has reference QP agreed with NTPC, same can be submitted for specific project after award of contract for BHEL/ NTPC 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. The contractor shall obtain the purchaser's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

10. 04 In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the BHEL / NTPC for waiver of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The purchaser reserves the right to waive conducting of any or all the specified type test(s) under this

contract. In case type tests are waived, the type test charges shall not be payable to the contractor.

10.05 Transformer to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for purchaser's approval the reports of all the type tests as listed below in specification and carried out within last ten years from the date of bid opening. The reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witness by a client. However if the contractor is not able to submit report of the type test(s) conducted within last ten years from date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the purchaser either at third party lab or in presence of purchaser's representative and submit the reports for approval.

10.06 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 equipment's & components shall be deemed to be included in the bid price.

10.07 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.

10.08 Type tests & special tests shall be conducted on one transformer of each rating and type. 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.

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

10.10 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.).

10.11 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.

10.12 For acceptance of short circuit reports for tests carried out earlier on similar transformers, successful bidder shall furnish the following documents for BHEL/ NTPC 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.

10.13 Each transformer shall be completely assembled with all fittings & accessories meant for the particular transformer before offering for inspection & testing by purchaser.

10.14 Bidder shall furnish List of sub-vendors/ makes of items along with bid. The same shall be subjected to BHEL / NTPC approval without any commercial implication.

10.15 **ROUTINE / TYPE TESTS ON TRANSFORMERS:**

S. No.	Routine Tests
1.	All routine test in accordance with IEC 60076 shall be carried out in all the transformers.
2.	Measurement of Voltage Ratio & phase displacement (as per IEC 60076-1)
3.	Measurement of winding resistance on all the taps (as per IEC 60076-1)
4.	Vector group and Polarity Check (as per IEC 60076-1)
5.	Magnetic Balance and Magnetising Current Test
6.	Measurement of no load current with 415 V, 50 hz AC supply
7.	Measurement of no load losses and current at 90%, 100% & 110% of rated voltage (as per IEC 60076-1)
8.	Load Loss & Short Circuit Impedance Measurement on principal & Extreme Taps
9.	IR measurement (As per IEC 60076-1)

10.	Measurement of capacitance & tan delta to determine capacitance between winding & earth.
11.	Dielectric tests shall be carried out as per IEC 60076-3.
12.	Separate Source Voltage Withstand Test (as per IEC 60076-3)
13.	Induced overvoltage test (ACSD Test)
14.	Repeat no load current/loss measurement & IR after completion of all electrical test
15.	Oil leakage test on completely assembled transformer along with unit coolers/ radiators (as per relevant clause of this sub section)
16.	Jacking test followed by D.P. test
17.	Marshalling Box/Cable box: It shall not be possible to insert a thin sheet of paper under gaskets and through enclosure joints.
18.	IR measurement on wiring of Marshalling Box.

S. No.	Type Tests
1.	Lightning impulse(Full & Chopped Wave) test on windings (as per IEC 60076-3)
2.	Lightning impulse test on Neutral (*)
3.	Short circuit test (special test) as per IEC 60076-5.
4.	Temperature Rise test at a tap corresponding to maximum losses. Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference.
5.	Measurement of acoustic noise level as per NEMA TR-1 (special test)
6.	Tank Pressure test
7.	Tank vacuum test

NOTE:-

i) All the type / special tests & temperature rise test shall be conducted after performing Short Circuit Test. If Tank Vacuum & Pressure Test is to be carried out then it shall be conducted before SC test.

ii) The power factors should not exceed 0.5% (at 20 oC). However in case of deviation from limiting values the same shall be resolved in line with IEEE Std-62.

iii) (*) this test is applicable on Transformer neutral earthed thru NGR.

11.00 DRAWINGS, DATA & DOCUMENTS TO BE SUBMITTED

11.01 Following shall be submitted along with the offer:

a) Unpriced Price Schedule (BOQ & price schedule, as enclosed with the specification) with "Quoted" word against each item, bidder's signature and company stamp.
b) Datasheet-B duly filled, with bidder's signature and company stamp
c) A copy of this sheet ("Instructions to Bidders for Preparing Technical Offer"), with bidder's signature and company stamp.
d) A copy of previous sheet ("List Of Contents"), with bidder's signature and company stamp.
e) Signed and stamped copy of "No Deviation" statement.
f) List of Sub Vendors.

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

g) The enclosed Data Sheet – C duly filled up.
b) Vendor Drawing submission schedule.
c) Design calculations for short circuit withstand capability (refer 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-I.

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.

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

Notes:

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

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

3). Provide 20% spare TBs.

Title:	**Standard Terminal Numbers for Marshalling Box of all Transformers (with ONAN cooling)**
Drawing No:-	**0000-203-PVE-B-001**

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LIST OF ENCLOSURES

1. ANNEXURE-I: DOCUMENT DISTRIBUTION SCHEDULE
2. ANNEXURE-II: QUALITY PLAN
3. ANNEXURE-III: TRANSFORMER LOSSES
4. DATASHEET-A
5. DATASHEET-B
6. DATASHEET-C
7. SCHEDULE OF PRICES – MAIN ITEMS (ANNEXURE-A, B, C, D).

