



POWER DEVELOPMENT DEPARTMENT

TENDER SPECIFICATION NO: SEPD/NIT- 202/2011

PART - I (SECTION - 1 & II)

GENERAL TERMS AND CONDITIONS

AND

PART- II (SECTION- 1 & II)

TECHNICAL SPECIFICATIONS

OF

160 MVA, 220/132/11 KV, 3-PHASE AUTO TRANSFORMER

FOR UDHAMPUR and BARN GRID STATIONS

OF JAMMU PROVINCE

IN JAMMU & KASHMIR STATE

2011

Tenders to be submitted to:
The Chief Engineer,
Planning & Design Wing,
Grid Station Premises, Gladni,
Narwal- Bala, Jammu.-180006

Correspondence Address :
Superintending Engineer,
Elect. Planning & Design Circle,
220 KV Grid Station Premises,
Gladni, Narwal- Bala, Jammu- 180006

**Office of the Superintending Engineer, Electric Planning & Design Circle PDD, 220 KV Grid
Station Premises, Gladni Narwal Bala Grid Station Complex, Jammu.**

To

M/s _____

No. SEP/J/NIT-202/2011.

**Sub:- Procurement, of 3 Nos. 160 MVA,220/132/11 KV, 3-Phase Auto Transformers with
OLTC required for various Grid Stations in Jammu Province. Tender specification
No: SEP/J/NIT-202/2011.**

Ref:- Your letter No.

Dated:

Dear Sir,

As desired vide your letter referred above, please find enclosed the requisite tender documents for NIT specification No. SEP/J/NIT-202/2011 comprising of two parts as under:-

- a) General Terms & conditions, Part-I (Section-I&II).
- b) Technical specifications of 160 MVA,220/132/11 KV, 3-Phase Auto Transformers required for Udhampur /Barn Grid station in Jammu Province Part-II (Section-I & II).

The tender duly completed in all respects should reach the office of the Chief Engineer, Elect. Planning & Design Wing, 220 KV Grid Station premises Gladni Narwal Bala Jammu (J&K State)- 180006 on or before_____upto_____hrs. which shall be opened on the same day or any other convenient working day at____hrs.

Yours sincerely,

**Superintending Engineer,
Elect. Planning & Design Circle,
Jammu.**

Copy to :-1.The chief Engineer, Planning & Design Wing, Jammu PDD 220 KV Grid Station premises Gladni, Narwal- Bala, Jammu for information.

2. Executive Engineer, Elect. Planning & Design Div-III, Jammu for information

PART- 1
SECTION-1

I N D E X
PART – I **SECTION – I**

CLAUSE No.	DESCRIPTION	PAGE NO.
1.1	INVITATION	2
1.2	GENERAL CONDITIONS	2
1.3	PREPARATION OF TENDER	6
1.4	SCOPE	6
1.5	RAW MATERIAL	6
1.6	EARNEST MONEY	6
1.7	PLACE OF MANUFACTURE & INSPECTION	7
1.8	PRICES	8
1.9	VALIDITY	8
1.10	DELIVERY	9
1.11	DAMAGES FOR DELAY OR NEGLIGENCE IN EXECUTION OF ORDERS	9
1.12	TERMS OF PAYMENT	10
1.13	WARRANTY	10
1.14	INSURANCE	11
1.15	INTIMATION TO CHIEF ENGINEER, P&D, POWER DEVELOPMENT DEPARTMENT AND CONSIGNEE	12
1.16	CENTRAL SALES TAX/VALUE ADDED	12

	TAX/ENTRY TAX & EXCISE DUTY	
1.17	CHARGES	14
1.18	PACKING	14
1.19	SPECIAL INSTRUCTIONS	14
1.20	INTERCHANGEABILITY	16
1.21	CANCELLATION	16
1.22	DESPATCH INSTRUCTIONS	16
1.23	ADDITIONAL QUANTITIES	16
1.24	CIVIL SUIT/LEGAL REMEDY	16
1.25	ARBITRATION	16
1.26	EXECUTION OF CONTRACT	17
1.27	VARIATIONS	17

Part-1

GENERAL TERMS AND CONDITIONS

OF

TENDER SPECIFICATION NO. SEPD/NIT-202/2011

FOR

160 MVA, 220/132/11 KV, 3-PHASE AUTO TRANSFORMER

FOR

UDHAMPUR AND BARN GRID STATIONS

OF

JAMMU PROVINCE

IN

JAMMU AND KASHMIR STATE.

SECTION - I

GENERAL TERMS AND CONDITIONS

1.1 INVITATION:

The Superintending Engineer, Electrical Planning and Designs Circle, Power Development Department, 220 KV Grid complex Gladni , Narwal-Bala Jammu-180006, on behalf of the Governor of Jammu & Kashmir State, hereby invites sealed tenders for the supply of **160 MVA,220/132/11 KV, 3-Phase Auto Transformer with OLTC** as indicated in SCHEDULE of SPECIFICATION AND REQUIREMENTS viz. Annexure III&IV. (Part-II, Section II). The purchaser reserves the right to modify the schedule of requirement, technical particulars and specifications at any time and then place orders as whole or in part and to reject any or all tendered received without assigning any reason whatsoever.

The tender document can be downloaded from the Website www.panddpddjk.in Such tenders will enclose a DD of Rs.5000/- only towards the cost of tender pledged to The Chief Engineer, Electric Planning and Design Wing Jammu with their bids.

1.2 GENERAL CONDITIONS:

The tender should be submitted in triplicate. Each copy should be separately tagged and clearly marked as **ORIGINAL, DUPLICATE** and **TRIPLICATE**. The tenders should be submitted in double sealed covers, both addressed to the Chief Engineer, Electric Planning and Design, Jammu (J&K) and sent either under registered cover or deposited in the office of Chief Engineer,

3.

Electric Planning and Design Wing, 220 KV Grid Station Premises Gladni, Narwal-Bala, Jammu-180006, on or before _____ Upto _____ hrs. Both inner and outer covers should be sealed and super scribed as **“TENDER FOR 160 MVA,220/132/11KV, 3-Phase Auto Transformers AGAINST NIT No. 202/2011 Due on_____”** The tender should also invariably contain the name of the bidder firm. The tenders should be prepared in 2 separate parts, marked Part-I and Part-II, and submitted in separate sealed covers. Part-I of the tender shall be super scribed **"QUALIFICATION FOR NIT NO: 202/2011** and shall contain **Earnest Money**, list of **past supplies** and **past performance** duly supported by necessary documents, year wise **Turn Over**, **Income Tax Clearance Certificate**, **Guaranteed Technical Particulars**, technical details, authenticated Photostat copies of **Test Certificate of similar/ higher ratings** from Govt. approved test houses/laboratories, **Catalogues / Drawings**, **Registration Certificate / Industrial License**, **Check List** to ensure supply of essential information and such information as enumerated below:-

- 1.2.1 (a) Earnest money for an amount of Rs.45.00Lacs shall be paid by the tenderer in the form of CDR/BG pledged to the Chief Engineer, Elect. Planning and Design Wing, Jammu. Photocopies of the CDR/BG shall also be enclosed with duplicate and Triplicate copies.
- (b) The local units registered with the Industries Department, Jammu and Kashmir State shall pay earnest money as per directives issued by the State Government from time to time.
- 1.2.2(a) **List of orders** for similar items (Equipment having same or higher capacity) received and executed in the last three years giving reference to the orders, status of supplies etc.

Note:- Photocopies of last three Purchase Orders executed (of State Electricity Boards/Govt. Deptt.) are required to be enclosed with the offer.

