BHEL-ISG
PROJECT ENGINEERING –ELECTRICAL

DATE: 31.08.2023

PRE-QUALIFICATION REQUIREMENT

Indents reference	**IS-1-19-2005/018**
Projects	**RAMAGUNDAM SUPER THERMAL POWER STATION STAGE –I (3 x 200 MW) RENOVATION & RETROFITTING OF ESP**
Scope of Supply	**Design, detailed engineering, submission of drawings for approval, manufacturing, inspection and testing at manufacturer's works, proper packing and forwarding of LT OIL FILLED SERVICE TRANSFORMER as mentioned in the specification.**

A. Pre-Qualification Requirement: (Technical)

1.	The Bidder should have manufactured & supplied at least two numbers (one each at two different installations) of 1.6 MVA, 6.6KV or higher rating oil filled transformers which should have been in successful operation for a period of at least two (2) years.
2.	Bidder should have his own facilities for conducting all routine and type tests as per IS:2026 (except short circuit test and lightning Impulse test).
3.	1.6MVA, 6.6KV class or higher rated oil filled transformers manufactured by Bidder should have been successfully short circuit tested.
4.	i. Bidder should be a manufacturer of Oil type transformers. ii. Bidder should not have been banned by "any BHEL unit" or "Government of India" or "Government of other states in India".

INSTRUCTIONS TO BIDDER:

1	Bidder shall submit Company's profile covering Organization Setup, Product Range, Details of Key Personnel, Organization Chart, List of Plants & Machinery, Facility for testing & Inspection.
2	Bids from **NTPC Approved vendors** only shall be considered for evaluation. Bidder to provide the necessary approval documents from NTPC to prove their credentials as an approved vendor of Oil filled transformer.
3	**The following Documentary evidence to be submitted by bidder for technical PQR evaluation:** **a) For evaluating Sl. No. A.1:** **i.** Purchase order copy indicating the project for which order was undertaken - Scope of work, Contact details of order placement agency - Completion certificate from order placement agency/End customer - Certificate stating that the transformers have been in successful operation for a period of at least two (2) years **b) For evaluating Sl. No. A.2**: Letter of undertaking by bidder along with previous test reports. **c) For evaluating Sl. No. A.3**: Short circuit type test reports from the testing agency. **d) For evaluating Sl No. A.4:** Undertaking from bidder in letter head

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Important Notes to the Bidder:

1. Bidder should submit all the necessary documents to comply with aforesaid criteria.
2. BHEL reserves the right to reject offer of any bidder based on their poor/ non-performance in past/ present projects/ orders.
3. Two different installations mean two different project sites or two different contracts.
4. Bidder to note that the acceptance of the offer is subjected to the "Bidder approval from our customer". Bidder shall provide any additional document required for Customer approval. **In case customer does not approve the credentials of the bidder, the bidder will be technically rejected.**
5. Quotations received from bidders who do not fulfill the PQR shall be summarily rejected without any further evaluation and information to bidders.

6. BHEL reserves the right to:
    a. May ask for further qualification during techno commercial scrutiny of bids received and bidder will comply.
    b. If any bidder is black listed or put on hold by any of the BHEL units, such bidder will not be eligible for this tender and their bids shall not be accepted.

Pre- Qualification Requirement : Financial Criteria

Average Annual financial turnover during the last 3 years, ending 31st March of the previous financial year, should be at least Rs. 55 Lakhs (Rs. Fifty Five Lakhs Only)

Documentary Proof:

Bidder shall submit audited balance sheets in proof of the above.

Important Notes:

1. Bidder to note that the acceptance of the offer is subjected to the "Bidder approval from our customer, NTPC" and BHEL reserves the right to reject offer of any bidder based on their poor/ non-performance in past/ present projects/ orders.
2. Bidder has to submit credentials/ details, required by the customer (NTPC) for seeking approval of customer. In case NTPC does not approve the credentials of the bidder, the bidder will be technically rejected.
3. Bidder shall have adequate field service organization to provide the necessary field fabrication & erection and management services required to successfully fabricate & erect the structure as required by the bidding documents.
4. Bidder shall submit requisite documents, to comply with aforesaid criteria, properly indexed, along with offer.
5. Bidder shall submit the point wise confirmation to the PQR points along with the offer.
6. Bidders to note that consortium bidding is not applicable for this tender.
7. BHEL reserves the right to:

    a) Accept or reject any bid received at its discretion without assigning any reasons whatsoever.

    b) Postpone the scheduled date without assigning any reason whatsoever.

    c) May ask for further qualification during techno commercial scrutiny of bids received and bidder will comply.

8. BHEL shall not be liable for any expenses incurred by bidder in preparation of bid irrespective of whether it is accepted or not.
9. Canvassing i.e. soliciting favor, seeking advantage etc. in any form is strictly prohibited and any bidder found to have engaged in canvassing shall be liable to have his bid rejected summarily.
10. If the bidder deliberately gives any wrong information in his tender to create circumstances for the acceptance to his bid, BHEL reserves the right to reject such application.
11. If any bidder is black listed or put on hold by any of the BHEL units, such bidder will not be eligible for this tender and their bids shall not be accepted.
12. All the supporting documents/documentary evidences shall be Self-attested.

NTPC Limited
(A Govt. of India Undertaking)

RAMAGUNDAM SUPER THERMAL POWER STATION
STAGE –I (3 x 200 MW)

RENOVATION & RETROFITTING OF ESP

ENQUIRY SPECIFICATION FOR

LT OIL FILLED OUTDOOR TRANSFORMERS

BHARAT HEAVY ELECTRICALS LIMITED

INDUSTRIAL SYSTEMS GROUP BANGALORE

Note: In case any clarification is required, with regard to technical specification, please contact us over Email: murali254@bhel.in,tkc@bhel.in, mas@bhel.in

Sangeetha.M.A

Digitally signed by Sangeetha.M.A
DN: cn=Sangeetha.M.A, o=BHEL, ou=BHEL-ISG, email=mas@bhel.in, c=IN
Date: 2023.09.07 16:45:33 +05'30'

NMK	Digitally signed by N Murali Krishna DN: cn=N Murali Krishna, o=BHEL, ou=ISG, email=murali254@bhel.in, c=IN Date: 2023.09.07 16:32:21 +05'30'	MAS		MAS	
NAME	SIGN	NAME	SIGN	NAME	SIGN
PREPARED BY		CHECKED BY		APPROVED BY	

CONTENTS

1) BIDS FROM NTPC APPROVED VENDORS ONLY SHALL BE CONSIDERED FOR EVALUATION. BIDDER TO PROVIDE NECESSARY APPROVALS FROM NTPC CORP QUALITY TO PROVE THEIR CREDENTIALS. NO NEW VENDOR APPROVAL SHALL BE TAKEN UP WITH NTPC.
IN CASE BIDDER IS UNABLE TO PROVIDE NECESSARY CREDENTIALS OR MEET PROVENNESS CRITERIA, BHEL RESERVES THE RIGHT TO REJECT OR ACCEPT ANY BID WITHOUT ASSIGNING ANY REASONS.

2) Please furnish point-wise confirmation against each clause of specification.

3) Deviation in specification shall be explicitly brought out in the offer, otherwise it is deemed that offer is in line with the requirement. In case any clarification is required, with regard to technical specification, please contact us over Email: murali254@bhel.in,tkc@bhel.in, mas@bhel.in

4) Since delivery is critical, the vendor shall take extra care to ensure correctness and accuracy of all technical information and data furnished with the offer, as they will be used for detailed engineering and hence the same will be binding on the vendors.

5) Vendors shall furnish all the information sought in Section-VI, positively, along with offer.

SECTION-I

1.0	**GENERAL SITE CONDITIONS**		
1.0.1	Owner / Purchaser	:	NTPC Limited.
1.0.2	Engineer/consultant	:	NTPC Limited.
1.0.3	Project Title	:	RAMAGUNDAM SUPER THERMAL POWER STATION, STAGE –I (3 x 200 MW) RENOVATION & RETROFITTING OF ESP
1.0.4	Project location	:	Ramagundam, Karimnagar Dist., Telangana
1.0.5	Elevation (above Sea level)	:	156 mtr Approx.
1.0.6	Design Ambient temperature	:	50 deg. C
2.0	**POWER SUPPLY SYSTEMS**		
2.**0.1**	**MV System**		
	System Voltage	:	6.6 kV ± 10%, 3 Phase, 3 Wire
	System Frequency	:	50 Hz ± 5%
	Combined Variation	:	10% (absolute)
	System Fault level	:	40 kA for 3s
	System Earthing	:	Earthed though resistance. Earth fault current limited to 300A.
2.**0.2**	**LV System**		
	System A.C voltage	:	415 V ± 10%
	System Frequency	:	50 Hz ± 5%
	Combined Variation	:	10% (absolute sum)
	Phase	:	3 Ph, 4- Wire
	System fault level	:	50 kA for 1sec
	System Earthing	:	Solidly grounded

	Panel space heater, lighting, AC Control & Protection Supply	:	240V, Single phase
2.0.3	**DC System**		
	System Voltage	:	220V (190-240V), 2-wire
	Fault level	:	25 kA
	System Earthing	:	Unearthed

SECTION-II

SCOPE OF SUPPLY

This specification covers the design, manufacture, inspection and testing at manufacturer's works, proper packing and delivery to site of **BIS certified OIL FILLED SERVICE TRANSFORMERS (Star-2 losses *(energy efficiency level 3 as per IS 1180)* as per BEE guideline and BIS Certification for rating upto 2.5 MVA 33kV Class, however the impedance value, list of routine tests & type tests, fittings shall be as per those mentioned in the specification and annexures & shall also comply with IS-1180** as mentioned in different sections of this specification, complete with all accessories for efficient and trouble-free operation.