ANNEXURE-I

S.No	Description of Drgs/Docs	No of Prints	No of CD ROMs/DVDs/Portable Hard Disk .
1	Drawings, Data sheets, Design calculations, Purchase specifications and other documents		
	First submission and submission with major changes		
	▪ Layout (A0&A1 sizes)	4	-
	▪ Other Drawings/Documents (A0&A1 sizes)	2	-
	▪ P&ID (All sizes)	4	-
	a) Final drawings/documents (Directly to site)	6	2
	b) "As Built" Drawing/Documents (Directly to site)	6	2
	c) Analysis reports of Equipments / piping /structures components/system employing software packages as detailed in the specifications.	2	2
2	Erection Manual (Directly to site)	4 sets	2
3	Operation & Maintenance manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2
4	Plant Hand Book i) First Submission	1	1
5	Commissioning and Performance Test Procedure manual i) First Submission	1 set	--
	ii) Final Submission (Directly to site)	4 sets	2

ANNEXURE-II

			CUSTOMER : NTPC			PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP			SPECIFICATION NO. : PE-TS-405-302-E001			
		QUALITY PLAN	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			REMARKS
									P	W	V	
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%	BHEL	BHEL	QC Record.	3/2		2	
		c) Chemical composition	Major	TEST	-	SPECIFICATION/	SPECIFICATION/	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

			CUSTOMER : NTPC			PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP			SPECIFICATION NO. : PE-TS-405-302-E001				
		QUALITY PLAN	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	W	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 : NTPC	PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP	SPECIFICATION NO. : PE-TS-405-302-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	One sample	BHEL SPEC./ 'MANFUF. STD / IS:335	BHEL SPEC./'MANFUF. STD / IS:335	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				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%	BHEL DRG./MANF.STD	BHEL DRG./MANF.STD	Supplier's TC	3/2		2,1	
2	**FITTING AND ACCESSORIES (MAKE SHALL BE AS PER ANNEXURE-1)**											
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 / BHEL SPEC./ IEC 60137	IS:2099 / IS:8603 / BHEL SPEC./ IEC 60137	QC records	2		1	
		b) Dimensional check	Major	Measure	100%			QC records	2		1	
		c) Dry power frequency	Major	Test	-			Supplier's TC	3/2		2,1	
		voltage withstand test	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

			CUSTOMER : NTPC			PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP			SPECIFICATION NO. : PE-TS-405-302-E001				
		QUALITY PLAN	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	W	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 Relief Device	a) Type, size & make	Major	Visual	100%	MANFUF. STD./'	MANFUF. STD./'	QC records	2		1		
		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 Lavel Gauge (MOG)	a) Type, size & make	Major	Visual	100%	MANFUF. STD'	MANFUF. STD.'	QC records	2		1		
		b) Dial marking	Major	Visual	-			Supplier's TC	3/2		2		
		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 Changer/Switch (if applicable)	a) Dimensions	Major	Measure	100%	MANFUF. STD'	MANFUF. STD'	QC records	2		-		
		b) Physical condition	Major	Visual	100%			QC records	2		-		
		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 Changer (if applicable)	a) Visual check	Major	Visual	100%	IS:8468/IEC 60214	IS:8468/IEC 60214	QC records	2		-		
		b) Dimensional check	Major	Measure	100%			Supplier's TC	2		-		
		c) Mechanical operation on Diverter & Selector switch, 4000 switching oper. (Min)	Major	Verify	-			Supplier's TC	3/2		2		
		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 switch compartment with oil	Major	Test	-			Supplier's TC	3/2		2,1		
		g) Mechanical test of Tap selector with motor drive 500 satisfactory opm(in all) from one extreme position to the other in air	Major	Test	-			Supplier's TC	3/2		2,1		
		h) Opm test of complete tapchanger	Major	Test	-			Supplier's TC	3/2		2,1		
		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

			CUSTOMER : NTPC			PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP			SPECIFICATION NO. : PE-TS-405-302-E001			
		QUALITY PLAN	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	W	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**	
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BIDDER'S/VENDORS COMPANY SEAL

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

			CUSTOMER : NTPC			PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP			SPECIFICATION NO. : PE-TS-405-302-E001			
		QUALITY PLAN	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	W	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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BIDDER'S/VENDORS COMPANY SEAL

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

BHEL	QUALITY PLAN	CUSTOMER : NTPC	PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP	SPECIFICATION NO. : PE-TS-405-302-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-Mechanical 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	1 unit each type	Appd. Doc./BHEL SPEC./CBIP	Appd. Doc./BHEL SPEC./CBIP	QC formate	3/2	1		
		o) Pressure test (Tank)	CR	Pressure test	1 unit each type			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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BIDDER'S/VENDORS COMPANY SEAL

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

			CUSTOMER : NTPC			PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP			SPECIFICATION NO. : PE-TS-405-302-E001			
		QUALITY PLAN	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	W	V	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
3.4	Test on Core	a) Dimensional check	Major	Measure	100%	Manf. Drg./stand.	Manf. Drg./stand.	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%			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		-	
3.5	Winding	a) Brazing procedure & Brazer qualification	Major	Review	100%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	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%			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%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	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%			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%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	QC Records	2		1	
		b) Lead disposition.	Major	Visual	100%			QC Records	2		-	
		c) Brazing of joints	Major	Visual	100%			QC Records	2		-	
		d) Crimping of joints	Major	Visual	100%			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%	Manf. Drg./Relevant stand.	Manf. Drg./Relevant stand.	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%			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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BIDDER'S/VENDORS COMPANY SEAL