- (b) Attested photocopies of the valid **Type Test Certificates** from Govt. approved Test Houses/ Laboratories in respect of Equipment of **similar ratings** or **of higher ratings of the same Voltage level**, failing which the bid shall not be evaluated. In case of bids accompanied with valid type tests certificates of higher ratings, the tenderer will have to get the **Type Tests conducted** for the similar rating equipment if the order is placed with the firm and if the test charges are not quoted by the firm the highest rates quoted by any of the qualifying bidders shall be loaded for purpose of comparison.
- 1.2.3 **Performance Certificates of similar or higher rated equipment** from SEBs/Government Departments etc. for proving past performance, for a period of minimum 3 years duly supported by documents.
- 1.2.4 (a) Year wise **Capital Turn Over** of the tenderers for the last three years
 (b) Income Tax clearance certificate.
- 1.2.5 **Guaranteed Technical Particulars** for the items quoted.
- 1.2.6 (a) No deviations in general /commercial terms and condition shall be acceptable .
 NIT condition shall be binding.
- 1.2.6 (b) No Technical deviations shall be accepted until and unless it has been properly reflected in the Schedule – C (i.e. Schedule of Deviations)
- (c) Tenderer will have to quote for the full quantity of the NIT. Any offer quoting for lesser quantity is liable to be rejected.
- 1.2.7 Part-II of the tenders shall be super scribed "**PRICE BID AGAINST NIT NO: 202/2011 FOR 160 MVA,220/132/11 KV, 3-Phase Auto Transformers**". This shall contain price quoted, delivery period, terms of payments, legal/ General Terms and other Conditions. The rates should be offered upto site i.e. Barn/ Udhampur Grid stations . However, break up of the same shall be given as (a) Ex-Works cost (b) Excise Duty.

- (c) CST (Without Form-C/D) (d) Freight & Insurance (e) Local Taxes (Entry Tax & Toll Tax) and charges on a/c various tests.
- 1.2.8 On the due date of opening of the tenders, only the part-I i.e. Qualification bid will be opened. The date of opening of part-II (i.e. price bid) shall be intimated only to those bidders whose part-I of the tender is found to be meeting with the technical part of the specifications. In case due date happens to be a holiday, the tender will be accepted and opened on the next working day or any other date convenient to the tender opening committee.
- 1.2.9 In case, it is not convenient/possible to open price bids on due date, the price bids will be opened on any other subsequent convenient day .In the later case the tenderer who qualify for opening of the price bids shall be intimated about the date of opening of these price bids.
- 1.2.10 Any tender not sent in separate and sealed covers as stipulated above shall not be entertained and is liable to be rejected/returned. Any tender not complying with aforesaid stipulations in Part-I and Part-II is liable to be rejected.
- 1.2.11 Any tender received by hand or by post after the due date of receipt of the tenders shall not be entertained even if the tender has been posted from the sending end before the due date of the opening.
- 1.2.12 The tender must be complete in all respects. The subsequent Clauses shall be carefully studied for the sake of submitting a complete and comprehensive tender. Failure to comply with any of these instructions or the offer with insufficient particulars, which is likely to complicate the fair comparison of the tender, shall not be considered. Any telegraphic offer, not followed by confirmation before the due date will not be considered. Tenders will be accepted from the tenderers who have either purchased the Tender document from the office of the Superintending Engineer , against payment of Rs. 5,000.00 or has downloaded from the website & has enclosed the D.D of Rs. 5,000.00 with the offer.

1.2.13 In the price bid, the tenderer shall clearly indicate the break-up of their quoted rates/prices i.e. ex-works rate, element of duties and taxes, packing and forwarding charges, transit insurance, freight ,test charges etc. However, the prices offered shall be Ex-destination basis. It shall be the responsibility of the contractor to deliver the goods/equipment at Ex-destination in good condition.

1.3 PREPARATION OF TENDER:

The tender shall be prepared in a formal manner with all quotations stated both in words and figures. There shall be no cuttings. Corrections, if any, such as totalling etc. should be neatly done and signed. A systematic form of totalling should be adopted to avoid any ambiguity with detailed description of the equipment offered.

1.4 SCOPE:

The specifications cover the design, manufacture testing, supply delivery of 3 Nos. **160MVA, 220/132/11 KV, 3-Phase Auto Transformers** and its erection, testing and commissioning shall be executed at site by the Department/Bidder as listed in schedule of requirements (Annexure IV). The successful tenderer, on whom order is placed for supply of equipment, shall be responsible for supervision of testing and commissioning of equipment ordered if required at site if purchaser so desires, for which tenderer should quote charges separately.

1.5 RAW MATERIAL:

All the raw material to be used in the manufacture of the goods /equipment to be supplied against the purchase order shall be of the best quality of its kind obtained from the market. The supplier shall be solely responsible for procurement of raw material required for this purpose.

1.6 EARNEST MONEY/SECURITY DEPOSIT:

1.6.1 Tenders shall be accompanied along with the earnest money in the form of CDR/Bank guarantee pledged to Chief Engineer, Electric Planning & Designs Wing, Jammu for an amount of Rs.45.00Lacs valid for one year from the date of opening of price bids.

- 1.6.2 Tenders not accompanied by the correct amount of earnest money shall be rejected and their price bid is liable to be ignored.
- 1.6.3 In case of successful tenderers, the amount of earnest money will be treated as part of security deposit. The actual amount of security deposit to be obtained will be subject to a minimum of 5% of the value of contract.
- 1.6.4 The successful tenderer, whenever it happens to be a private person or firm, has to furnish security deposit @ 5 % of the value of the order as the case may be. The Earnest money will be adjusted towards security deposit in the case of successful tenderer for faithful execution of the contract.
- 1.6.5 The earnest money will be forfeited in case of withdrawal/ revision of prices of their offer within the validity of the tender.
- 1.6.6 In case of the unsuccessful tenderers, the earnest money shall be refunded within 60 days from the issue of the purchase order to the successful tenderer.
- 1.6.7 Security deposit shall be released in favour of successful tenderer after obtaining report with regard to successful execution of the contract from the consignee.

1.7 PLACE OF MANUFACTURE AND INSPECTION:

The tenderer shall state in his tender the make, the place of manufacturer, testing and inspection of the equipment offered in the tender. The purchaser or his duly authorized engineer shall have access to tenderer's works at any time during working hours for the purpose of inspecting the manufacture and testing of material and complete equipment and the tenderer shall provide the necessary facilities for inspection. For any particular inspection, at least three weeks advance notice shall be given. No material shall be despatched without prior inspection and approval of test certificate by the purchaser or its authorized Inspection Agency unless otherwise directed. However the department reserves the right to get the material/equipment inspected through CPRI.

1.8 PRICES:

- 1.8.1 The Prices shall be variable with the base date of one month prior to date of opening clear cut Formula for working out variations along with value of all parameters must be indicated. The ceiling for price variation must also be stated which will be taken into account while comparing the offers. Price variation would be applicable both on positive as well as negative side. The basic cost of raw materials on which the quoted prices are based must also be indicated.
- 1.8.2 The prices shall be quoted upto site i.e. Udhampur/Barn Grid stations which will form the basis of the contract. It shall be the responsibility of the contractor to deliver the goods /equipment at site in good condition. Besides, the Ex-works price, duties and taxes applicable, shall also be mentioned in order to compute the Excise Duty and CST component etc. indicating clearly the rates applicable/chargeable. Any ambiguity in this regard shall be dealt in accordance with the departmental practice.
- 1.8.3 The rates quoted should be both in figures and words. No extra payment, unless otherwise specified, will be made for packing, carriage, handling and transportation of material.