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

Item wise quantity requirement is mentioned in below table:

Sr. No.	Item Description	Unit	Quantity
1.0	1600kVA, 6.6KV/0.433KV, 3 phase, 2 winding, outdoor, ONAN, Z=8%, Dyn11, 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)	NO.	2
2.0	EXTRA OIL (10%) IN SEALED NON RETURNABLE STANDARD DRUMS for 1600KVA Transformer	NO.	2
3.0	**Type Test Charges for 1600KVA Transformer**		
3.1	TANK PRESSURE TEST	No	1
3.2	TANK VACUUM TEST	No	1
3.3	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1 (SPECIAL TEST)	No	1

3.4	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (DGA 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).	No	1
3.5	LIGHTNING IMPULSE (FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	No	1
3.6	SHORT CIRCUIT TEST (SPECIAL TEST) AS PER IEC 60076-5**	No	1
4.0	**Mandatory Spares**		
4.1	HV bushing	Nos	3
4.2	LV bushing	Nos	3
4.3	Neutral bushing	No	1
4.4	Winding Temperature indicator with alarm and trip contacts	No	1
4.5	Oil Temperature indicator	No	1
4.6	Pressure relief device	No	1
4.7	Buchholz Relay.	Set	1
4.8	Complete set of Valves (1 Nos of Each Size as applicable)	Set	1
4.9	Complete set of gaskets (1 Nos of Each size as applicable)	No	1
4.10	Magnetic Oil Level Gauge	No	1
4.11	Diaphragm for explosion vent	Set	1
4.12	Floats with contacts for Buchholz relay	Set	1
5.0	Supervision of Erection and Commissioning	Man-days	4

NOTES	
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.). THIS PRICE SHALL NOT BE CONSIDERED FOR EVALUATION PURPOSE.
2	BIDDER SHALL SUPPLY 10% EXTRA OIL AS PER THE QUOTED PRICE. QUANTITY OF EXTRA OIL SHALL BE SUBJECT TO APPROVAL DURING DETAIL ENGINEERING.
3	IN CASE TYPE/ SPECIAL TESTS ARE WAIVED, THE TYPE/ SPECIAL TEST CHARGES SHALL NOT BE PAYABLE TO THE BIDDER.
4	CHARGES FOR ALL TYPE/ SPECIAL TESTS SHALL BE CONSIDERED FOR PRICE COMPARISONS PURPOSE EXCEPT SHORT CIRCUIT TEST

	AS MENTION AT SL NO.1 OF NOTES
5	IN CASE ANY OF THE TYPE/ SPECIAL TESTS ARE REQUIRED TO BE REPEATED, THE SAME SHALL BE CARRIED OUT BY THE VENDOR WITHOUT ANY COMMERCIAL / DELIVERY IMPLICATION TO BHEL.
6	PVC SHALL BE APPLICABLE FOR THIS ENQUIRY AS PER IEEMA CIRCULAR (ENCLOSED) WITH UPPER CEILING LIMIT OF 20% & NO NEGATIVE CEILING LIMIT. PRICE VARIATION IS NOT APPLICABLE FOR EXTRA OIL, MANDATORY SPARES & TYPE TEST.
7	1 set consists of gaskets required for 1 No. transformer for the following (a) protection and monitoring devices (b) cooler circuit, if applicable (c) largest inspection cover, if applicable (d) HV/LV turret, if applicable (e) OCTC inspection cover, if applicable

Important Points to be considered by Bidder:

1) The transformer shall be complete with all accessories including material for earthing of transformers.
2) **Bidder shall conduct all type tests for this project as mentioned in specifications & annexures and the same shall be witnessed by BHEL/NTPC and approval shall be provided on successful acceptance test results only.** BHEL/NTPC reserves the right to waive conducting of any or all the specified type tests under this contract.
3) All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desiccators packs as necessary.
4) Contacts Tap Changer-1 Set and Pressure Gauge-1 No. of each type shall be supplied if applicable without any cost implication.
5) All the spares shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.

6) Each spare part shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.
7) The Bidder shall warrant that all spares supplied will be new and in accordance with the Contract Documents and will be free from defects in design, material and workmanship.

TERMINAL POINTS

1. HV Bushings of transformer with suitable termination for HV cable (approx. 3Cx240Sqmm, 6.6/6.6kV HT XLPE A2XWY) with terminal connector for cable glands & lugs for cable connection.
2. LV bushings with terminal connector (3phase + 1Neutral) for busduct.
3. 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.
4. For LV Earthing: Neutral earth busbar brought near the base of transformer/ cable glands & lugs in case of cable connection.
5. Transformer Earthing pads

SECTION-III

TECHNICAL SPECIFICATIONS

S.NO.	ITEM	PARTICULARS
1	Rating	1600 kVA (As per BOQ mentioned in section II)
2	Voltage Ratio (KV)	6.6/0.433 kV
3	Frequency	50 Hz
4	Winding	Primary/Secondary
5	Nos of Phase	Three
6	Vector Group	Dyn11
7	Cooling	ONAN
8	Service	Outdoor
9	Duty	Continuous
10	Tap Changer	OCTC +/- 5%
11	Impedance at 75 ºC	8% for 1600 kVA
12	Permissible Temperature rise over an ambient of 50 deg C (Irrespective of tap)	
	a) Top Oil by Thermometer	40 ºC
	b) Winding by Resistance	45 ºC
13	Insulation Level	As per IS
11	Earthing (Copper Flat)	Copper Flat (100x10mm)
12	Termination, SC withstand time & Fault Level	HV – Cable box, LV – Bus duct 40kA for 1 seconds
13	Noise Level	As per NEMA TR-1
14	Loading capability	Continuous operation at rated MVA on any tap with voltage variation of +/- 10%, also transformer shall be capable of being loaded in accordance with IS:6600/IEC60076-7.
15	Flux density	Not to exceed 1.9 Wb/sq.m at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following overfluxing conditions due to combined voltage and frequency fluctuations: a) 110% for continuous rating b) 125% for at least one minute c) 140% for at least five seconds

Note:

1) LT Auxiliary transformers shall be 3phase, 4 wire system with additional LVN bushing for equipment earthing.

Winding

1.	Highest System Voltage (kV)	**36**	**12**	**7.2**	**3.6**	**0.433**
2.	Lightning Impulse withstand voltage, kVp	170	75	60	40	-
3.	One min power frequency withstand voltage, kVrms	70	28	20	10	3
4.	Insulation	uniform	uniform	uniform	uniform	uniform

Method of neutral earthing and Vector Group:

KVA Rating	HV Rating (kV)	LV Rating (kV)	Vector Group	Method of Neutral Earthing
1600	6.6	0.433	Dyn11	LVN – Solidly Grounded

Bushing CT Parameters

SNO	Transformer Rating	CT Parameters	
		Earth Fault CT Class: 5P20	R.E.F CT Class : PS
1	1600kVA, 6.6/0.433kv, Z=8%, Dyn11		2500/1A, RCT≤12.5Ω, VK≥450V, Im≤30mA at VK/2

Bushing Rated Current (in Amperes)

SNO	KVA Rating	HV Rating(kV)	LV Rating (kV)	HV-Line	LV-Line	Neutral
1	1600	6.6	0.433	250	3150	3150

XLPE Cable Size:

SNO	KVA Rating	HV Rating(kV)	LV Rating (kV)	HV-Side	LV-Side
1	1600	6.6	0.433	3Cx240 sqmm	Busduct

TRANSFORMER TRANSPORTATION - Transportation shall be Oil filled.

For detailed Technical specifications on transformers bidder shall refer **Annexure-1** enclosed with this specification and shall comply the same.

CODES AND STANDARDS

Transformers	IS:2026, IS:6600, IEC:60076, IS 1180
Bushings	IS:2099, IEC:60137
Insulating Oil	IEC:60296
Bushing CTs	IS:2705, IEC 60185
Shunt Reactor	IS 5553 & IEC 60076-6
Indian Electricity Act 2003, BEE Guideline & CEA notification	

SECTION-IV

QUALITY ASSURANCE PLAN

For Quality assurance plan, refer **Annexure-2 and as per specification.**

SECTION-V

DOCUMENTATION

The bidder as per the schedule given below shall submit following drawings, documents and reproducibles:

Sl. No.	Description	Form	Qty	Remarks
A)	**With technical offer**			
Refer **Section-VI** for details/ documents to be furnished along with Technical Offer				
B)	**After Purchase Order**			
1.	OGA, Dimension detail of foundation plan, R&D plate etc. Guaranteed Technical Parameters / Data sheets & QAP, Calculations for hot spot temperature, FQP	Soft Copy	1	For approval within 7 days of PO
2.	Marshalling Box GA & Wiring drawings, Bill of material, Testing procedures etc.	Soft Copy	1	For approval within 7 days of PO
3.	Type test reports	Soft copy	1	For approval
4.	Routine Test certificates.	Original + soft copy	1	Internal test certificates are to be submitted for review prior to customer's Inspection
5.	All approved drawings	Original	2	Final before dispatch
6.	All As built drawings	Original	2	For final records
7.	Catalogues, and O & M manuals	Prints	2	For final records
8.	Reproducible for items at Sl. No. 1,2 & 5	RTF's	2 Sets.	For final records

1. Drawing/Documents provided are tentative & may change, there shall be no commercial/delivery implication to BHEL on this account.