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

			CUSTOMER : NTPC			PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP			SPECIFICATION NO. : PE-TS-405-302-E001				
		QUALITY PLAN	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			REMARKS	
									P	W	V		
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 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%	As per APPROVED DATA SHEET/IS:2026/BHEL SPEC.	As per APPROVED DATA SHEET/IS:2026/BHEL SPEC.	Manf. Test Records/QC Formats	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				
		g) Sepatate Source Voltage Withstand test	Major	Measure	100%				2	1			
		h)Measurementof capacitance & Tan delta to determine capacitance between winding & earth,	Major	Measure	100%				2	1			
		i) Measurement of No-load losses & current at 90)%, 100% & 110% rated voltage.	Major	Measure	100%				2	1			
		j) .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			

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BIDDER'S/VENDORS COMPANY SEAL

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

		QUALITY PLAN	CUSTOMER : NTPC			PROJECT TITLE : 3 X 660 MW NORTH KARANPURA STPP			SPECIFICATION NO. : PE-TS-405-302-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			REMARKS	
									P	W	V		
1	2	3	4	5	6	7	8	9	10			11	
		p) Verification of oil leakage test with all fitting & accessories at normal presure plus 35KPA for 24 hours.	Major	Measure	100%	As per APPROVED DATA SHEET/IS:2026/MANF. STD.	As per APPROVED DATA SHEET/IS:2026/MANF. STD.	Manf. Test Records/QC Formats	2	1			
		q) Jacking Test followed by D.P. Test	Major	Measure	100%				2	1			
		r) Paint shade & adhession test	Major	Measure	100%				2	1			
		s) Protection on M. Box by paper insertion	Major	Measure	100%				2	1			
		t) 2 KV test on M.Box wiring & functional check for component of MB	Major	Measure	100%				2	1			
		u) Slope and alignment of Buchhoz relay	Major	visual	100%				2	1			
		v) DFT of paint	Major	Measure	100%				2	1			
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				

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ANNEXURE TO QP

TYPE TEST	APPLICABLE (Y/N)	REMARKS
A) Temperature Rise test at a tap corresponding to maximum losses. Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference.	Y	
B) Measurement of acoustic noise level as per NEMA TR-1 (special test)	Y	
C) Short circuit test (special test) as per IEC 60076-5	**	**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.).
D) Lightning impulse(Full & Chopped Wave) test on windings (as per IEC 60076-3)	Y	
E) Lightning impulse test on Neutral for transformer neutral earthed through NGR.	Y	This test is applicable on Transformer neutral earthed thru NGR
F) TANK PRESSURE TEST	Y	
G) TANK VACCUM TEST	Y	

QUALITY ASSURANCE

OUT DOOR TRANSFORMER

Attributes / Characteristics Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	WPS & PQR	Routine Test as per relevant test	Routine Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y						
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y							
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y		Y	
Gasket	Y				Y	Y		Y				Y	
Transformer Oil (IS:335 / IEC296)												Y	
Off-Circuit Tap Changer	Y									Y			
Core Coil Assembly & Pre-tanking	Y								Y				
Marshalling Box	Y	Y					Y					Y	
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve,	Y									Y			
Welding (ASME Sect-IX)	Y										Y		
Complete Transformer (IS:2026/ IEC-60076)	Y												Y

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2) All major Bought Out Items will be subject to NTPC approval.

ANNEXURE III

TRANSFORMER LOSSES

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

33KV/11.5KV, 33KV/3.45KV, 11KV/3.45KV, 11KV/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
7.5 MVA	7.2 kW	50.0kW
5.0MVA	5.5kW	36.0kW
2.0MVA	2.4 kW	24.0kW
1.6MVA	2.1kW	19.0kW
1.0MVA	1.5kW	12.0kW

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 US $ 3275 per kW. The penalty shall be calculated for each transformer as given below:

4. For 4 No. 2MVA, 11KV / 0.433KV low loss transformers

a) Total loss at 50% load shall be 5.4 KW (Max.).

b) Total loss at 100% load shall be 18.4 KW (Max.).

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

SPECIFIC TECHNICAL REQUIREMENTS
(DATA SHEET-A)

Technical Datasheet for Transformers 11/0.433 kV, 3.3/0.433kV

S. No.	Description	Unit	Particulars
1.0	Quantity	As per BOQ	1000 kVA 1600 kVA 2000 kVA
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 per S.no.1
9.0	Rated Voltage a) HV Winding b) LV Winding	 kV kV	 11.0, 3.3 0.433
10.0	No Load transformation ratio		11/0.433 3.3/0.433
11.0	Vector group		Dyn1
12.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	1000 kVA : 6.25% 1600 kVA : 8% 2000 kVA : 10%
13.0	Total range of tappings and tapping steps		± 5% in steps of 2.5%
14.0	Type of tap changing equipment		Off-Circuit
15.0	Temperature rise a) Top oil by thermometer b) Winding by resistance	 deg. C deg. C	 50 deg. C above ambient of 50 deg.C 55 deg. C above ambient of 50 deg.C

16.0	System Highest Voltage		
	a) HV Winding	kV	12.0, 3.6 kV
	b) LV Winding	V	415V + 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		
	a) HV Winding	kV	28 (11kV), 10 (3.3 kV)
	b) LV Winding	kV	3
18.2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV), 40 (3.3 kV)
	b) LV Winding	kVp	-
19.0	Terminal details		
	a) HV Line		Cable box (XLPE cables)
	b) HV Neutral		N.A.
	c) LV Line		
	i) 11KV/0.433KV		Flange throat for TPN non-segregated Al Busduct
	ii) 3.3KV/0.433KV		Cable box (XLPE cables)
	d) LV Neutral		
	i) 11KV/0.433KV		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.
	ii) 3.3KV/0.433KV		One neutral as part of LV cable box 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	40 kA RMS
	b) LV Winding	kA	50 kA RMS