1.9 VALIDITY/ EXTENSION OF VALIDITY AND CLARIFICATIONS:

- 1.9.1 The tender should be unconditionally valid for a period of 365 days from the date of opening of the tenders. Any tenderer revising the offer within the validity period is likely to be black listed.
- 1.9.2 Bidder shall not be requested or permitted to alter their bids after the deadline of receipt of bids/ tenders. The purchaser shall ask the bidders for clarification needed to evaluate their bids but shall not ask or permit the bidders to change the substance or price of their bids after the bid opening. Requests for clarification and the bidder's response shall be made in writing.

1.9.3 EXTENSION OF VALIDITY OF BIDS:

Purchaser shall complete evaluation of bids and award of contracts within the initial period of bid validity so that extensions are not necessary. Any extension of bid validity if required shall be requested from all the bidders in writing. Bidder shall have the right to refuse to grant such an extension without forfeiting their bid security, but those who are willing to extend the validity of their bids, shall be required to provide a suitable extension of bid security.

1.9.4 Any party who makes post tender developments directly or indirectly may be blacklisted for a period of three (3) years.

1.10 DELIVERY :

The delivery of equipment/material, unless otherwise specified in Annexure IV i.e. Schedule of Requirements, may be required to commence within 6 months from the issue of the purchase order and completed within 3 months thereafter.

1.11 DAMAGES FOR DELAY FOR NEGLIGENCE IN EXECUTION OF ORDERS:

1.11.1 For supplies with respect to delivery schedule stipulated above, a penalty @ ½% (Half percent) of the cost of the undelivered portion per week of the period of delay subject to a maximum of 5% cost of undelivered equipment as damages will be leviable. However, in case of part of equipment supplied within the delivery period but which can not be commissioned due to the late delivery of portion of such equipment, the damages will be recovered at the rate of ½% per week of the period of delay, subject to a maximum of 5% of the total contract price as damages.

1.11.2 In case the supplier fails to rectify/ replace the defective/ damaged material (including transit damages / shortages) supplied by them within one month from the date of intimation of such shortages/damages, a penalty of ½% per week, subject to a maximum of 5% the cost of equipment that could not be commissioned due to failure of the firm to rectify/ replace the

defective/damaged material.

- 1.11.3 In case of failure to deliver, in full or part of the equipment within delivery period, purchaser will have the right to make a risk purchase at the cost of supplier or cancel the contract and claim reasonable compensation /damages.

1.12 TERMS OF PAYMENT:

- 1.12.1 Unless otherwise provided, 90% payment with taxes and duties shall be made against receipt and verification of material along with despatched documents at consignees site after material is despatched by road transport after satisfactory inspection and 10% after successful commissioning of the equipment at site.
- 1.12.2 Advance payment clause is not accepted since it requires Govt. sanction which is time consuming process. Advance payment clause shall alter evaluation of bid as per standard practice of the department.
- 1.12.3 Payment against letter of credit is not acceptable since it requires Govt. sanction which besides time consuming is normally denied.

1.13 WARRANTY:

- 1.13.1 The supplier shall be responsible to replace free of cost along with the transportation and insurance expenses to the purchaser up to the destination, the material specified in the schedule of requirements, the whole or any part of the material which under normal, proper use and maintenance prove defective due to design or manufacturing defects or bad workmanship within 12 months from the

date of commissioning or 18 months from the date of despatch, which ever expires earlier provided the consignee gives prompt notice of such defects to the supplier. Such replacement shall be the supplier's responsibility. Supplier's responsibility arising out of supplying of materials or its use within warranty period or otherwise, shall not in any case exceed the cost of correcting the defects or replacing the defective equipment within or even beyond the expiry of the period mentioned above. The firm shall have to furnish performance guarantee value @ 5% of the purchase order.

- 1.13.2 The above provisions shall also apply to the material replaced/repaid by the supplier under this clause in case the same is again found to be defective within 12 months from its replacement/repairs.

1.14. INSURANCE:

- 1.14.1. The rates are required to be quoted on FOR Destination basis. It is the responsibility of the supplier to deliver the goods in sound condition at the destination. For this purpose, the supplier shall insure the material against all risks during transit for full delivered value of the material up to destination. All formalities in connection with making/settling of claims, with railways / Roadways and Insurance Company, shall be carried out by the supplier. Necessary information required in connection with making/settling such claims, shall be provided by the consignee. All damages and/or shortage during transit as covered by the insurance shall be made good immediately on receipt of such information from consignee without waiting for settlement of the claims. However, in case of apparent damages and/or shortage, the consignee shall obtain the loss/damage certificate from the Railway / Transport authorities and send the same to the supplier within a period of 30 days from the date of receipt of material. A certificate shall be submitted by the supplier with each consignment to

this effect that the material has been duly insured.

- 1.14.2 The consignee shall report losses and damages to the firm within 30 days of the arrival of the equipment at site. It will however, be the suppliers responsibility to refer timely claims on the insurance underwriters and to arrange replacement thereof to the consignee within 30 days without waiting for settlement of claims with underwriters etc.

1.15. INTIMATION TO CHIEF ENGINEER, PLG. & DESIGNS POWER DEVELOPMENT DEPARTMENT AND CONSIGNEE.

- 1.15.1 The supplier will have to intimate the probable date of despatch followed by telegraphic/Fax intimation regarding the actual date of despatch to the Consignee to enable him to arrange payment, failing which demurrage, wharf age etc. will be to suppliers account. A copy each of such intimation should also be sent to Chief Engineer, Planning & Designs Power Development Department, Jammu and Chief Engineer of concerned System and Operation Wing, for ready reference simultaneously.

1.16 CENTRAL SALES TAX/ VALUE ADDED TAX/ ENTRY TAX AND EXISE DUTY:

- 1.16.1 The material on order is required for use in transmission/ distribution of electrical energy to public.

Local Taxes i.e. Value Added Tax /Entry Tax, as applicable, shall be levied on the goods/equipment.

1.16.2 CENTRAL SALES TAX.

FORM-C/D shall not be furnished by the Deptt. CST is required to be quoted accordingly And When the CST is to be paid by the supplier, the same shall be paid by the consignee subject to the submission of the following certificate:

- A. Certified that the transaction on which tax has been claimed, has been/ will be included in the return submitted/to be submitted to the Sale Tax Authorities for the assessment of the sales tax and the amount claimed from the Power Development Department has been/shall be paid to the Sales Tax Authorities.
 - B. Certified that the goods on which sales tax has been charged have not been exempted under Central Sales Tax Act, as per provisions of the rules made there under, and the charges on account of the sales tax of these goods are correct under the provision of the relevant Act or rules made there under.
 - C. Certified that we shall indemnify the Power Development Department in case it is found at a later stage that wrong or incorrect payment has been made on account of the sales tax paid by us.
 - D. Certified that the payment has been made under protest. The bills for the sales tax and insurance charges, if any, shall be submitted separately.
 - E. The Power Development Department being a department of the J&K Government, as such, CST shall be payable extra without furnishing any declaration form.
- 1.16.3 The tenderer shall reflect ED & CST as actually applicable/ chargeable at the time of tendering and shall furnish proof (Certificate from the Superintendent, Excise duty, concerned range) for confirming ED / CST rates quoted.
- 1.16.4 For evaluation of bids for comparison, the ED / CST component shall be worked out on the basis of quoted rates only in case it is well evidenced, otherwise it shall be worked out as per maximum ED / CST rates received against the tender notification.
- 1.16.5 For actual payment of ED/ CST, the quoted rates shall be the basis, if the rates prevalent / ruling at the time of valid actual delivery are at par or higher than the quoted rates. However, in case the ruling rates of ED / CST at the time of valid actual delivery are lower than the quoted rates,

then the ruling rates shall be the basis of actual payment of ED / CST.