2. Incomplete drawing & delay in drawing submission will be counted as delay in supply and will be considered as total delay for LD purposes. Revised drawings incorporating comments from customer shall be resubmitted within 7 days.

3. In BOM, each of the item to be uniquely identified with item code no. or item S.no. Supplied to ensure that all the items which will find separate mention in the packing list are covered in detailed BOM. Supplier to give following undertaking in BOM: *"The BOM provided here completes the scope (in content and intent) of material supply under PO no. --- dtd ----. Any additional material which may become necessary for the intended application of supplied item/package will be supplied free of cost in most reasonable time."*

4. If Vendor has already TYPE/SPECIAL test report of any or all rating transformer, vendor shall submit TYPE/SPECIAL test report along with corresponding drawings of same rating.

5. All documents are to be submitted with approved Title Block and Drawing Numbering System, a soft copy of which shall be provided to successful bidder.

6. Approval of drawings shall not relieve the supplier of his responsibility in terms of the contract.

7. All drawings submitted shall, wherever relevant, be in sufficient detail to indicate the type, size, arrangement, weight of each component, breakdown for packing and shipping, the external connections, fixing arrangements required, the dimensions required for installation & interconnection with other equipment's and materials, clearances and spaces required between various portions of the equipment and any other information that is either relevant or specifically requested for.

8. All documents such as drawings, test certificates, bill of materials etc. shall be marked as " Certified" and signed by the competent authority on the supplier's side.

9. All revisions shall be duly recorded, numbered, signed and dated chronologically while maintaining the original drawing number.

10. Test certificate shall invariably consist of details such as Nameplate data, Project/ Customer's name, and equipment identification no etc.

11. Records of test results/ readings etc. made during internal testing shall be available during testing/ inspection in customer's presence.

SECTION-VI

DETAILS TO BE FURNISHED ALONG WITH TECHNICAL OFFER

The following information / documents shall be specifically submitted by the bidder along with the bid in addition to the other information as called for in various sections of this specification:

1. **Duly Signed and stamped copy of Provenness criteria as per Annexure-3 & 3A along with all supporting documents.**
2. Duly signed and stamped copy of complete enquiry specifications (all pages).
3. Duly signed and stamped copy of unpriced format mentioning "quoted" or "not quoted" against each item.
4. Duly signed and stamped copy of deviation format by clearly indicating technical deviations if any.
5. Deviations to the technical specifications, if any, shall be clearly brought out along with the justification/ alternate options in offer in the technical deviation sheet.
6. Confirm inclusion of all required fittings/ accessories under scope, even if the same have not been explicitly brought out in the Specifications, but essential for the proper installation and operation of the equipment.

"DEVIATION FORMAT" shall be submitted along with the offer if any. Otherwise, bidder to categorically confirm that there are no deviations.

ANNEXURE - 1
TECHNICAL REQUIREMENTS

SUB-SECTION-II-E-08

OUTDOOR TRANSFORMER

1.00.00 TECHNICAL PARAMETERS

1.01.00 Outdoor Transformers

(a)	Rated output	As per Requirement
(b)	Cooling	ONAN
(c)	Type	Two winding
(d)	Voltage Ratio	As per Requirement
(e)	Frequency	50 Hz
(f)	Phase	Three (3)
(g)	Service	Outdoor
(h)	Duty	Continuous
(i)	Overload capacity	As per IS: 6600 and specified elsewhere in the specification.
(j)	Permissible Temperature rise over an ambient temp. of 50 deg. C	
(1.)	Winding (by resistance method)	~~55 deg. C~~ 45 deg C
(2.)	Top oil (by thermometer)	~~50 deg. C~~ 40 deg C
(k)	Impedance at 75 deg.C	As per details of Transformers under "Key Technical Parameter-Transformers" Subsection.
(l)	Noise Level	AS PER NEMA TR-1
(m)	System fault level 6.6kv - 40kA for 1 sec	As per requirement. However indicative min. values are: 36kV or Transformer fed from 33kV side – 12.5kA 12kV or Transformer fed from 11kV side – 40kA 3.6kV or Transformer fed from 3.45kV side

		– 40kA 0.433kV – 50kA

(n) **Winding**

1.	Highest System Voltage(kV)	**36**	**12**	**7.2**	**3.6**	**0.433**
2.	Lightning impulse withstand voltage, kVp	170	75	60	40	-
3.	One min power frequency withstand voltage, kVrms	70	28	20	10	3
4.	Insulation	uniform	uniform	uniform	uniform	uniform

5. Method of neutral earthing and Vector group (Indicative only):

KVA RATING	HV RATING (kV)	LV RATING (kV)	Vector Group	Method of Neutral Earthing
16,000	11	3.45	Dyn1	As per requirement
12,500	11	3.45	Dyn1	As per requirement
2,000	11	0.433	Dyn1	LVN – Solidly Grounded.
1,600	6.6	0.433	Dyn11	LVN – Solidly Grounded.
1,000	6.6	0.433	Dyn11	LVN – Solidly Grounded.
1,000	3.3	0.433	Dyn1	LVN – Solidly Grounded.
630	6.6	0.433	Dyn11	LVN – Solidly Grounded.

(o) **Tap changer details:**

i) Tap range	As per requirement

ii) Tap Control	As per requirement

(p) **Bushing CT Parameters** (Indicative only)

SI NO.	Transformer Rating	CT Parameters	
		Earth fault CT Class: 5P20	R.E.F.CT Class: PS
1.	16MVA,11/3.45kV,Z=12.5%,Dyn1	600/1, Burden: 10 VA	3000/1A, RCT ≤ 15Ω, VK ≥450V, Im ≤ 30mA at VK/2
2.	12.5MVA,11/3.45kV,Z=10%,Dyn1	600/1, Burden: 10 VA	2500/1A, RCT ≤ 12.5Ω, VK ≥450V, Im ≤ 30mA at VK/2
3.	2MVA,11/0.433kV,Z=10%,Dyn1		3000/1A, RCT ≤ 15Ω, VK ≥450V, Im ≤ 30mA at VK/2
4.	1.6MVA, 6.6/0.433kV, Z=8%, Dyn11		2500/1A, RCT ≤ 12.5Ω, VK ≥450V, Im ≤ 30mA at VK/2
5.	1.0MVA, 6.6/0.433kV, Z=5%, Dyn11		1600/1A, RCT ≤ 8Ω, VK ≥450V, Im ≤ 30mA at VK/2
6.	1MVA,3.3/0.433kV,Z=5%,Dyn1		1600/1A, RCT ≤ 8Ω, VK ≥450V, Im ≤ 30mA at VK/2
7.	630 kVA, 6.6/0.433kV, Z=5%, Dyn11		1000/1A, RCT ≤ 5Ω, VK ≥450V, Im ≤ 30mA at VK/2

(q) **Bushing Parameters**

	Parameters	36 KV	12 KV	7.2KV	3.6kV	433 V
(1 .)	Rated Voltage(kV)	36	12	7.2	3.6	1.1
(2 .)	Lightning impulse withstand voltage, kVp	170	75	60	40	-
(3 .)	One min power frequency withstand voltage , kV (rms)	77	30	22	11	3.0
(4 .)	Minimum total creepage distances (mm)	25mm/kV x Rated Voltage of Bushing.				
(5 .)	Mounting	Tank / Transformer body				

(6 .)	Rated Current	As per details of Transformers under (r) Subsection.

(r) **Bushing Rated Current (in Amperes)**

SR. No.	KVA RATING	HV RATING (kV)	LV RATING (kV)	HV-Line	LV-Line	Neutral
(1.)	16,000	11	3.45	1250	4000	4000
(2.)	12,500	11	3.45	1250	3150	3150
(3.)	2,000	11	0.433	250	3150	3150
(4.)	1,600	6.6	0.433	250	3150	3150
(5.)	1,000	6.6	0.433	250	2000	2000
(6.)	1,000	3.3	0.433	250	2000	2000
(7.)	630	6.6	0.433	250	1250	1250

(s) **Termination Details (Indicative only)**

(1.)	HV Phase Terminal 33kV,11kV, 3.3kV	Cable box suitable for XLPE insulated cable.
(2.)	LV Phase Terminal 11.5 KV	Cable box/Busduct suitable for XLPE insulated cable.
(3.)	LV Phase Terminal 3.45 KV	Busduct (Non-Segregated)
(4.)	LV Phase Terminal 0.433KV	Busduct (Non-Segregated) Or Cable Box
(5.)	LV Neutral Terminal 3.45kV	Grounded through NGR
(6.)	LV Neutral Terminal 0.433kV	Solidily grounded through Copper flat connection.