21.0	Method of System Earthing	
	a) HV System	Low resistance earthed to limit earth fault current to 600A. (Solidly grounded for 2 no. of 2000KVA Transformers)
	b) LV System	Solidly grounded
	c) Through fault withstand time	2 Sec.
22.0	Details of Cooling Equipment	Detachable tank mounted radiators
23.0	Provision/ accommodation of CTs	
	LV Neutral	**2** Core PS CLASS or 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 per Section-C
	b) Exterior	As per Section-C
25.0	Space/ Layout Limitation if Any	
26.1	Cable details (11KV/0.433KV)	
	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, one run
	b) LV side	
	i) Type	N.A
	ii) Voltage Grade	kV N.A
	iii) Conductor material & size	N.A
	iv) No. of cores & runs	N.A
26.2	Cable details (3.3KV/0.433KV)	
	a) HV side	
	i) Type	XLPE
	ii) Voltage Grade	3.6kV Unearthed
	iii) Conductor material & size	Stranded Aluminium,

			after award of contract
	iv) No. of cores & runs		Three core, one run
	b) LV side		
	i) Type		XLPE
	ii) Voltage Grade	1.1kV	Unearthed
	iii) Conductor material & size		Stranded Aluminium, after award of contract
	iv) No. of cores & runs		Three core, one run
27.0	Penalty for Losses		
	a) Rates for bid evalution		N.A.
	b) 'A' (for no load loss)		Losses not to exceed max. losses as per annex-III to sec-D of the specification
	ii) 'B' (for load losses)		- Do-
	c) Rates for penalty		
	i) 'A' (for no load loss)		US $ 3275 per kW
	ii) 'B' (for load loss)		US $ 3275 per kW

Technical Datasheet for Transformers
11/3.45kV

S. No.	Description	Unit	Particulars
1.0	Quantity	As per BOQ	5.0MVA 10.0 MVA
2.0	Service (Unit/Station)		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 per S.no.1
9.0	Rated Voltage		
	a) HV Winding	kV	11.0
	b) LV Winding	kV	3.45
10.0	No Load transformation ratio		11/3.45
11.0	Vector group		Dyn1
12.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	5.0 MVA : 7% 10.0 MVA : 9%
13.0	Total range of tappings and tapping steps		± 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	V	3.6 kV
18.0	Phase Connection		
	a) HV Winding		Delta

	b) LV Winding		Star
18.0	Insulation Levels		
18.1	One minute power frequency withstand voltage		
	a) HV Winding	kV	28 (11kV),
	b) LV Winding	kV	10 (3.3 kV)
18.2	Impulse withstand voltage		
	a) HV Winding	kVp	75 (11kV), 40 (3.3 kV)
	b) LV Winding	kVp	-
19.0	Terminal details		
	a) HV Line	Cable box (XLPE cables)	
	b) HV Neutral		N.A.
	c) LV Line	Flange throat for TPN non-segregated Al Busduct	
	d) LV Neutral	Cable box (XLPE cables)	
20.0	System Fault Level		
	a) HV Winding	kA	40 kA RMS
	b) LV Winding	kA	40 kA RMS
21.0	Method of System Earthing		
	a) HV System	Low resistance earthed to limit earth fault current to 600A	
	b) LV System	Low resistance earthed to limit earth fault current to 600A	
	c) Through fault withstand time		2 Sec.
22.0	Details of Cooling Equipment	Detachable tank mounted radiators	
23.0	Provision/ accommodation of CTs		
	LV Neutral	**2** Core PS CLASS or 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 per Section-C	
	b) Exterior	As per Section-C	

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, one run

b) LV side

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

c) LV Neutral

i)	Type		XLPE
ii)	Voltage Grade	3.6kV	Unearthed
iii)	Conductor material & size		Stranded Aluminium, after award of contract
iv)	No. of cores & runs		One core, two run

27.0 Penalty for Losses

a) Rates for bid evalution	N.A.
b) i)'A' (for no load loss)	Losses not to exceed max. losses as per annex-III to sec-D of the specification
ii) 'B' (for load losses)	- Do-

c) Rates for penalty

i) 'A' (for no load loss)	US $ 3275 per kW
ii) 'B' (for load loss)	US $ 3275 per kW

Technical Datasheet for Transformers
33/11.5 kV, 33/3.45kV

S. No.	Description	Unit	Particulars
1.0	Quantity	As per Requirement	2.0 MVA 5.0 MVA 7.5 MVA
2.0	Service (Unit/Station)		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 per S.no.1
9.0	Rated Voltage a) HV Winding b) LV Winding	 kV kV	 33.0 11.5, 3.45
11.0	No Load transformation ratio		33/11.5, 33/3.45
11.0	Vector group		Dyn11
12.0	Impedance voltage at rated current and frequency for the principal tapping at 75 deg. C	%	2.0 MVA : 6% 5.0 MVA : 8% 7.5 MVA : 7%
13.0	Total range of tappings and tapping steps		± 5% in steps of 2.5%
14.0	Type of tap changing equipment		Off-Circuit
15.0	Temperature rise a) Top oil by thermometer b) Winding by resistance	 deg. C deg. C	 50 deg. C above ambient of 50 deg.C 55 deg. C above ambient of 50 deg.C
16.0	System Highest Voltage a) HV Winding	 kV	 36.0 kV