1.16.6 The documentary evidence in respect of ED / CST actually paid at the time of actual delivery shall be furnished by the tenderer as a proof thereof.

1.16.7 The supplier shall pay service tax as applicable for the services rendered and charged by him

1.17 CHARGES:

No variation or modification or waiver of any of the terms and provision hereafter shall be deemed valid unless mutually agreed upon by purchaser and the supplier in writing.

1.18 PACKING:

All material shall be suitably packed and despatched, and shall be conforming to the relevant ISS, railway / highway rules, and transported direct to site and the supplier shall be responsible for all damages/losses due to improper packing. All crates shall be marked with proper signs indicating up and down side of the crates and also unpacking instructions considered necessary by the supplier. The contents of crates shall have place marks corresponding to the number in the packing list to enable easy identification. The quoted prices shall be deemed to include the cost of packing.

1.19 SPECIAL INSTRUCTIONS:

- a. Tenders not submitted on the lines indicated above are liable to be rejected without correspondence.
- b. Requests for extending the above mentioned due date of receipt of tenders is likely to be ignored.
- c. Tender will be entertained from manufacturers of equipment or their authorized agents who should send their offers, certificates issued to them by their principals appointing them as their authorized agents.
- d. No printed general conditions of sales attached with the

tender shall be accepted. Any technical deviation from the clauses in the tender specification must be clearly reflected in the Schedule of deviations viz Schedule C, otherwise it shall be deemed that offer is in line with the requirement of specifications.

- e. The tenderer will submit with the offer, the performance report for a period of minimum 3 years issued by the Electricity Boards/Government Departments in respect of equipment of similar specification supplied under different purchase orders executed earlier by the tenderer/manufacturer.
- f. Tenderer will quote for the full quantity of the NIT. Any offer quoting for the part quantity is liable to be rejected.
- g. The tender should be accompanied by a reference list of purchase orders received/executed by the tenderer for similar equipment of same specification as indicated in NIT in the following Performa:

Designation and Purchase order Full particulars No. & date Of the purchaser	Quantity and brief description of equipment
1	2
3	
Status of supplies	Performance remarks
4.	5.

- h. Services of Erection Engineers:- The tenderer shall state the rates and the testing charges for the services of suitable erection engineer for installation, testing and commissioning of the equipment is transformer, OLTC and accessories.
- i. Tools:- The transformer shall be supplied with one complete set of all special tools as may be required to de-assemble and re-assemble the equipment.

1.20 INTERCHANGEABILITY:

Corresponding parts of similar items shall be interchangeable in every respect.

1.21 CANCELLATION:

The purchaser reserves the right to cancel the purchase order in case of default on the part of the supplier and also prior to receipt of intimation regarding taking in hand of the manufacture of material against the purchase order.

1.22 DESPATCH INSTRUCTIONS:

The equipment/material shall be despatched to Jammu/ Srinagar duly consigned to the consignee to whom R/R and other despatched documents are to be sent through J&K Bank Limited. All bank charges for negotiation of RR etc. shall be to the suppliers account. A telegraphic /Fax information shall have to be sent to the consignee to retire

the documents without delay and make further arrangements for proper despatched. It is to be noted that no RR shall be accepted or acknowledged without being preceded by a Performa invoice along with test certificate well in to advance, ensure the consignee to check that bill/s have been raised as per terms of the order and that the equipment/material has been duly tested

1.23 ADDITIONAL QUANTITY:

The purchaser reserves the right to order additional equipment as specified up to 50% of the ordered quantities at the same rate and conditions any time during the pendency of the contract.

1.24 CIVIL SUIT/LEGAL REMEDY:

All legal proceedings in connection with the order will be subject to the jurisdiction of local courts of Jammu & Kashmir.

1.25 ARBITRATION:

In case of any doubt, dispute or difference arising out of the purchase order, the case shall be referred to the State Government for decision under J&K State Arbitration Act only.

1.26 EXECUTION OF CONTRACT:

It will be obligatory on the part of the successful tenderer to execute a legal contract/agreement with the purchaser on stamped paper immediately after the issue of the purchase order. Sufficient number of extra copies of the contract and specifications shall be supplied, the cost of which shall be deemed to have been included in the tender prices.

1.27 VARIATIONS:

The tenderer should specify the limits of variation that are likely to occur in various parameters of the equipment/material at the stage of quotation and that of supply. In other words, indication of variation at tendering stage and detailed designing stage be clearly brought out. Any variation beyond the tolerance of relevant Indian Standards shall not be accepted. Where such parameters are not covered by ISS, the variation shall be restricted to that mutually agreed upon.

J.E**Asstt. Ex. Engineer****T.O****Executive Engineer****Superintending Engineer**

PART I

SECTION-II

PART – I SECTION – II

19.

Clause No.	DESCRIPTION	PAGE NO.
2.1	SCOPE	21
2.2	LOCATION /QUANTITY REQUIRED	21
2.3	COMMUNICATION AND TRANSPORT	21
2.4	DELIVERY AND THE COMPLETION PERIOD	21
2.5	QUANTITIES	22
2.6	COMPLETENESS OF THE TENDER	22
2.7	EXTRAS	22
2.8	SPARES	22
2.9	PRICES	23
2.10	STANDARDS	23
2.11	MAKER'S STANDARDS AND DEPARTURE FROM SPECIFICATIONS	23
2.12	INTERCHANGEABILITY	24
2.13	MATERIALS AND WORKMANSHIP	24
2.14	FAILURE TO MEET WITH GUARANTEE AND REQUIREMENTS OF THE SPECIFICATIONS	25
2.15	INSPECTION AND TESTING	25
2.16	INSTRUCTION BOOKS/ MANUALS AND SPARE PARTS	27
2.17	DRAWINGS	27

2.18	NOTICE TO CONTRACTOR	28
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2.19	FINANCIAL RESOURCES AND EXPERIENCE	29
2.20	PATENT RIGHT	29
2.21	RESPONSIBILITY FOR OBTAINING INFORMATION AND TAKING ACTION IN TIME	30
2.22	PACKING AND MARKING	30
2.23	CONDITIONS OF CONTRACT	31
2.24	INSTRUCTIONS TO THE TENDERERS	31
2.25	CLIMATIC CONDITIONS	31

SECTION – II

SUPPLEMENTARY CONDITIONS OF TENDERS

(TO BE READ ALONG WITH SECTION-I)

2.1 SCOPE:

This section of the specification deals with supplementary conditions of contract in addition to those stipulated in Section-I. Detailed specification and particulars of equipment are given in the subsequent Section-II (Part-II) and these sections shall be deemed to form part of the detailed specification for the equipment. The tenderers may also note that certain other conditions have been stipulated under this section dealing with technical specifications. The offer, therefore, should satisfy these conditions also in addition to those mentioned under Section-I.

2.2 LOCATION/QUANTITY REQUIRED:

GRID STATIONS LOCATED IN JAMMU PROVINCE OF THE J&K STATE ARE AS UNDER:-

- | | |
|---|--------|
| 1. 220/132/11 KV Grid station Udampur | 2 Nos. |
| 2. 220/132/11 KV Grid station BARN(JAMMU) | 1 No. |

2.3 COMMUNICATION AND TRANSPORT:

The bridges and culverts enroute from Jammu (Railway Station) to Respective sites have a limited loading capacity and, therefore, the weight of the heaviest package shall be restricted to limit, if any, specified in Schedule-A1 (Part-II, Section-II)

2.4 DELIVERY AND THE COMPLETION PERIOD:

Early delivery of equipment may be an important consideration in the award of contract. The tenderers shall, therefore, quote shortest delivery period possible.