(t) **XLPE Cable size**

SR. No.	KVA RATING	HV RATING (kV)	LV RATING (kV)	HV side	LV side
(1.)	16,000	11	3.45	Cable	Bus duct
(2.)	12,500	11	3.45	Cable	Bus duct

SR. No.	KVA RATING	HV RATING (kV)	LV RATING (kV)	HV side	LV side
(3.)	2,000	11	0.433	3 Cx150	Busduct
(4.)	1,600	6.6	0.433	3Cx240	Busduct
(5.)	1,000	6.6	0.433	3Cx240	Busduct
(6.)	1,000	3.3	0.433	3 Cx150	Busduct/Cable
(7.)	630	6.6	0.433	3Cx240	2R 3Cx400

(u) **Minimum Clearance in air (mm)**

System voltage	33 kV	11 kV	6.6 kV	3.3 KV	433 V
Phase to Phase	350	130	100	70	25
Phase to Earth	320	120	90	60	25

1.02.00 **NEUTRAL GROUNDING RESISTORS**

NOT APPLICABLE

1.02.01 **3.6 KV & 11 KV NGR**

Sr. No	Parameters	3.6 kV	11 kV
i)	Resistance Value at 50 deg. C.	3.32 Ohms	11.07 Ohms
ii)	Rated current	600A for 10 seconds	600A for 10 seconds
iii)	Service	Outdoor	Outdoor
iv)	Resistor material & connection	Punched stainless steel grid element type	Punched stainless steel grid element type
v)	Maximum allowable temperature rise over ambient 50 oC	350 deg. C	350 deg. C
vi)	Mounting	3.6 KV grade insulators.	12 KV grade insulators.
vii)	Power frequency test level	10 KV (rms)	28 KV (rms)

viii)	Application	Refer "Key Technical Parameter-Transformers" Subsection.

NOTE:-
Also refer Annexure-A to this Sub-section.

1.02.00 **Details of Transformers** : As per Requirement

1.03.00 GENERAL

1.04.00 STANDARDS

All equipment provided under the specification shall in general, conform to the latest issue of the following standards:

Indian Standards No.	Title	International & internationally recognize standards
IS: 2026	Power transformers	IEC: 60076
IS: 3639	Fittings & accessories for power transformers	
	Insulating oils for transformer and switchgear	IEC: 60296, BS:148
IS: 2099	Bushing for alternating voltages above 1000 V	IEC: 60137, BS: 223
IS: 2705	Current transformers	IEC: 60185
IS: 325	Three phase induction motors	IEC: 60034
IS: 3637	Gas operated relays	
IS: 10028	Code of practice for selection installation & maintenance of transformers	
IS: 4691	Degree of protection provided by enclosure for rotating electrical machinery	
IS: 13947	Specification for low voltage switchgear & control gear Part - I	IEC: 144
IS : 5	Colours for ready mix paints	
IS: 1866	Code of practice for maintenance & Supervision of mineral insulating oil in	

	Indian Standards No.	Title	International & internationally recognized standards
		equipment	
	IS: 6272	Industrial cooling fans	
	IS: 6600	Guide for Loading of oil immersed transformers	IEC: 60076-7
	IS: 3347 IS:8603	Specification for dimensions of porcelain bushing	
	IS: 8468	Tap changers	IEC: 214
		High voltage test technique	IEC: 60
		Insulation co-ordination	IEC: 71
		NEMA standard publication for Power transformers	NEMA-TR-1
	IS: 10596	Code of practice for selection, Installation operation & maintenance of pumps for Industrial applications	
	IS: 9434	Guide for sampling & analysis of free & dissolved gas & oil from oil filled electrical equipment	IEC: 567
	IS: 2544	Porcelain post insulators for systems with nominal voltage greater than 1000 V	
	IS: 5561	Specification for electric power connectors	
	IS: 5621	Hollow insulators for use in electrical equipment	
	IS: 2633	Methods for testing uniformity of coating of Zinc coated articles	
	IS: 12676	Dimensions for OIP insulated condenser bushings	
	BEE Guideline & CEA notification		

1.05.00 The electrical installation shall meet the requirements of Indian Electricity act 2003.

2.00.00 PERFORMANCE

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

(b) The transformer & all its accessories including CT's etc, shall be designed to withstand without injury the thermal & mechanical effects of any external short circuit to earth & of short circuits at the terminal of any winding for a period of 2 sec.

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

1)	110 %- continuous
	125%- for one minute
	140%- for five seconds
2)	Bidder shall indicate 150% & 170% over voltage withstand time.
3)	Over fluxing characteristics up to 170 % shall be submitted.

(d) The transformers shall be capable of being operated continuously without danger on any tapping at the rated MVA with voltage variation of ±10% corresponding to the voltage of tapping.

(e) The transformers shall be capable of being loaded in accordance with IS: 6600 / IEC: 60076-7 up to load of 150 %. There shall be no limitation imposed by bushings, tap changers etc. or any other associated equipment.

3.00.00 CONSTRUCTION

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

3.01.00 TANK AND TANK ACCESSORIES

(a) Tank shall be of welded construction & fabricated from tested quality low carbon steel of adequate thickness. The welding procedure specification (WPS), procedure qualification record (PQR), shop welding schedule, welder's qualification shall be subject to Employer's approval. After completion of welding, all joints shall be subjected to visual examination. In case of doubt particular weld shall be checked by D.P. Test. However weld joints of load bearing member shall be left unpainted till carrying out of jacking test followed by DP Test during final inspection of transformer. Details of acceptance norms of welding shall be

	submitted for Employer's approval which shall include permissible undercut, overlap, surface crack, porosity, out of alignment of plate surface in butt joints, maximum gap due to incorrect fit up of fillet joint etc.
(b)	Each tank shall be provided with : (i.) Lifting lug suitable for lifting the equipment complete with oil. (ii.) A minimum of four jacking pads in accessible position to enable the transformer complete with oil to be raised or lowered using hydraulic or mechanical screw jacks. (iii.) Suitable haulage holes shall be provided for transformer wheeling in all four directions.
(c)	For all transformers, suitable bi-directional skids with pre-drilled holes shall be provided integral with the tank body for fixing the transformer tank on foundation. These skids shall be such that the bottom of the tank body is at a sufficient height above foundation for cleaning purposes. The transformers (except transformers upto and including 2 MVA) are to be provided with four no. of bi - directional flat rollers of detachable type & shall be mounted on wheels on foundation. Suitable locking arrangement shall be provided for the wheels to prevent accidental movement of transformer.
(d)	At least two adequately sized inspection openings one at each end of the tank shall be provided for easy access to bushing & earth connections. The inspection covers shall not weight more than 25 Kg. Handles shall be provided on the inspection cover to facilitate lifting.
(e)	All bolted connections shall be fitted with weather proof, hot oil resistant, rubberized cork gasket in between for complete oil tightness. If gasket is compressible, metallic stops shall be provided to prevent over compression.
(f)	The tank shall be designed in such a way that it can be mounted on the plinth directly.
(g)	Wherever possible the transformer tank & its accessories shall be designed without pockets wherein gas may collect. Where pockets can not be avoided, pipes shall be provided to vent the gas into the main expansion pipe.
(h)	The main tank body shall be capable of withstanding full vacuum.
3.02.00	**Core**
(a)	The core shall be constructed from cold rolled, super grain oriented (CRGO), silicon steel laminations of equivalent to M4 or better grade.
(b)	The core isolation level shall be 2 kV (rms.) for 1 minute in air.
(c)	Adequate lifting lugs will be provided to enable the core & windings to be lifted.
3.03.00	**Windings**

(a) The contractor shall ensure that windings of all transformers are made in dust proof & conditioned atmosphere. The bidder shall furnish details of the facilities available at his works along with the Techno- Commercial bid.

(b) The conductors shall be of electrolytic grade copper free from scales & burrs.

(c) All windings of the transformers having voltage less than 66 kV shall be fully insulated.

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

3.04.00 Insulating Oil

No inhibitors shall be used in the transformer 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, mm^2/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/dm^3 at 20 ° C	≤ 0.895
6.	Interfacial Tension N/m at 25° C	≥ 0.04
7.	Neutralisation value, mgKOH/g	≤ 0.01
8.	Corrosive sulphur	Non Corrosive
9.	Water content mg/kg	≤ 30 in bulk supply ≤ 40 in drum supply
10.	Anti oxidants additives	Not detectable
11.	Oxidation Stability Neutralization value, mgKOH/g Sludge, % by mass	 ≤ 1.2 ≤ 0.8
12.	Breakdown voltage As delivered, kV After treatment, kV	 ≥ 30 ≥ 70

S.No.	Property	Permissible values
13.	Dissipation factor, at 90° C And 40 Hz to 60 Hz	≤ 0.005
14.	PCA content	≤1%
15.	Impulse withstand Level, kVp	≥ 145
16.	Gassing tendency at 50 Hz after 120 min, mm^3/min	≤ 5

Subsequently oil samples shall be drawn at:

(a) After placement of transformer on foundation, Oil of main tank shall be tested for

i)	BDV	60 kV (min)	Applicable for all transformers including 16 MVA.
ii)	Moisture content	10 ppm (max.)	
iii)	Tan delta at 90 deg. C	0.002 (max.)	Applicable for 16 MVA & above Transformers only.
iv)	Resistivity at 90 deg. C	35 x 10^{12} ohm-cm (min)	
v)	Interfacial tension	0.040 N/m (min)	

(b) Prior to energization at site for following properties & acceptance norms:

i)	BDV	60 kV (min)	Applicable for all transformers including 16 MVA.
ii)	Moisture content	10 ppm (max.)	
iii)	Tan delta at 90 deg. C	0.05 (max.)	Applicable for 16 MVA & above Transformers only.
iv)	Resistivity at 90 deg. C	1 x 10^{12} ohm-cm (min)	
v)	Interfacial tension	0.035 N/m (min)	

3.04.02 Oil Preservations System

(a) The transformers rated below 7.5 MVA shall have the following types of oil preservation systems:

(i.) Conventional Conservator

The transformer shall be provided with conventional single compartment conservator with dry air filling the space above the oil. The top of the conservator shall be connected to the atmosphere through a cobalt free indicating type silica gel breather with transparent enclosure. The Buchholz relay shall also be provided.