	b) LV Winding	V	12 , 3.6 kV
7	Phase Connection		
	a) HV Winding		Delta
	b) LV Winding		Star
18.0	Insulation Levels		
18.1	One minute power frequency withstand voltage		
	a) HV Winding	kV	70 (33kV),
	b) LV Winding	kV	28 (11kV) 10 (3.3 kV)
18.2	Impulse withstand voltage		
	a) HV Winding	kVp	170 (33kV)
	b) LV Winding	kVp	-
19.0	Terminal details		
	a) HV Line	Cable box (XLPE cables)	
	b) HV Neutral		N.A.
	c) LV Line	Cable box (XLPE cables)	
	d) LV Neutral		
	i) 33/11.5KV	Neutral with copper earthing bar for system earthing brought near the base of the transformer.	
	ii) 33/3.45KV	Cable box (XLPE cables)	
20.0	System Fault Level		
	a) HV Winding	kA	12.5 kA RMS
	b) LV Winding	kA	40 kA RMS
21.0	Method of System Earthing		
	a) HV System	Solidly grounded	
	b)LV System		
	i) 11KV	Solidly grounded	
	ii) 3.3KV	Low resistance earthed to limit earth fault current to 600A	
	c) Through fault withstand time	2 Sec.	
22.0	Details of Cooling Equipment	Detachable tank mounted radiators	
23.0	Provision/ accommodation of CTs		
	LV Neutral	**2** Core PS CLASS or 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 per Section-C
b) Exterior	As per Section-C

25.0 Space/ Layout Limitation if Any

26.0 Cable details

c) HV side

i)	Type	XLPE
ii)	Voltage Grade	36kV Earthed
iii)	Conductor material & size	Stranded Aluminium, after award of contract
iv)	No. of cores & runs	Single core/phase, one run

d) LV side

i)	Type	N.A
ii)	Voltage Grade	12kV Earthed 3.6kV Unearthed
iii)	Conductor material & size	Stranded Aluminium, after award of contract
iv)	No. of cores & runs	After award of contract

27.0 Penalty for Losses

e) Rates for bid evalution	N.A.
f) 'A' (for no load loss)	Losses not to exceed max. losses as per annex-III to sec-D of the specification
ii) 'B' (for load losses)	- Do-

g) Rates for penalty

i) 'A' (for no load loss)	US $ 3275 per kW
ii) 'B' (for load loss)	US $ 3275 per kW

DATA SHEET-B

(TO BE SUBMITTED ALONG WITH OFFER FOR EACH RATING)

FOR 11kV/0.433V

S. No	Description	2.0MVA	1.6MVA	1.0MVA	2.0MVA (Low loss transformer)
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				

FOR 3.3kV/0.433V

S. No	Description	1.0MVA
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	

FOR 11kV/3.45kV

S. No	Description	10.0MVA	5.0MVA
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		

FOR 33kV/3.45kV

S. No	Description	7.5MVA	2.0MVA
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		

FOR 33kV/11.5kV

S. No	Description	5.0MVA
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	

DATASHEET-C

Clause No.	Item	(For AUX Transformer)		
1.00.00	Manufacturer's name and address			
1.01.00	Standard Applicable			
1.02.00	Rating (MVA)			
1.03.00	Voltage ratio			
1.04.00	Winding connection			
1.05.00	Vector group			
1.06.00	Number of phases			
1.07.00	Frequency (Hz)			
1.08.00	Type of cooling			
1.09.00	Impedance data Guaranteed positive sequence impedance @ 75 deg. C			
	AUX TR	**HV-LV**	**-**	**-**
(a.)	At Principal Tap			
(b.)	At Maximum Tap			
(c.)	At Minimum Tap			
1.10.00	Guaranteed max. losses in KW at 100 % rated voltage at 75 deg. C at principal tap (1)			
	Iron loss at rated voltage & frequency (2)			
	Copper loss at full load			
	(3) Guaranteed Cooler losses at 100% load			
1.11.00	HV winding DC resistance at 75 deg. C			
	(a) Principal tap			
	(b) Maximum tap			
	(c) Minimum tap			
1.12.00	LV winding DC resistance at 75 deg. C			

	(a)Number of coolers and rating as % of transformer cooling equipment	
	(b)Mounting	
	(c)Fan Motor Data	
	(i)Number per cooler/radiator Cooling requirement (indicate no. of spare fans also)	
	(ii) Type & make	
	(iii) Rating	
	(iv) Speed	
	(v) Locked rotor current	
	(e) Cooler/radiator details	
	(i)Overall dimensions l x b x h (mm)	
	(ii)Type of mounting	
	(iii)Weight with oil (kg)	
	(iv)Weight without oil (kg)	
1.14.00	**Thermal Data**	
	(a) Temperature rise in top oil over an ambient of 50 deg.C	
	(b) Temperature rise in winding by resistance measurement method over an ambient of 50deg. C.	
	(c) Thermal time constant (Hours)	
	(d) Oil temperature at cooler inlet at rated load at max temperature	

	load at max temperature	
	(f) Calculated Hot Spot Temperature (Design value)	
1.15.00	Withstand time for short circuit at terminals (sec.)	
1.16.00	Over excitation withstand time (secs.) for % over excitation of	
	(i) 110%	
	(ii)125%	
	(iii)140%	
	(iv)150%	
	(v)170%	
1.17.00	Bushings	
	a) High voltage	
	(i) Manufacturer	
	(ii) Type	
	(iii) Rated current (Amps)	
	(iv) Total creepage distance (mm)	
	(v) Mounting	
	c) Low voltage	
	(i) Manufacturer	
	(ii) Type	
	(iii) Rated current (Amps)	
	(iv) Total creepage distance (mm)	
	(v) Mounting	