2.5 QUANTITIES:

The quantities of the equipment are given in Annexure-IV viz. the Schedule of Requirement in Part-II Section-II. The purchaser reserves the right to increase or decrease the final quantities at time of placing the order for which rates quoted/accepted shall be valid.

2.6 COMPLETENESS OF TENDER:

The tenders shall be complete in all respects and shall include all minor accessories not specifically mentioned in the specification schedules, but which are essential for the completeness of work. The tenderer shall also not be eligible for any extra cost in respect of such minor accessories, not specifically included in the tenderer's specification schedules.

2.7 EXTRAS:

- 2.7.1 The tenderer shall, when asked in writing by the purchaser, perform extra work and furnish extra material not covered in the specification or included in the schedule but which may form inseparable part of the work contracted for.
- 2.7.2 For such material supplied or items of work done, for which rates are not available in the contractor schedule, payment shall be made at the rates as mutually agreed upon between the purchaser and the tenderer. This shall, however, not apply to the minor accessories specified in clause 2.6 for which no extra amount is payable.

2.8 SPARES:

The tenderer shall recommend the quantity required and quote spare parts as in his opinion would be required for ten years normal working of equipment offered. He shall also quote unit rate for additional spare parts. The spare parts shall comply with requirement of specification for complete equipment. The tenderer shall be required to supply such additional quantities of spare parts as may be ordered from time to time after the expiry of the contract. In

case the tenderer contemplates to close down the manufacture of the item, he shall intimate the purchaser well in time to decide.

2.9. PRICES:

- 2.9.1 Item wise prices shall be quoted for various items of equipment as given in Schedule-C.
- 2.9.2 The tenderer shall quote prices upto destination separately for BARN(Jammu)/ Udampur which shall form the basis for the evaluation of bids and subsequently the financial comparison of bids. In this connection clause 1.8 may be referred to.

2.10 STANDARDS:

Unless otherwise specified, all material and equipments shall comply in all respects with the requirement of the latest issue of Indian Standards or International Electro Technical/ Commission Standards (IEC). If the tenderer offers equipment manufactured to standards other than those mentioned above their salient points compared to the specified standard shall be clearly brought out in the tender, making at the same time, necessary corrections for operation under the conditions specified therein. A complete set of the standard specifications adopted by the tenderer shall in that case, be supplied in English language.

2.11 MAKER'S STANDARDS AND DEPARTURE FROM SPECIFICATIONS:

- 2.11.1 The general principles on which these specifications are drawn is to permit adaptation of modern manufacturing standards and the tenderer is requested to tender for his own standard equipment as far as possible provided these comply in all respects with the conditions of the specifications given in Part-II of the NIT.

2.11.2 Should the contractor wish to depart from the provision of these specifications either on account of manufacturing practice or for any other reason, he shall specifically draw attention to the proposed point of departure in the schedule of deviations in specifications, which will enable relative merits or demerits of his proposals fully appreciated or known.

2.11.3 Any deviation in Commercial and General Terms and Conditions shall not be entertained. Except for the Technical deviations which are specifically brought out in the schedule of deviations viz Schedule-H, it shall be taken that the tender fully conforms to the requirements of the technical specification. In the event of NIT specifications and the General Terms and Conditions and tendered specifications and General Terms and Conditions are found to be at variance, the NIT specifications and General Terms/ Conditions shall be held binding.

2.11.4 Except for the Technical deviations which are specifically brought out in the Schedule-H, it shall be taken that the tender fully conforms to the requirements of these technical specifications. In the event of NIT specifications and the general terms conditions and contract specifications general terms and conditions are found to be at variance during the execution of the contract, NIT specifications and general terms conditions shall be held as binding, unless the Technical deviations have been duly approved by the purchaser.

2.12 INTERCHANGEABILITY:

All parts shall be made accurately to standard gauge wherever possible so as to facilitate replacement and repair. All corresponding parts of similar equipment including the spare parts shall be interchangeable.

2.13 MATERIALS AND WORKMANSHIP:

All materials shall be of the best class and capable of satisfactory operation when exposed to the tropical sun and other specified atmospheric conditions.

All works shall be performed and completed in a thoroughly workman like manner and shall follow the modern practice in the manufacturing and installation of equipment, notwithstanding any omissions in these specifications.

2.14 FAILURE TO MEET WITH GUARANTEE AND REQUIREMENTS OF THE SPECIFICATIONS:

2.14.1 Should the factory tests for the operation of equipment under specified service conditions, show that it does not meet with guarantees and/or requirement of the specifications, it shall be optional with the purchaser to accept or reject the equipment and direct the contractor to proceed at once to furnish such new parts as may be necessary to make it meet the guarantee and requirements.

2.14.2 If after installation, the operation of the equipment proves to be unsatisfactory to the purchaser, he shall have the right to operate it until it can be taken out of service without loss to him, for correction of defects, errors or for replacement in case of rejection.

2.15 INSPECTION AND TESTING:

2.15.1 The tenderer shall state in his tender the place of manufacturing, testing and inspection of various items of equipment included in these specifications.

2.15.2 All materials shall comply with the requirements of tests specified in the Governing standards and in addition to such other tests as are stipulated in these specifications.

2.15.3 Duplicate copies of the manufacturer's test certificate shall be submitted to the Purchaser as soon as tests are completed.

2.15.4 In addition to the aforesaid test and those included in the Contract, the purchaser reserves to himself the right of having at his expense, any inspection or test of reasonable natures carried out at materials for which price shall be quoted by the tenderer.

2.15.5 All material and requirements covered under these specification shall be submitted for inspections by the purchaser and/or authorized agent/agents

during the various stages of the manufacture. The demand for inspection shall be made in time so that inspection can be carried out according to schedule. No portion of the work shall be considered complete in accordance with the terms of the tender unless the purchaser/his authorized agents shall have certified in writing that the same has been inspected and approved by him.

2.15.6 The suppliers shall be at his own expense provide to the purchaser and/or the authorized agent/s of the purchaser all reasonable facilities and such accommodation as may be necessary for satisfying themselves that the material are being and/or have been manufactured in accordance with the requirements. The authorized agents of the purchaser shall have full and free access at any time during the execution of the contract to the contractor's works for the aforesaid purpose, and they may require the contractor to make arrangements for inspection of items at any other place specified by the agents, and if the contractor has been permitted to employ the services of sub-contractors, he shall in his contract with the sub-contractor reserve to the authorized agents of the purchaser a similar right.

2.15.7 The contractor shall provide without any extra charges all materials, tools, labour and assistance of every kind which the authorized agent of the purchaser may demand of him for any test and examination other than special or independent test which he shall require to be made in the contractor's premises and the contractors shall bear and pay all costs to attendant thereon.

2.15.8 The Bidder/ Contractor shall offer the equipment of its patent type for which all the type tests [as per relevant IS/IEC specifications] have already been got done. The equipment shall be inspected by CPRI on behalf of the Department . The inspection charges, on this account, shall be initially borne by the contractor in the first instance which shall be reimbursed to the contractor as per actual against documentary evidence when the same is billed for in the Invoice. The firm shall have to arrange all the routine, acceptance tests through CPRI as per the relevant IEC/IS specifications amended up to date. The firm shall also furnish the type tests certificates to the CPRI Inspector and

obtain their clearance . However, if the CPRI Inspector is not satisfied with any of the type test reports the firm shall have to get the equipment type tested for that very particular test at their own cost as per the relevant IEC/IS specifications.

2.16 INSTRUCTION BOOKS/MANUALS AND SPARE PARTS:

- 2.16.1 The contractor shall supply nine sets, free of cost of the following:-
- a) Complete Instruction book/manuals for erection, testing and commissioning of equipment.
 - b) Full instructions for the operation and maintenance of the equipment.
 - c) List of spare parts with prices.
- 2.16.2 The instruction book shall be supplied well before completion of the delivery period of the equipment.