The conservator shall be fitted with a cobalt free indicating type silica gel filter breather of transparent enclosure breather, which shall be so designed that:

→ Passage of air is through a dust filter and silica gel.

→ Silica gel is isolated from atmosphere by an oil seal.

→ Moisture absorption indicated by a change in colour of the tinted crystal can be easily observed from a distance.

→ Breather is mounted not more than 1400 mm above rail top level.

(b) For transformers rated 7.5 MVA and above, bidder shall offer air cell type oil sealing in the conservator to prevent oxidation and contamination of oil due to contact with water. The requirement of air cell type constant oil preservation system are given below:

i. Contact of the oil with atmosphere is prohibited by using a flexible urethane or nitrile rubber reinforced with nylon cloth air cell.

ii. The connection of air cell to the top of reservoir is by air proof seal preventing entrance of air into the conservator.

iii. The temperature is likely to rise upto 100 Deg C when the transformer is in operation. As such air cell used shall be suitable for operating continuously at 100 deg. C.

iv. A silica gel breather shall be provided in the air side vent line.

3.05.00 Terminal Arrangements

3.05.01 Bushings

(a) The electrical & mechanical characteristics of bushings shall be in accordance with IS: 2099, IS: 3347 & IS: 12676.

(b) Bushings for 52 kV & above shall be of the oil filled condenser type & shall be of draw lead/ rod type to facilitate removal. Bushings of rating below 52 kV shall be solid porcelain or oil communicating type.

(c) Condenser type bushings shall be provided with :

(i.) Oil level gauge,
(ii.) Oil filling plug & drain valve (if not hermetically sealed)
(iii.) Tap for capacitance & tan delta test.

(d) Clamps & fittings shall be of hot dip galvanized steel.

(e) Bushing & fittings shall be provided with vent pipes that shall be connected to route any gas collection through the Buchholz relay.

(f) No arcing horns shall be provided on the bushings.

(g) Wherever cable termination is specified, bushing terminals shall be provided with suitable terminal connectors of approved type and size for cable termination.

(h) Where current transformers are specified, the bushings shall be removable without disturbing the current transformer.

3.05.02 **Neutral Terminal Arrangement**

3.05.03 **Neutral Termination**

(a) The neutral terminal of 433 V winding shall be brought out on a bushing along with the 433 V phase terminal to from a 4 wire system for the 433 V. Neutral CT's shall be located in the lead coming out of the winding and location of these CT's shall not be inside the tank.

(b) The neutral terminal of winding not connected to NGR (as per "Key Technical Parameter-Transformers" Subsections), shall also be brought out through an outdoor bushing. Further this neutral terminal shall be connected by a copper flat of size 50 mm x 8 mm, which shall be brought down upto 100 mm above ground. The copper flat shall be insulated and supported from the tank body. The connection shall be made by using two (2) bolted neutral grounding terminals with necessary accessories.

(c) The neutral terminal of winding connected to NGR (as per "Key Technical Parameter-Transformers" Subsections), shall be brought to an outdoor bushing, away from the busduct termination arrangement (wherever applicable). It shall be connected to associated neutral grounding resistor by a copper flat, which shall be supplied & installed by the contractor along with the necessary intermediate supporting insulators & supporting structure. Also NGR shall be grounded through copper flat which shall be insulated and properly supported and shall be brought down upto 100 mm above ground.

3.05.04 **Bus Duct Terminations**

(a) A flanged throat or equivalent connection shall be provided for termination of busduct enclosure. The winding termination shall be on outdoor type of bushings. The Employer would provide necessary flexible connection between the bushing terminal & the bus duct conductor. The material of the busduct termination shall be non-magnetic.

(b) The shape of the bus duct conductor shall be informed during detailed engineering. The bushing pads shall be silver/tin plated. A drain with stopcock arrangement shall be provided at flange to drain leakage of oil/water at termination. As bus duct will be pressurized stopcocks shall be airtight.

(c) Tolerance permissible for the height of the terminal connected to busduct over rail top level is ± 10 mm. Contractor has to ensure that radiator & conservator does not obstruct the path of the bus ducts in position & during movement of transformer. The contractor shall co-ordinate final design of terminal arrangement to suit bus duct arrangement during detailed engineering.

(d) The transformer bushing enclosed in bus duct enclosure shall be designed for satisfactory operation in the high ambient temperature existing inside the bus duct enclosure. The temperature inside the bus duct enclosure may be of the order of 90 – 100 deg. C. The bus duct conductor temperature may be as high as 105 deg. C & temperature in the bus duct enclosure will be of the order of 80 deg. C.

3.05.05	**Cable boxes & disconnecting chamber**
(a)	HV Cable boxes shall be of phase segregated air insulated type & shall be of sufficient size to accommodate Employer's cable & termination (as applicable). Phase segregation shall be achieved by insulating barriers.
(b)	Cable boxes shall have bus bars / terminal connectors of adequate size & bolt holes to receive cable lugs.
(c)	A suitable removable gland plate of non-magnetic material drilled as per the Employer's instruction shall also be provided in the cable box.
(d)	The support from base for the cable box shall be of galvanized iron.
(e)	The contractor shall provide earthing terminals on the cable box, to suit Employer's GI flat.
(f)	The final cable size & type, number & length of terminating cable (from cable gland plate to the cable lug) shall be furnished during detailed engg.
(g)	Cable boxes shall be designed such that it shall be possible to move away the transformer without disturbing the cable terminations, leaving the cable box on external supports.
(h)	Cable boxes shall have removable top cover & ample clearance shall be provided to enable either transformer or each cable to be subjected separately to high voltage test.
3.05.06	**TERMINAL CONNECTOR** (If applicable)
(a)	Bushing terminal shall be provided with terminal connectors of approved type & size for connection to external part. Terminal connectors must have been successfully type tested as per IS: 5561.
(b)	Aluminium alloy if used shall conform to designation 4600 M of IS: 617 or of better quality.
(c)	No current carrying part of a clamp shall be less than 10 mm thick.
(d)	All ferrous parts shall be hot dip galvanized conforming to IS: 2633.
(e)	For bi-metallic clamp, copper alloy liner of minimum 2-mm thickness shall be cast integral with aluminum body. Alternatively Bidder may offer bimetallic connector with loose bimetallic sleeve.
(f)	Flexible connectors shall be made from tinned copper sheets.
(g)	Size of terminal/conductor for which the clamp is suitable & rated current under the conditions shall be embossed / punched on each component of the clamp, except hardware.
(h)	Rated current of the terminal connectors shall be same as that of corresponding bushing.

3.06.00 Bushing Current Transformer

(a) Current transformer shall comply with IS: 2705.

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

(c) All secondary leads shall be brought to a weatherproof terminal box near each bushing. These terminals shall be wired out to transformer marshalling box using separate cables for each core.

3.07.00 Terminal Marking

The terminal marking & their physical position shall be as per IS: 2026 unless specified otherwise.

3.08.00 Marshalling Box(M. BOX) Unit

(a) Each transformer shall be provided with one Marshalling Box housing all the cooler control, OTI & WTI etc. **OTI & WTI shall have 4-20mA analog output for communication with PLC**

(b) The sheet steel used for all the cabinet boxes shall be at least 2.5 mm thick. The gasket used shall be of neoprene rubber. A space heater & cubicle lighting with on–off switch shall be provided in each cabinet. A circuit breaker/contactor with thermal overload device for controlling the AC auxiliary supply shall be provided.

(c) Terminal Blocks

(1.) The terminal blocks to be provided shall be fully enclosed with removable covers & made of molded, non-inflammable plastic material with blocks & barriers molded integrally. The terminal blocks shall be of 650V grade & have 10 A continuous rating. Terminal blocks for current transformer secondary leads shall be provided with test links & isolating facilities. Also current transformer secondary leads shall be provided with short circuiting & earthing facilities. At least 20% spare terminals shall be provided on each panel & these spare terminals shall be uniformly distributed on all terminal blocks.

(2.) Terminal blocks shall be suitable for connecting the following conductors on each side :

(i.) Current transformer circuits – minimum of two No. of 2.5 sq. mm copper wires each side

(ii.) Other circuits— minimum of one No. of 2.5 sq. mm copper wire each side

(d) The temperature indicators shall be so mounted that the dials are not more than 1500 mm from ground level. Glazed door of suitable size shall be provided for convenience of reading.

(e) All incoming cables shall enter the marshalling box from the bottom. A removable undrilled gland plate shall be provided at the bottom of the box for accommodating

glands for Employer's incoming and outgoing cables, which shall not be less than 450 mm from finished floor level.