	e) Low voltage (N)	
	(i) Manufacturer	
	(ii) Type	
	(iii) Rated current (Amps)	
	(iv) Total creepage distance (mm)	
	(v) Mounting	
1.18.00		
	Neutral(LV)Bushing CT Parameters	
	CORE-1/2/3	
	(i) Core no.	
	(ii) Service	
	(iii) Ratio	
	(iv) Accuracy class	
	(v) Knee point voltage (V) min	
	(vi) VA Burden	
	(vii) Max. CT resistance	
	(vii) Magnetisation current (max) at Vk/2 (mA)	

	transportation	
	(i). Oil filled or N2 filled	
	(ii). Road Freight/ Rail Freight	
1.20.00	Is vacuum filling required, if so state absolute pressure (mm of Hg)	
1.21.00	Total quantity of oil (liters)	
1.23.00	Insulation level	
	HV Windings	
	(i) (a) Lightning impulse withstand voltage(kVp)	
	(b) CW Impulse withstand voltage (kVp)	
	(ii) Switching surge withstand voltage (kVP)	
	(iii) Power frequency withstand voltage (kV)	
	(iv) HV winding insulation (Graded/ Uniform)	

	LV Windings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
	HV Bushings	
	(i) (a) Lightning impulse withstand voltage(kVp)	
	(b) CW Impulse withstand voltage (kVp)	
	(ii) Switching surge withstand voltage (kVP)	
	(iii) Power frequency withstand voltage (KV)	
	LV Bushings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
	LVN Bushings	
	(i) Lightning impulse withstand voltage (kVp)	
	(ii) Power frequency withstand voltage (kV)	
1.24.00	Approximate Dimensions	
	a) Tank (lxbxh) (mm)	
	b) Overall dimensions with coolers (lxbxh) (mm)	
	c) Height for un-tanking (mm)	
	d) Shipping dimensions	
	e) Dimensions of largest package(lxbxh) (mm)	

	a) Core (kg.)	
	b) Windings (kg.)(copper)	
	c) Total cellulose weight (kg)	
	d) Weight of Paper insulation (kg)	
	e) Weight of Press board, frame, barrier spacer etc (kg)	
	f) Tank and fittings (kg)	
	g) Oil (kg)	
	h) Untanking weight (heaviest piece) (kg)	
	i) Total weight (kg)	
	j) Weight of heaviest pkg. (kg)	
	k) Total shipping weight (kg)	
	l) Parts detached for transport(furnish list)	
1.26.00	Permissible overloading (% of rating and time in minutes)	
1.27.00	(a.)Clearances to tank in oil (mm)	
	(b.) Minimum clearance of HV winding to earth in oil (mm)	
	(c.) Clearance between coils & core(mm)	
	(d.) Clearance between coils (mm)	
	(e.) Clearance between neutral to ground (mm)	
1.28.00	Conservator	
	a) Total volume (Liters)	
	b) Volume between highest and lowest levels (Liters)	
1.29.00	Capacitance Values (pF)	
	b) LV to earth	
	c) HV to LV	
	d) Tap winding to earth	
1.30.00	a) Type of oil preservation	
	b) Material of diaphragm/air cell	
	c) Continuous temperature withstand/ capability of the diaphragm/air cell	

	a) Quality of oil	
	i) Moisture content (ppm)	
	ii) Max. tan-delta value	
	iii) Interfacial tension(N/m)	
	iv) Breakdown strength (kV)	
	b) Total Quantity including 5% extra (liters)	
		Before Energizing
	i) Moisture content (ppm)	
	ii) Max. tan-delta value	
	iii) Interfacial tension(N/m)	
	iv) Breakdown strength (kV)	
	b) Total Quantity including 5% extra (liters)	
	c) Oil flow inside Transformer (Directed/ Forced/ Normal)	
1.32.00	Core	
	a) Type of construction(core/shell)	
	b) Net core area (mm^2)	
	c) Core material and grade used	
	d) Type of joint between core and yoke	
	e) Thickness of stamping (mm)	
	f) Percentage silicon content (%)	
	g) Maximum flux density in core at rated frequency and at	
	i) 90% voltage (wb/m^2)	
	ii) 100% voltage (wb/m^2)	
	iii) 110% voltage (wb/m^2)	
1.33.00	Winding	
	a) Type of winding	
	i) HV	
	iii) LV	
	iv) Tap	
	b) Current density at rated load	
	i) HV (A/mm^2)	

	iii) LV (A/mm^2)	
	iv) Tap	
'	c) Conductor area (mm2)	
	i) HV	
	iii) LV /LV1/LV2	
	iv) Tap	
	d) Magnetizing inrush current(Amps)	
	i) % Component of 2nd harmonic current (max & min)	
	e) No load current (Amps) at rated frequency and at	
	i) 90% voltage	
	ii) 100% voltage	
	iii) 110% voltage	
	f) Magnetising current at rated frequency and at rated voltage	
	g) Leakage reactance	
	i) HV	
	ii) MV	
	iii) LV /LV1/LV2	
	h) Resistance	
	i) HV	
	ii) MV	
	iii) LV /LV1/LV2	
	i) Air core reactance of HV winding	
1.34.00	Tank	
	a) Tank cover-Conventional/Bell Type	
	b) Approximate thickness of	
	i) Side (mm)	
	ii) Bottom (mm)	
	iii) Cover	
1.35.00	Vacuum withstand capability of	
	a) Main tank	
	b) Coolers and accessories	
1.36.00	Minimum draw bar pull required to move the transformer on level track(kg)	
1.37.00	Size of filter hose	
1.38.00	Fault level	