2.17 DRAWINGS:

- 2.17.1 The tenderer shall submit along with his tender all drawings as called for in the technical specifications.
- 2.17.2 Within thirty days of the receipt of the order the contractor shall furnish to the purchaser free of cost ten sets of all contract drawings listed in Schedule-J including all accompanying descriptive pamphlets. These drawings shall demonstrate fully the apparatus to be furnished that will conform to the provision and intents of the specifications. The drawings shall be accurately drawn to scale and shall be clear to read all information in English language. Subsequently, revisions of these drawings, if any, shall also be submitted for approval of the purchaser in

similar manner before fabrication, manufacture or assembly is commenced. Within one month from the date of receipt of the proper and correct drawings and other descriptive pamphlets, the purchaser shall communicate the approval to the contractor, if no discrepancies are noticed in the drawings.

2.17.3 After approval of the drawings by the purchaser the contractor shall within one month furnish six sets of approved drawings together with one set on translucent prints for suitable reproduction by direct contact method.

2.17.4 Upon approval by the purchaser, the drawings shall become the contract drawings and thereafter, the contractor shall not depart from them in any way whatsoever except with the written permission of the purchaser.

2.17.5 Any manufacturing work in connection with the equipment prior to the approval of the drawings shall be at the contractor's risk. The contractor shall make changes in the designs which are necessary to make the equipment conform to the provision and intentions of these specifications without additional cost to the purchaser. Approval of the contract drawings shall not be considered to have relieved the submitted for approval.

2.18 **NOTICE TO CONTRACTOR:**

A notice to the contractor may be sent by mail or cable to his address given in the tender or delivered by hand/posted to his duly authorized representative at site. Such delivery/posting shall be deemed as good services of such notice.

2.19 FINANCIAL RESOURCES AND EXPERIENCE:

- 2.19.1 The tenderer is requested to submit a statement of facts in details as to his previous experience in performing a similar or comparable work and of the business and technical organization, financial resources and manufacturing facilities available and to be used in performing the contract work.
- 2.19.2 The tenderer is further requested to furnish the information specifically on the following points:-
- A) Standing of the firm as designer and manufacturer of the equipment covered by the specifications.
 - B) Particulars of equipment/material etc. produced so far at his works.
 - C) List of important locations for which material have been supplied and/or erected in India or else where.
 - D) Bankers report.
 - E) Income and sales tax clearance certificates.
 - F) Yearly turnover.

2.20 PATENT RIGHTS:

The contractor shall at his cost defend any claim which infringes any patent of the country of origin or India if notified promptly in writing and given authentic information and assistance for the defense, and contractor shall pay all damages and costs awarded against the purchaser in such suit or proceedings for patent infringement. In case the equipment in such suit or proceedings is held constitute infringement and the use of the equipment or parts thereof is prohibited, the contractor shall at his own expenses either procure for the purchaser the right to continue using the equipment, or parts thereof, or replacement of same with non-infringing one, or remove the

equipment and refund the purchaser prices plus transportation and installation costs thereof, besides payment of damages suffered by the department.

2.21 RESPONSIBILITY FOR OBTAINING INFORMATION AND TAKING ACTION IN TIME:

Whenever any information or clarification in respect of designs or construction of materials have to be obtained from the purchaser/various other authorities, the contractor shall be responsible for taking action well in time so that there are no delays on this account. The contractor shall also take prompt action in all other matters such as indenting necessary railway wagons etc. The completion period offered in the tender shall be deemed to include the time taken for such incidental work. The request for extension of the delivery of completion dates on such ground shall not be entertained.

2.22 PACKING AND MARKING:

2.22.1 The equipment shall be packed suitably for transportation direct to site in a manner suitable for tropical conditions and the contractor shall be responsible for all damages due to improper preparation for transportation and inadequate packing.

2.22.2 Special care should be taken to provide ample protection against termites and mechanical devices. For transport by road from the rail head to site wherever necessary proper arrangements for attaching slings for lifting shall be provided. Markings on packing shall be clearly marked with signs showing the up and down sides of the boxes and any handling and unpacking instruction considered necessary.

Bolts, nuts etc. shall be supplied in boxes suitably packed to prevent stacks being torn in transit. The contents of such packages shall bear marking that can be readily identified from the packing list. All packing cases, packing material shall remain the property of the purchaser.

2.22.3 Each part shall properly match and marked to ensure correct assembly on alignment of part in the field.

2.23 **CONDITIONS OF CONTRACT:**

The work covered in this specification shall be carried out in accordance with the conditions of the contract as per E.C. 31 of J&K Financial Code Volume-II.

2.24 **INSTRUCTIONS TO TENDERERS:**

Tenders shall be submitted in the bidding schedule, included in the last part of the presentative specification. These schedules must be duly filled in, signed and submitted by the tenderer failing which the offer is likely to be ignored.

2.25 **CLIMATIC CONDITIONS:**

2.25.1 The climatic conditions in Jammu Province:

1. Minimum temperature of Air in shade	-6°C
2. Maximum temperature of Air in shade	46°C
3. Maximum temperature of Air in Sun	60°C
4. Relative Humidity:	
Maximum	82%
Minimum	10%
5. No.of rainy days per year	85 Approx.
6. Average rainfall per year	118mm

7. Average No.of thunderstorm days/year	30 days
8. No.of months tropical monsoon	3 months (July-Sept.)
9. Maximum wind pressure	130kg/mt ²
10. Height above sea level	300m to 2200m
11. Seismic coefficient:	
Horizontal	0.1 g
Vertical	0.95 g

PROTECTION AGAINST EARTH QUAKE:-

All the supporting structures should withstand repeated earth quakes (suitable for zone-V condition) and wind loads of 130kg/m² on the projected area (Non-simultaneous) without damage and spurious operation of the equipment due to heavy vibrations.

J.E

A.E. E.

T.O.

Executive Engineer

Superintending Engineer

Part-II

TECHNICAL SPECIFICATIONS

OF

TENDER SPECIFICATION NO. SEPD/NIT-202/2011

FOR

160 MVA,220/132/11 KV, 3-PHASE AUTO TRANSFORMER

FOR

UDHAMPUR AND BARN GRID STATIONS

OF

JAMMU PROVINCE

IN

JAMMU AND KASHMIR STATE

Part-II Sec-I

TECHNICAL

SPECIFICATIONS

FOR

AUTO

TRANSFORMER

TECHNICAL SPECIFICATIONS FOR POWER TRANSFORMER

CONTENTS

Part-II (Section-I)

CLAUSE	TITLE	PAGE NO.
1.0	TECHNICAL SPECIFICATIONS.....	4
1.1	GENERAL.....	4
1.2	GENERAL TECHNICAL REQUIREMENTS.....	5
1.3	SPECIFIC TECHNICAL REQUIREMENTS.....	5
1.4	GUARANTEED AND OTHER TECHNICAL PARTICULARS.....	5
1.5	DRAWINGS.....	5
1.6	WORK SCHEDULE.....	7
1.7	DUTY REQUIREMENT.....	8
1.8	FREQUENCY.....	9
1.9	RADIO INTERFERENCE AND NOISE LEVEL.....	9
1.10	THERMAL AND MECHANICAL STRESS.....	10
1.11	OVER FLUXING.....	10
1.12	TERTIARY WINDING(For transformer above 100 MVA).....	10
1.13	TEMPRATURE RISING.....	10
1.14	TRANSFORMER LOSSES.....	10
1.15	PARALLEL OPERATION.....	12
1.16	CLEARANCES.....	12
1.17	CONSTRUCTIONAL DETAILS.....	13
1.17.1	TANK AND TANK ACCESSORIES.....	13
1.17.2	CORE.....	21
1.17.3	WINDINGS.....	22
1.17.4	INSULATING OIL.....	24
1.17.5	TERMINAL ARRANGEMENT.....	27