(f) All devices and terminal blocks inside the marshalling box shall be clearly identified by symbols corresponding to those used on applicable schematic or wiring diagram.

(g) It shall be located in such a way that, the same shall not face towards the transformer.

(h) The gland plate shall be made into two detachable halves, for facilitating the termination of Employer's cable and Contractor's cables separately. The gland plate and the associated compartment shall be sealed in a suitable manner to prevent the ingress to moisture, rodents, insects etc.

(i) One dummy terminal block in between each trip wire terminal shall be provided.

(j) Wiring Scheme shall be engraved in a plate and the same shall be fixed inside the Marshalling Box door.

3.09.00 Control Wiring & Cabling

Supply, laying & termination of all cables & accessories required of proper termination from the M. Box except for those stated under next clause below so as to make equipment complete & functional shall be in scope of supplier. The cable between the M. Box & transformer shall be laid by the supplier through GI conduits/ pipes. Cable box / sealing end shall be suitable for following types of cables

1)	415 V power	1100 V grade PVC insulated aluminum conductor cable with armour.
2)	Control	1100 V grade PVC insulated 2.5 sq. mm stranded copper conductor with armour.

3.10.00 PAINTING

Painting of transformer and its accessories shall be in accordance with the following chart.

	PARTS NAME	TYPE OF PAINT	NO.OF COATS	TOTAL DFT
(1.)	Inside of tank and accessories (except M Box)	Oil & heat resistant fully glossy white	One coat	atleast 30 micron
(2.)	External surface of transformer and accessories	Chemical resistant epoxy zinc phosphate primer, MIO	One coat each	Atleast 100 micron

	PARTS NAME	TYPE OF PAINT	NO.OF COATS	TOTAL DFT
	including M Box (except radiator)	(Micaceious iron oxide) as intermediate paint followed by polyurethane finish paint of blue colour corresponding to RAL 5012.		
(3.)	External radiator surface	Anticorrosive primary paint followed by high quality full glossy outer finish paint (blue colour corresponding to RAL 5012.)	Two coats each	Atleast 100 micron
(4.)	Internal radiator surface	Hot oil proof, low viscosity varnish and subsequent flushing with transformer oil	---	---
(5.)	Internal surface of 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

3.11.00 **Cooling Equipment**

The radiators shall be detachable type, mounted on the tank. Each radiator shall be provided with the following:

(a) A drain plug at the bottom.

(b) An air release plug at the top.

3.12.00 **TAP CHANGER DEVICE**

3.12.01 Off Circuit Tap change Switch

(a) The tap change switch shall be three phase, hand operated for simultaneous switching of similar taps on the three phases by operating on external hand wheel.

(b)	The tap changing shall be possible without disturbing the transformer in any way except de-energising.
(c)	Arrangement shall be made for securing and pad-locking the tap changer in any of the working positions, and it shall not be possible for setting or padlocking it in any intermediate position. An indicating device shall be provided to show the tap in use.
(d)	The Cranking device for manual operation of the off circuit tap changing gear shall be removable and suitable for operation by a man standing on ground level. The mechanism shall be complete with the following:- (i.) Mechanical tap position indicator which shall be clearly visible from near the transformer. (ii.) Mechanical stops to prevent over cranking of the mechanism beyond the extreme tap positions. (iii.) The manual operating mechanism shall be labeled to show direction of operation for raising the secondary voltage and vice versa. (iv.) A warning plate indicating "The switch shall be operated only when the transformer has been de-energised" shall be fitted.
3.13.00	**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. They shall be of full way type with internal screw and shall open when turned counter clockwise when facing the hand wheel.
(b)	Suitable means shall be provided for locking the valves in the open and close positions. Provision is not required for locking individual radiator valves.
(c)	Each valve shall be provided with the indicator to show clearly the position of the valve.
(d)	Gland packing/gasket material shall be of teflon rope/nitrile rubber. In case of gate/globe valves, gland packing preferably of teflon rope shall be used to prevent oil seepage through the gland.
(e)	After testing, inside surface of all cast iron valves coming in contact with oil shall be applied with one coat of oil resisting paint/varnish with two coats of red oxide zinc chromate primer followed by two coats of fully glossy finishing paint conforming to IS:2932 and of a shade (Preferably red or yellow) distinct and different from that of main tank surface. Outside surface except gasket setting surface of butterfly valves shall be painted with two coats of red oxide zinc chromate conforming to IS:2074 followed by two coats of fully glossy finishing paint.
(f)	All hardware used shall be cadmium plated/electro galvanised.
(g)	Sampling & drain valves should have zero leakage rate.

3.14.00 Neutral Grounding Resistors (If applicable)

The earthing resistors are required for LV neutral point earthing of the various transformers. (as specified elsewhere in this specification)

(a) Resistor Elements

The resistors shall be of punched stainless steel grid element type. The grids shall be securely supported at sufficient number of points so that no damage is caused to the grids due to vibrations and no mechanical stresses are developed. The resistor element shall be insulated from supporting base by mica tubes. The insulating material used in the construction shall be heat resistant such as mica.

(b) Stacking

Various sections comprising the neutral grounding resistor shall be capable of being stacked one above the other. The insulators supporting the resistor assemblies shall be of outdoor type. Connecting links shall be provided to connect adjacent stacks.

(c) Enclosure

The neutral grounding resistor shall be housed in a 2.5 mm thick sheet steel enclosure. The enclosure shall be weather proof having IP 33 degree of protection in accordance with IS: 13947. The resistor neutral side terminal shall be brought out on the roof and the ground side terminal at the side of the enclosure through porcelain bushings. The ground side terminal shall be brought to ground level by a copper flat supported from the mounting structure by porcelain insulators. The copper bar shall have two (2) bolted neutral grounding terminals with hole size suitable for M10 bolt size and necessary accessories for connecting to ground mat through two MS 'flats'. The enclosure shall be supported on insulators placed on the mounting structure.

(d) Mounting Structure

The Contractor shall supply and erect a galvanized structure to support the NG resistor enclosure so that the base of the enclosure shall be at a minimum height of 2.4M above ground level. The NG resistor enclosure mounting and the neutral connection shall be such that it does not obstruct the busduct routing in any way.

A heating circuit with Thermostat to be provided inside the enclosure to control humidity.

3.15.00 Bolts & Nuts

All bolts & nuts exposed to weather shall be hot dip galvanised steel /cadmium plated steel.

3.16.00 Gasket

The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. Supplier shall also recommend quality & make of gaskets to be used for replacement during maintenance if required. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, contractor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established.

4.00.00 FITTINGS

4.01.00 The following fittings shall be provided with each transformer covered in this specification:

1) Conservator for main tank with oil filling hole and cap, isolating valves, drain valve, magnetic oil level gauge with low level alarm contacts and dehydrating cobalt free indicating type silica gel breather with transparent enclosure. Breather for conservators shall be mounted not more than 1400 mm above rail top.
2) Oil preservation system: - as specified elsewhere.
3) Minimum two Nos. of spring operated pressure relief devices with alarm/trip contacts for transformer of 2 MVA & above rating. Discharge of PRD shall be properly taken through pipes & directed away from the transformer /other equipment.
4) Buchholz relay double float type with isolating valves on both sides, bleeding pipe with Gas collecting device at the end to collect gases and alarm and trip contacts. Control cable termination at Buchhloz relay shall be properly sealed to prevent water entry.
5) Air release plug.
6) Inspection openings and covers.
7) Bushing with metal parts and gaskets to suit the termination arrangement.
8) Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs.
9) Protected type Mercury or alcohol in glass thermometer.
10) Bottom and top filter valves with threaded male adapters, bottom Sampling valve & drain valve.
11) Rating and diagram plates on transformers (English & Hindi) and auxiliary apparatus.
12) Radiator as specified.
13) Prismatic/toughened glass oil gauge for transformers.
14) 150 mm dial type oil temp indicator with alarm and trip contacts, maximum reading pointer & resetting device. Accuracy class shall be ± 1.5 % or better.
15) 150-mm dial type Winding temp indicator with alarm and trip contacts, maximum reading pointer & resetting device. Accuracy class shall be ±

1.5 % or better.

16) Flanged bi-directional wheels.

17) Marshalling Box.

18) Off load tap changing gear

19) Cooling equipment.

20) Bushing current transformers.

21) Insulating oil.

22) Drain valves/plugs shall be provided in order that each section of pipe work can be drained independently. Sludge valve at bottom most point of tank to be provided for easy flush out/removal of sludge during maintenance.

23) Terminal marking plates.

24) Valves schedule plates.

25) Two (2) earthing terminals on all the equipment mounted separately suitable for connection to suitable GI flat along with 2 Nos. tapped holes. M10 bolts etc.

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

4.02.00 The fittings listed above are only indicative and other fittings, which generally are required for satisfactory operation of the transformer, are deemed to be included.

In CLAUSE 5.00.00 INSPECTION AND TESTING, TO BE READ AS
1) CONTRACTOR I.E. BIDDER
2) OWNER/EMPLOYER I.E NTPC & BHEL

5.00.00 INSPECTION AND TESTING

(a) The Contractor shall carry out a comprehensive inspection and testing program during manufacture of the transformer. The owner may waive conduction of any test subject to availability of test facility. An indication of inspection envisaged by the Employer is given elsewhere in the specification. This is however not intended to form a comprehensive program, as it is Contractor's responsibility to draw up and carry out such a program in the form of detailed quality plan duly approved by Employer for necessary implementation.