PRICE SCHEDULES

ANNEXURE-A

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
3 X 660 MW NORTH KARANPURA STPP

SCHEDULE OF PRICES – TRANSFORMERS

S. No.	DESCRIPTION	TOTAL (Nos)	UNIT PRICE Rs.	TOTAL PRICE Rs.
1	1000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.25%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	2		
2	1600kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=8.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	2		
3	2000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=10.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	26		
4	2000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=10.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination) – Low loss transformer	4		
5	1000kVA, 3.3kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.25%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and with solidly grounded LVN termination)	2		
6	5000kVA, 33kV/11.5kV, 3 phase, 2 winding, outdoor, ONAN, Z=8%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and with solidly grounded LVN termination)	2		
7	2000kVA, 33kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=6%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and LVN termination)	2		
8	7500kVA, 33kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=7%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and LVN termination)	2		
9	5000kVA, 11kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=7%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with cable box type LVN termination)	2		
10	10000kVA, 11kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=9%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with cable box type LVN termination)	2		

NOTES

1. BIDDER TO NOTE THAT THE COST OF TRANSFORMER SHALL INCLUDE THE COST OF SPECIAL TESTS AS ROUTINE TESTS AS MENTIONED IN CLAUSE 10.15 (ROUTINE TESTS).
   THE ABOVE MENTIONED TEST SHALL BE CARRIED OUT ON ALL TRANSFORMERS WITHOUT ANY ADDITIONAL COST. BIDDER SHALL QUOTE ACCORDINGLY.

ANNEXURE-B

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
3 X 660 MW NORTH KARANPURA STPP

SCHEDULE OF PRICE - EXTRA OIL

S. NO.	DESCRIPTION	QTY. OF TRANSFORMERS	COST OF 10% EXTRA OIL PER TRANSFORMER	TOTAL COST OF 10% EXTRA OIL
	10 % EXTRA TRANSFORMER OIL IN SEALED NON RETURNABLE STANDARD DRUMS FOR			
1	1000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.25%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	2		
2	1600kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=8.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	2		
3	2000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=10.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination)	26		
4	2000kVA, 11kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=10.0%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with solidly grounded LVN termination) - Low loss Transformer	4		
5	1000kVA, 3.3kV/0.433kV, 3 phase, 2 winding, outdoor, ONAN, Z=6.25%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and with solidly grounded LVN termination)	2		

6	5000kVA, 33kV/11.5kV, 3 phase, 2 winding, outdoor, ONAN, Z=8%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and with solidly grounded LVN termination)	2		
7	2000kVA, 33kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=6%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and LVN termination)	2		
8	7500kVA, 33kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=7%, Dyn11, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, LV and LVN termination)	2		
9	5000kVA, 11kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=7%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with cable box type LVN termination)	2		
10	10000kVA, 11kV/3.45kV, 3 phase, 2 winding, outdoor, ONAN, Z=9%, Dyn1, OFF Circuit taps ±5% in steps of 2.5% (with cable box type HV, with bus-duct type LV and with cable box type LVN termination)	2		

Note:
Bidder shall supply 10% extra oil as per the quoted price. Quantity of extra oil shall be subject to approval during detail engineering.

ANNEXURE-C

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
3 X 660 MW NORTH KARANPURA STPP

LIST OF
TYPE TESTS/ SPECIAL TESTS ON TRANSFORMERS

1) 1000kVA, 11kV/0.433kV

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).	01	
5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

2) 1600kVA, 11kV/0.433kV

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	

4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).	01	
5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

3) 2000kVA, 11kV/0.433kV

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).	01	
5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

4) 2000kVA, 11kV/0.433kV – Low loss transformer

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).	01	
5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

5) 1000kVA, 3.3kV/0.433kV

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).	01	

5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

6) 5000kVA, 33kV/11.5kV

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).	01	
5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

7) 2000kVA, 33kV/3.45kV

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	

4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).	01	
5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	LIGHTNING IMPULSE TEST ON NEUTRAL (For transformer neutral earthed through NGR)	01	
7	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

8) 7500kVA, 33kV/3.45kV

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).	01	
5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	LIGHTNING IMPULSE TEST ON NEUTRAL (For transformer neutral earthed through NGR)	01	
7	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

9) 5000kVA, 11kV/3.45kV

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567), results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).	01	
5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	LIGHTNING IMPULSE TEST ON NEUTRAL (For transformer neutral earthed through NGR)	01	
7	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

10) 10000kVA, 11kV/3.45kV

S.NO	DESCRIPTION	QTY. OF TRANSFORMERS	UNIT PRICE Rs.
1	TANK PRESSURE TEST	01	
2	TANK VACUUM TEST	01	
3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1	01	
4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (Gas Chromatography shall be conducted on oil sample taken before & immediately after temp. rise test. Gas analysis shall be as per IS: 9434 (based on IEC: 60567),	01	

	results will be interpreted as per IS: 10593 (based on IEC: 60599). Result shall be recorded for future reference).		
5	LIGHTNING IMPULSE(FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	01	
6	LIGHTNING IMPULSE TEST ON NEUTRAL (For transformer neutral earthed through NGR)	01	
7	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	01	

NOTE:

1 **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.).