1.17.6	TERMINAL MARKING.....	29
1.17.7	BUSHING CURRENT TRANSFORMER.....	29
1.18	NEUTRAL EARTHING ARRANGEMENT.....	30
1.20	AUXILIARY POWER SUPPLY FOR OLTC,COOLER CONTROL AND POWER CIRCUIT....	30
1.21	TAP CHANGING EQUIPMENT.....	30
1.21.1	GENERAL REQUIREMENTS.....	31
1.21.2	ON LOAD TAP CHANGING GEAR(OLTC).....	32
1.21.3	OLTC CONTROL ROOM.....	34
1.22	COOLING SYSTEM AND ITS CONTROL.....	36
1.22.1	TYPE OF COOLING.....	36
1.22.2	OIL NATURAL AIR FORCED COOLING(ONAF).....	37
1.22.3	OIL FORCED AND AIR FORCED COOLING(OFAF).....	37
1.22.4	COOLER CONTROL.....	44
1.23	LOCAL OLTC CONTROL CABINET,COOLER CONTROL CABINET AND REMOTE TAP CHANGER CONTROL PANEL(RTCC).....	41
1.24	CONTROL CABINET/MARSHALLING BOX.....	43
1.25	BOLTS AND NUTS.....	43
1.26	FITTINGS AND ACCESSORIES.....	43
1.27	MOTORS.....	45
1.28	INSPECTION,TESTING AND INSPECTION CERTIFICATES.....	45
1.28.11.1	TYPE TESTS.....	50
1.28.11.2	ADDITIONAL TYPE TESTS.....	51
1.28.11.3	ROUTINE TESTS.....	52
1.28.11.4	ADDITIONAL ROUTINE TESTS.....	52
1.28.11.5	SPECIAL TESTS.....	53
1.28.11.6	TESTS ON TRANSFORMER BUSHINGS.....	54
1.28.11.7	TESTS ON INSULATING OIL.....	54
1.28.11.8	TESTS ON ON-LOAD TAP CHANGER.....	54
1.28.11.9	TESTS ON ACCESSORIES.....	54

1.28.11.10	TESTS ON BUCHHOLZ RELAY.....	54
1.28.11.11	COOLING PLANT.....	55
1.28.11.12	OIL PUMPS.PIPE WORKS AND VALVES.....	55
1.28.11.13	OTHER AUXILLARY EQUIPMENTS.....	55
1.28.11.14	ADDITIONAL TESTS.....	56
1.28.11.15	PREASHIPMENT CHECK AT MANUFACTURER’S WORKS.....	56
1.28.11.16	INSPECTION AND TESTING AT SITE.....	56
1.28.11.17	RECEIPT AND STORAGE CHECKS.....	56
1.28.11.18	INSTALLATION CHECKS.....	57
1.28.11.19	COMMISSIONING CHECKS.....	57
1.29	OIL STORAGE TANKS.....	59
1.30	OIL SAMPLING BOTTEL.....	60
1.31	ONLINE DISSOLVED GAS MONITOR.....	60
1.32	PACKING AND FORWARDING.....	61
1.33	DELIVERY.....	62
1.34	FIRE PROTECTION.....	62
1.35	SPARE PARTS.....	62
1.36	ERECTION AND MAINTENANCE TOOLS/EQUIPMENTS.....	62
1.37	TOOLS AND TACKLES.....	62
1.38	OPERATION,MAINTENANCE AND ERECTION MANUALS.....	63
	ANNEXURE – I.....	64
	AUXILIARIES.....	64
	ANNEXURE –II.....	73
	LIST OF TRANSFORMER ACCESSORIES AND TEST CERTIFICATES REQUIRED FOR THEM.....	73
	List of mandatory spares.....	79

TECHNICAL SPECIFICATIONS FOR POWER TRANSFORMER

1.0 TECHNICAL SPECIFICATIONS:

1.1 GENERAL

1.1.1 The scope covers the design, engineering, manufacture, testing at Manufacturer's works before dispatch, packing and forwarding, transportation, insurance, handling, delivering at site, supervision of erection testing and commissioning of the transformers of following rating in various substations of Jammu region complete with all materials, accessories and fittings, erection and maintenance tools and tackles, mandatory spares, OLTC and RTCC cubicle and terminal connectors with first filling of transformer oil including extra oil required during guarantee period, as detailed in this specifications for:-

i) 160 MVA, 220 KV/132 KV/11 KV three phase Auto transformer

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

1.1.3 Any material and equipments not specifically stated in this specification but which are necessary for satisfactory operation of the equipment shall be deemed to be included unless specifically excluded and shall be supplied without any extra cost.

1.1.4 Components having identical rating shall be interchangeable.

1.1.5 The supply of all materials for connecting the neutral ends to form neutral point and grounding connection thereof shall also be included in the scope supply.

1.1.6 The performance of the equipment shall be guaranteed as per **Section-"Guaranteed and Other Technical Particulars"**.(part-II, section-II)

1.1.7 The bidder has to furnish the testing facilities available at the manufacturer's works.

1.1.8 Transportation

1.1.8.1 It shall be the sole responsibility of the supplier to transport the transformer up to the consignee's site in good condition. The supplier shall be responsible to select and verify the route, mode of transportation and make all necessary arrangements with the appropriate authorities for the transportation of the equipment. The dimension of the equipment shall be such that when packed for transportation, it will comply with requirement of loading and clearance restrictions for the selected route. It shall be the responsibility of the contractor to coordinate the arrangement for transportation of the transformer for all the stages from the manufacturer's work to site. All metal blanking plates and covers which are specifically required to transport the transformer shall be considered part of the transformer and handed over to the purchaser after completion of the erection. Bill of quantity and relevant drawings of these items shall also be included in the manual to enable the purchaser to have it re-manufactured, if required.

1.1.8.2 **The transformer shall preferably be transported on Hydraulic Trailers so as to minimise the impact on winding etc during transportation.** The supplier shall carry out the route survey along the transporters to ensure safe delivery of equipment at purchaser's site of work.

1.1.8.3 The supplier shall despatch the transformer in an atmosphere of Nitrogen/dry air. Necessary arrangement shall be ensured by the Contractor to take care of pressure drop of nitrogen or dry air during transit and storage till completion of oil filling during erection. The total duration of storage at site with dry gas shall be limited till three months after which the transformer shall be processed and filled with oil. A gas pressure testing valve with necessary pressure gauge and adaptor valve shall be provided. During storage, internal pressure of dry air/nitrogen shall be monitored and gas filling is to be carried out if required to maintain the internal pressure. **The transformer shall also be fitted with sufficient number of impact recorders/accelerometer during transportation to record the movement due to impact in all three directions perpendicular to each other**, out of which the main direction shall be in the direction of transportation. The recording shall commence on the factory and must continue till the unit is installed on its foundation. The records shall be submitted to purchaser as a part of quality process.

1.2 GENERAL TECHNICAL REQUIREMENTS

The transformer shall be of three phase, oil immersed type and shall be suitable for the outdoor service as step down transformers. The transformer and its accessories shall confirm to IEC:60076/IS:2026 and other relevant IEC/IS standards of latest edition including amendments except to the extent explicitly modified in the specification and shall also be in accordance with requirement specified in this section. **A list of relevant Standards are given in Annexure-II of Section-“General Technical Requirements:.**

1.3 SPECIFIC TECHNICAL REQUIREMENT

The technical parameters of the transformer are detailed in **Section-“Guaranteed and other technical particulars”** of the Specification., Annexure-III of part-II section-II. Any other particulars considered necessary may also be given in addition to those listed in that Section.