(b) The Contractor shall carry out all type tests and routine tests on the transformers. The tests are listed elsewhere in the specification.

(d) The equipment checks to be carried out by the Contractor are given elsewhere in the specification.

(f)	The makes of all major bought out items shall be subjected to Employer's approval. The contractor shall also prepare a comprehensive inspection and testing program for all bought out/sub-contracted items and shall submit the same to Employer.
(g)	Each transformer shall be completely assembled with all fittings and accessories meant for the particular transformer before offering for inspection and testing by Employer.
(h)	The type tests shall be carried out in presence of the employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the employer'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.
(i)	The owner 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.
(j)	
(k)	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

Type and Routine tests

Routine Tests

Sr. No.	Routine Tests	OIL FILLED OUTDOOR TRANSFORMER
1	All routine test in accordance with IEC 60076 shall be carried out in all the transformers.	√
2	Measurement of Voltage Ratio	√
3	Measurement of winding resistance on HV & LV on all the taps	√
4	Vector group and Polarity Check	√
5	Magnetic Balance 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	√
8	Impedance & Load Loss Measurement on principal, Max & Min. Taps	√
9	IR measurement (As per IEC 60076-1)	√
10	Dielectric tests shall be carried out as per IEC 60076-3.	√
11	Separate Source Voltage Withstand Test (As per IEC 60076-3)	√
12	Induced Over Voltage Withstand test as per IEC 60076-3	√
13	Repeat no load current/loss measurement & IR measurement after completion of all dielectric test	√
14	Measurement of capacitance & tan delta to determine capacitance between winding & earth. (As per IEC 60076-1)	√
15	Oil leakage test	√
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.	√
	Type Tests	
19	Dynamic Short circuit test (special test) as per IEC 60076-5.	√
20	Temp. rise test at a tap corresponding to maximum losses. DGA 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).	√
21	Lightning impulse (Full & Chopped Wave) test on windings	√
22	Lightning impulse test on Neutral	√ (refer note iii)
24	Measurement of acoustic noise level as per NEMA TR-1 (special test)	√

Note:

i) (√) mark indicates that the test to be carried out.
(x) mark indicates that the test need not be carried out.

ii) All the type tests shall be conducted after short circuit test. If Tank Vacuum &

Pressure Test is to be carried out then it shall be conducted before SC test.

iii) Applicable on transformer neutral connected with NGR.

5.01.02 Type tests on Components

Type test reports shall be submitted for following:

(a) Tank Vacuum & Pressure Test

(b) Neutral Grounding resistors

5.02.00 TANK TEST

(a) Routine test

(1.) Oil leakage test on assembled transformer

All tank & 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 & applying pressure equal to the normal pressure plus 35 KN/sq. m measured at the base of the tank. The pressure shall be maintained for a period of not less than 6 hours during which time no sweating shall occur. This test shall be done on completely assembled transformer.

(b) Type Tests

(1.) **Vacuum Test**

Each type of transformer tank shall be subjected to the vacuum test as per CBIP norms.

(2.) **Pressure Test**

Transformer tank of each type shall be subjected to a pressure test as per CBIP norms.

5.03.00 NGR Testing

(a) The following routine tests shall be conducted on each resistor covered in this package.

(1.) Ohmic value measurement (For resistance & reactance separately).

(2.) Insulation resistance measurement before & after HV test

(3.) HV test for 1 min. at a voltage corresponding to the insulation level of the resistor.

(b) DOP test on enclosure (routine test) as follows.

It shall not be possible to insert a 2.5mm dia. steel wire into the enclosure from any direction without using force.

Type tests

Type test reports shall be submitted for following:

(a) Short time current test along with temperature rise test.

(b) Degree of protection test for IPX3.

5.04.00 Pre-shipment Checks at Manufacture's Works

(a) Check for interchangeability of similar transformers for mounting dimensions.

(b) Check for proper packing and reservation of accessories like radiators, bushings, dehydrating breather, rollers, Buchhloz relay, fans, control cubicle, connecting pipes, conservator etc.

(c) Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.

5.05.00 Inspection and Testing at Site ← NOT APPLICABLE

The Contractor shall carry out a detailed inspection and testing program for field activities covering areas right from the receipt of material stage up to commissioning stage. An indicative program of inspection as envisaged by the Employer is given below. This is however not intended to form comprehensive program, as it is contractor's responsibility to draw up and carry out such a program duly approved by the Employer. Testing of oil sample at site shall be carried out as specified elsewhere in this specification.

5.05.01 Receipt and Storage Checks ← NOT APPLICABLE

Following checks as detailed out in finalized/agreed FQP shall be followed.

(a) Check and record condition of each package, visible parts of the transformer etc. for any damage.

(b) Visual check for wedging of core and coils before filling up with oil and also check conditions of core and winding in general, if transformer filled with N2/dry air.

5.05.02 Installation Checks ← SUPERVISION OF COMMISSIONING BY BIDDER

(a) Inspection and performance testing of accessories like tap changers etc.

(b) Check whole assembly for tightness, general appearance etc.

(c) Check oil sample.

(d) Leakage test on bushing before erection, if bushing is transported separately.

(e)	Capacitance & tan delta measurement of condenser bushing before fixing / connecting to the winding, contractor shall furnish these values for site reference.
5.05.03	**Commissioning Checks** ← SUPERVISION OF COMMISSIONING BY BIDDER
(a)	Check the colour of silica gel in silicagel breather.
(b)	Check the oil level in the breather housing, conservator tanks, cooling system, condenser-bushing etc.
(c)	Check the bushing for conformity of connection to the lines etc. and tan delta test for bushing.
(d)	Check for correct operation of protection devices and alarms: (i.) Buchhloz relay. (ii.) Excessive winding temperature (iii.) Excessive oil temperature (iv.) Low oil level indication (v.) Pressure relief valve
(e)	Check for the adequate protection on the electric circuit supplying the accessories.
(f)	Check resistance of all windings on all steps of the tap changer.
(g)	Insulation resistance measurement for the following: (i.) Control wiring. (ii.) Main windings (iii.) Tank & turret mounted CT's
(h)	Check for cleanliness of the transformer and the surroundings.
(i)	Check the following (i.) Buchholz, oil level indicator, pressure gauges, temp indicators etc. for fitting & operation. (ii.) Earthing of main tank, marshaling Box, tap changer driving gear, cable box, fan motor etc. (iii.) Neutral earthing (iv.) Calibration of WTI and OTI (v.) Earthing of bushing test tap (vi.) Connection of WTI CT with its heater (vii.) Tightness of CT secondary connection and shorting of unused CTs (viii.) All valves for their correct opening and close sequence
(j)	Phase out and vector group test.

(k)	Ratio test on all taps.
(l)	Magnetizing current test (HV winding & LV winding).
(m)	Capacitance and Tan delta measurement of winding
(n)	Oil Dielectric strength test-the various test on oil shall be conducted prior to filling in main tank at site & prior to energization at site as specified elsewhere in this specification. Oil samples are to be drawn from top & bottom of main tank & cooling system.
(o)	DGA of oil before commissioning
(p)	Magnetic balance test
(q)	Short circuit impedance measurement
(r)	Test on tank/turret mounted CT's (i.) IR value between secondary winding & earth and between windings (ii.) Secondary resistance (iii.) Polarity (iv.) Ratio test (v.) Magnetization current
(s)	WTI and OTI setting for alarm/trip, fan start/stop (if applicable) and pump start/stop (if applicable).
(t)	Final IR Value (i.) HV/E+LV (ii.) LV/E+HV (iii.) HV/LV
(u)	Continuously observe the transformer operation at no load for 24 hrs. w.r.t. Voltage, no load current, temperature rise and noise. Gradually put the transformer on load, check and measure increase in temperature in relation to the load and check the operation with respect to temperature rise and noise level etc.

ANNEXURE - 2
STANDARD QAP

QUALITY ASSURANCE

AUXILIARY / LT TRANSFORMER

Items/Components Sub Systems / Attributes / Characteristics	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.	Functional check	WPS & PQR	Routine Test as per relevant standard / NTPC Specification
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y					Y	
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y				Y			
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y			Y
Gasket	Y	Y			Y	Y		Y		Y			Y
Transformer Oil (IEC296)			Y										Y
OLTC / Off-Circuit Tap Changer	Y									Y			Y
Core Coil Assembly & Pre-tanking	Y								Y	Y			
Marshalling Box	Y									Y	Y		Y
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Valves	Y									Y	Y		
Welding (ASME Sect-IX)	Y						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 3A - PROVENNESS CRITERIA

Sno:	Clause	Documents	
5.1.1	The Bidder should have manufactured & supplied at least two numbers (one each at two different installations) of 1.6MVA, 6.6KV or higher rating oil filled transformers which should have been in successful operation for a period of at least two years. **Note: Two different installations means two different project sites or two different contracts.**	**Customer - 1**	
		PO copy	
		Transformer rating/Type	
		Customer feedback Copy	
		Customer - 2	
		PO copy	
		Transformer rating/Type	
		Customer feedback Copy	
		Any Other POs and supporting documents	
5.1.2 a)	Bidder should have his own facilities for conducting all routine tests as IS:2026.	YES/NO	
5.1.2 b)	Bidder should have his own facilities for conducting all type tests as per IS:2026 (except short circuit test). In case of non-availability of in-house test facility for conducting type tests, the same type tests to be conducted at third party labs i.e. CPRI / ERDA.	YES/NO	
5.1.3	1.6MVA, 6.6KV class or higher rated oil filled transformers manufactured by Bidder should have been successfully short circuit tested.	Test Report copy to be enclosed	

NOTE:

1) Subvendor to use their own performa for giving details of all routine and type test facilities available with them.