ANNEXURE-D

AUXILIARY SERVICE TRANSFORMERS (OIL FILLED)
3 X 660 MW NORTH KARANPURA STPP

SCHEDULE OF PRICES – MANDATORY SPARES

S. NO.	**DESCRIPTION**	QTY.	**UNIT PRICE (Rs)**	**TOTAL PRICE (Rs)**	**REMARKS**
1	HV bushing with metal parts & gaskets	3 no each type			
	a) 11.0/0.433kV, 1000KVA	3 no.			
	b) 11.0/0.433kV, 1600KVA	3 no.			
	c) 11.0/0.433kV, 2000KVA	3 no.			
	d) 3.3/0.433kV, 1000KVA	3 no.			
	e) 33.0/11.5kV, 5000KVA	3 no.			
	f) 33.0/3.45kV, 2000KVA	3 no.			
	g) 33.0/3.45kV, 7500KVA	3 no.			
	h) 11.0/3.45kV, 5000KVA	3 no.			
	i) 11.0/3.45kV, 10000KVA	3 no.			
2	LV bushing with metal parts & gaskets	3 no each type			
	a) 11.0/0.433kV, 1000KVA	3 no.			
	b) 11.0/0.433kV, 1600KVA	3 no.			
	c) 11.0/0.433kV, 2000KVA	3 no.			
	d) 3.3/0.433kV, 1000KVA	3 no.			

	e) 33.0/11.5kV, 5000KVA	3 no.			
	f) 33.0/3.45kV, 2000KVA	3 no.			
	g) 33.0/3.45kV, 7500KVA	3 no.			
	h) 11.0/3.45kV, 5000KVA	3 no.			
	i) 11.0/3.45kV, 10000KVA	3 no.			
3	LV Neutral bushing with metal parts & gaskets	1 no each type			
	a) 11.0/0.433kV, 1000KVA	1 no.			
	b) 11.0/0.433kV, 1600KVA	1 no.			
	c) 11.0/0.433kV, 2000KVA	1 no.			
	d) 3.3/0.433kV, 1000KVA	1 no.			
	e) 33.0/11.5kV, 5000KVA	1 no.			
	f) 33.0/3.45kV, 2000KVA	1 no.			
	g) 33.0/3.45kV, 7500KVA	1 no.			
	h) 11.0/3.45kV, 5000KVA	1 no.			
	i) 11.0/3.45kV, 10000KVA	1 no.			
4	WTI with contacts	1 no each type			
	a) 11.0/0.433kV, 1000KVA	1 no.			
	b) 11.0/0.433kV, 1600KVA	1 no.			
	c) 11.0/0.433kV, 2000KVA	1 no.			
	d) 3.3/0.433kV, 1000KVA	1 no.			
	e) 33.0/11.5kV, 5000KVA	1 no.			

	f) 33.0/3.45kV, 2000KVA	1 no.			
	g) 33.0/3.45kV, 7500KVA	1 no.			
	h) 11.0/3.45kV, 5000KVA	1 no.			
	i) 11.0/3.45kV, 10000KVA	1 no.			
5	OTI with contacts	1 no each type			
	a) 11.0/0.433kV, 1000KVA	1 no.			
	b) 11.0/0.433kV, 1600KVA	1 no.			
	c) 11.0/0.433kV, 2000KVA	1 no.			
	d) 3.3/0.433kV, 1000KVA	1 no.			
	e) 33.0/11.5kV, 5000KVA	1 no.			
	f) 33.0/3.45kV, 2000KVA	1 no.			
	g) 33.0/3.45kV, 7500KVA	1 no.			
	h) 11.0/3.45kV, 5000KVA	1 no.			
	i) 11.0/3.45kV, 10000KVA	1 no.			
6	Pressure relief Device	1 no. of each type			
7	MOG	1 no. of each type			
8	Buchholz relay complete	1 no. for each type			
9	Set of gaskets	1 set			
	a) 11.0/0.433kV, 1000KVA	1 no.			
	b) 11.0/0.433kV, 1600KVA	1 no.			
	c) 11.0/0.433kV, 2000KVA	1 no.			
	d) 3.3/0.433kV, 1000KVA	1 no.			
	e) 33.0/11.5kV, 5000KVA	1 no.			
	f) 33.0/3.45kV, 2000KVA	1 no.			

	g) 33.0/3.45kV, 7500KVA	1 no.			
	h) 11.0/3.45kV, 5000KVA	1 no.			
	i) 11.0/3.45kV, 10000KVA	1 no.			
10	Set of valves	1 set			
	a) 11.0/0.433kV, 1000KVA	1 no.			
	b) 11.0/0.433kV, 1600KVA	1 no.			
	c) 11.0/0.433kV, 2000KVA	1 no.			
	d) 3.3/0.433kV, 1000KVA	1 no.			
	e) 33.0/11.5kV, 5000KVA	1 no.			
	f) 33.0/3.45kV, 2000KVA	1 no.			
	g) 33.0/3.45kV, 7500KVA	1 no.			
	h) 11.0/3.45kV, 5000KVA	1 no.			
	i) 11.0/3.45kV, 10000KVA	1 no.			
11	Air cell for conservator	1 no. (As applicable)			

NOTES:

1) 1 set consists of quantities required for 1 complete transformer/reactor of each type (as applicable).