2) Sub-vendor may provide any additional information regarding short circuit test on transformers and enclose the same.

3) If needed Sub-vendor may use own performa for giving necessary details regarding short circuit test conducted on transformers and enclose the same.

Date :

Place :

(Signature).....

(Printed Name).....

(Designation).....

(Common seal).....

3X800MW PVUNL PATRATU TPP PHASE-I

PVC FOR OIL FILLED TRANSFORMERS

The prices are variable as per variable as per IEEMA price variation formula as given below with base month one month prior to the date of tendering with ceiling limit of 20% on positive side and there is no limit on negative side.

Price variation formula for copper wound service (for Single & Three Phase of ratings up to 2500 KVA and voltage up to 33 KV)

$$P = \frac{P_0}{100}\left\{7 + 41\frac{C}{C_0} + 23\frac{ES}{ES_0} + 10\frac{IS}{IS_0} + 5\frac{IM}{IM_0} + 8\frac{TO}{TO_0} + 6\frac{W}{W_0}\right\}$$

Wherein,

P = Price payable as adjusted in accordance with the above formula.

P_0 = Price quoted/confirmed.

C_0 = Price of CC copper rods
This price is as applicable for the month, **ONE** month prior to the date of tendering.

ES_0 = Price of CRGO Electrical Steel Lamination
This price is as applicable for the month, **ONE** month prior to the date of tendering.

IS_0 = Price of HR Coil of 3.15 mm thickness
This price is as applicable for the month, **ONE** month prior to the date of tendering.

IM_0 = The average price of Insulting materials (in Rs./Kg) of pre-compressed pressboards of size 3 mm and 10 mm thick, 3200 mm x 4100 mm C&F price in free currency per MT converted into Indian Rupees
This price is as applicable for the month, **ONE** month prior to the date of tendering.

TO_0 = Price of Transformer Oil
This price is as applicable for the month, **ONE** month prior to the date of tendering.

W_0 = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt. of India (Base: 2016 = 100)
This index number is as applicable for the month, **THREE** months prior to the date of tendering.

For example, if date of tendering falls in December 2021, applicable prices of Copper (C_0), Transformer Oil (TO_0), CRGO Steel Sheets (ES_0), MS Plate (IS_0) and Insulating material (IM_0) should be as on 1st November 2021 and all India average consumer price index no. (W_0) should be for the month of September 2021.

Price variation formula for copper wound service transformers (for Single & Three Phase of ratings above 2500 KVA up to 10 MVA and voltage up to 33 KV)

$$P = \frac{P_0}{100}\left\{8 + 40\,\frac{C}{C_0} + 24\,\frac{ES}{ES_0} + 8\,\frac{IS}{IS_0} + 4\,\frac{IM}{IM_0} + 8\,\frac{TO}{TO_0} + 8\,\frac{W}{W_0}\right\}$$

Wherein,

P = Price payable as adjusted in accordance with the above formula.

P_0 = Price quoted/confirmed.

C_0 = Price of CC copper rods
This price is as applicable for the month, **ONE** month prior to the date of tendering.

ES_o = Price of CRGO Electrical Steel Lamination
This price is as applicable for the month, **ONE** month prior to the date of tendering.

IS_o = Price of MS Plate of 6 mm thickness
This price is as applicable for the month, **ONE** month prior to the date of tendering.

IM_0 = The average price of Insulting materials (in Rs./Kg) of pre-compressed pressboards of size 3 mm and 10 mm thick, 3200 mm x 4100 mm C&F price in free currency per MT converted into Indian Rupees
This price is as applicable for the month, **ONE** month prior to the date of tendering.

TO_0 = Price of Transformer Oil
This price is as applicable for the month, **ONE** month prior to the date of tendering.

W_0 = All India average consumer price index number for industrial workers, as published by the Labour Bureau, Ministry of Labour, Govt. of India (Base: 2016 = 100)
This index number is as applicable for the month, **THREE** months prior to the date of tendering.

For example, if date of tendering falls in December 2021, applicable prices of Copper (C_0), Transformer Oil (TO_0), CRGO Steel Sheets (ES_0), MS Plate (IS_0) and Insulating material (IM_0) should be as on 1st November 2021 and all India average consumer price index no. (W_0) should be for the month of September 2021.

The period / month of the applicability of the PVC clause shall be as per IEEMA Circular No. 140/PVC/ DT_PT/05 dt. 10/11/2021. Also, PVC shall be applicable within the contractual delivery period (including any delivery extension thereto).

RAMAGUNDAM SUPER THERMAL POWER STATION STAGE-1 (3x200MW)

SUPPLY & SERVICES OF OIL FILLED AUXILIARY SERVICE TRANSFORMER - UNPRICE BID

Date: 22.09.2023

ITEM :	**SUPPLY & SERVICES OF OIL FILLED AUXILIARY SERVICE TRANSFORMER**
PROJECT:	**RAMAGUNDAM SUPER THERMAL POWER STATION STAGE-1 (3x200MW)**

S. NO.	DESCRIPTION	UOM	QTY	Unit	Qty.(A)	Unit price (inclusive of packing & forwarding charges,freight & GST) (B)	Total Ex works price (inclusive of packing & forwarding charges, freight & GST) (C=A*B)
1	1600kVA, 6.6KV/0.433KV, 3 phase, 2 winding, outdoor, ONAN, Z=8%, Dyn11, 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)	NO.	2	**Quoted**	**Quoted**	**Quoted**	**Quoted**
2	EXTRA OIL (10%) IN SEALED NON RETURNABLE STANDARD DRUMS for 1600KVA Transformer	NO.	2	**Quoted**	**Quoted**	**Quoted**	**Quoted**
3	TANK PRESSURE TEST	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
4	TANK VACUUM TEST	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
5	MEASUREMENT OF ACOUSTIC NOISE LEVEL AS PER NEMA TR-1 (SPECIAL TEST)	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
6	TEMPERATURE RISE TEST AT A TAP CORRESPONDING TO MAXIMUM LOSSES. (DGA 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).	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
7	LIGHTNING IMPULSE (FULL & CHOPPED WAVE) TEST ON WINDINGS (AS PER IEC 60076-3)	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
8	Mandatory Spare - HV bushing	Nos	3	**Quoted**	**Quoted**	**Quoted**	**Quoted**
9	Mandatory Spare - LV bushing	Nos	3	**Quoted**	**Quoted**	**Quoted**	**Quoted**
10	Mandatory Spare - Neutral bushing	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
11	Mandatory Spare - Winding Temperature indicator with alarm and trip contacts	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
12	Mandatory Spare - Oil Temperature indicator	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
13	Mandatory Spare - Pressure relief device	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
14	Mandatory Spare - Buchholz Relay.	Set	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
15	Mandatory Spare - Complete set of Valves (1 Nos of Each Size as applicable)	Set	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
16	Mandatory Spare - Complete set of gaskets (1 Nos of Each size as applicable)	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
17	Mandatory Spare - Magnetic Oil Level Gauge	No	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
18	Mandatory Spare - Diaphragm for explosion vent	Set	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
19	Mandatory Spare - Floats with contacts for Buchholz relay	Set	1	**Quoted**	**Quoted**	**Quoted**	**Quoted**
20	Supervision of Erection and Commissioning	Man-days	4	**Quoted**	**Quoted**	**Quoted**	**Quoted**
				GRAND TOTAL (In Rs.)			**Quoted**

Note:

1	Transit Insurance is in BHEL Scope . Prior Dispatch intimation shall be issued to Insurance agency about the value of consignment, dispatch details, along with one set of documents consisting of LR / RR copy, Packing List, Challan indicating the items dispatched (with their weights). A copy of above should be sent to the following : a) BHEL. Site office (Address same as Consignee address) b) Sh. D K Basha, Dy. Engineer, BHEL-ISG, Prof CNR Rao Circle, IISc Post, Malleswaram, Bangalore- 560 012
2	Bidder to note that the cost of transformer shall include the cost of routine tests and shall be carried out on all transformers without any additional cost. Bidder shall quote accordingly.
3	Charges for all type/ special tests except short circuit test shall be considered for price comparisons purpose.
4	Bidder shall supply 10% extra oil as per the quoted price. Quantity of extra oil shall be subject to approval during detail engineering.
5	In case any of the type/ special tests are required to be repeated, the same shall be carried out by the vendor without any commercial / delivery implication to bhel.
6	Pvc shall be applicable for this enquiry as per ieema circular (enclosed) with upper ceiling limit of 20% & no negative ceiling limit. Price variation is not applicable for extra oil, mandatory spares & type test.
7	In case type/ special tests are waived, the type/ special test charges shall not be payable to the bidder

8	1 set consists of gaskets required for 1 No. transformer for the following (a) protection and monitoring devices (b) cooler circuit, if applicable (c) largest inspection cover, if applicable(d) HV/LV turret, if applicable (e) OCTC inspection cover, if applicable