1.4 GUARANTEED AND OTHER TECHNICAL PARTICULARS

The bidder shall furnish all the Guaranteed and other technical particulars for the offered transformers as called for in Section-“Guaranteed and other Technical Particulars”. Annexure-III of part-II section-II. Any other particulars considered may also be given in addition to those listed in that section.

1.5 DRAWINGS

1.5 Drawings to be submitted along with the Bid

1.5.1.1 In addition to any other drawings which the tenderer may like to supply, the following drawings/catalogues shall be submitted with the tender:

- (a) General outline drawings showing front and side elevation and plan views of the transformer and all accessories and external features with detailed dimensions, net and shipping weights, crane lift for untanking and/or erection/removal of bushings, size of lifting lugs and pulling eyes, HV and LV terminal clearances, quantity of insulating oil etc.
- (b) Drawings showing mounting details including foundation, track gauge for each equipment offered.

- (c) Technical and descriptive literature giving details of the equipment and accessories offered including bought out items.

1.5.1.2 The Contractor shall furnish completely filled in Schedule for submission of drawings, schedule-J.

1.5.1.3 Each drawing shall be identified by a drawing number and each subsequent resubmission/revision or addition to the drawing shall be identified by a revision number .All drawings shall be thoroughly checked for accuracy and completeness and signed by a responsible officer of the supplier on his behalf. Any mistakes or errors in drawings shall not form a basis for seeking extension of delivery period.

1.5.2 Drawings and documents to be submitted after receipt of order.

After receipt of the order, the successful tenderer will be required to furnish five(5) prints of the following drawings and documents for approval of Purchaser/Owner.

1.5.2.1 Outline General Arrangement drawing of transformer showing

- a) Plan
- b) Elevation
- c) End view

List of all accessories with detailed weights, quantity of insulating oil, dimensions clearances, spacing of wheels in direction, centre of gravity, location of cooler etc.

1.5.2.2 Loading details for transformer foundation

1.5.2.3 Foundation Plan showing reaction at points of support, clamping arrangements and location of jacking pads.

1.5.2.4 Technical Data requirement sheet of transformer

1.5.2.5 Over fluxing with stand duration curve.

1.5.2.6 Schematic wiring diagram of cooling arrangement along with write up on scheme

1.5.2.7 Schematic wiring diagram of OLTC along with write up on scheme

1.5.2.8 Mounting Arrangement and wiring diagram of remote WTI along with write up.

1.5.2.9 Bushing Drawing showing electrical and mechanical characteristics.

- a) HV Bushing
- b) IV Bushing
- c) LV Bushing
- d) Neutral Bushing

1.5.2.10 Assembly drawings of HV,IV & LV bushings and bimetallic terminals.

1.5.2.11 Outline and General Arrangement of Cooler Control Cabinet.

- 1.5.2.12 Cooler Control Cabinet schematic and wiring drawing.
- 1.5.2.13 Magnetisation Characteristics of bushing CTs and neutral CTs
- 1.5.2.14 Hysteresis Characteristics of iron core
- 1.5.2.15 Rating and Diagram Plate giving details of terminal marking and connection diagram
- 1.5.2.16 Over all Transport dimension drawing of transformer.
- 1.5.2.17 Drawing showing typical sectional view of the windings with details of insulation, cooling circuit, method of cooling and core construction etc.
- 1.5.2.18 Oil Flow Diagram
- 1.5.2.19 Valve Schedule Plate drawing
- 1.5.2.20 Twin Bi-directional Roller.
- 1.5.2.21 Connection diagram of all protective devices marshalling box showing physical location.
- 1.5.2.22 List of spares.
- 1.5.2.23 Technical Literature of all fittings and accessories.
- 1.5.2.24 **Calculation to support short circuit with stand capacity of transformer**
- 1.5.2.25 Calculation of hot spot temperature.
- 1.5.2.26 Value of air core reactants with a typical write up of calculation
- 1.5.2.27 Oil Sampling Bottle details.
- 1.5.2.28 Typical heating and cooling curves.
- 1.5.2.29 GA of RTCC panel.
- 1.5.2.30 Transformer oil storage tank drawing
- 1.5.2.31 Complete bill of material
- 1.5.2.32 Customer inspection schedule
- 1.5.2.33 Test procedure of transformer
- 1.5.2.34 Type test reports of transformer
- 1.5.2.35 O&M manual of transformer

1.6 WORK SCHEDULE

- 1.6.1 The tenderer shall furnish with his offer a detailed programme for manufacturing and delivery, supervision of erection, testing and commissioning of the equipment offered by him in the form of master network identifying key phases in the various areas of work.

- 1.6.2 The Bidder shall attach a proposed Bar or PERT chart, starting from the date of letter of intent till completion as per delivery schedule.
- 1.6.3 The Programme shall include but not limited to commencement and completion of all engineering and design works including the time required for the Consulting engineers comments.
- 1.6.5 The work schedule shall be discussed and finalised at the time of award.
- 1.6.5 Within one month of acceptance of letter of award, the successful tenderer shall submit for review and approval, detailed schedules(mutually agreed by the Purchaser and Tenderer)showing the logic and duration of following activities:
- (a)Detailed engineering, procurement(bought out items and raw material),manufacture, shop inspection ,testing, despatch and receipt at site.
- (b)Supervision of erection, testing and commissioning activities.
- (c)Inputs required from Purchaser, data/information to be submitted by the Tenderer for furt her related engineering.

1.7 DUTY REQUIREMENT

- 1.7.1 The transformers shall be of three phase, oil immersed and shall be suitable For the outdoor service. The transformers shall be suitable for highly polluted atmospheres.
- 1.7.2 The transformers would be used for bi-directional flow of rated power.
- 1.7.3 The transformer shall be capable of being operated without danger on any tapping at the rated MVA with voltage variation of +- 10% corresponding to the voltage of that tapping.
- 1.7.4 Transformers shall be operating under the natural cooled conditions upto the specified load. The forced cooling equipment shall then come into operation by pre-set contacts of winding Temperature Indicator(WTI) and the transformer shall operate as a forced cooling unit initially as ONAF upto specified load and then as OFAF. Cooling shall be so designed that during total failure of power supply to cooling fans and oil pumps, the transformer shall be able to operate at full load for atleast ten(10) minutes without the calculated winding hot spot temperature exceeding 150°C.Transformers shall be fitted with two numbers of cooler banks each capable of dissipating 50% of the losses at Continuous Maximum Rating(CMR).Transformers shall be capable of operating for 20 minutes in the event of failure of oil circulating pumps or blowers associated with all cooler banks except one cooler bank without the calculating winding hot spot temperature exceeding 150°C.The Contractor shall submit supporting calculations for the above for Purchaser's approval.
- 1.7.5 **The maximum flux density in any part of the core and yoke at rated MVA, normal voltage and frequency shall be such that under 10% continuous over voltage condition it does not exceed 1.9 Tesla at the lowest tap position.**

- 1.7.6 The transformers shall be having constant ohmic impedance between HV and LV as specified.
- 1.7.7 External or internal reactors shall not be used to achieve the HV/LV impedance specified.
- 1.7.8 **The air core reactants of HV winding of transformer shall not be less than 20%. Successful bidder is to furnish supporting calculation for Purchaser's reference. The Knee point voltage shall not be less than 1.1 per unit.**
- 1.7.9 The Transformers and all its accessories like CTs etc. shall be designed to withstand without **injury, the thermal and mechanical** effects of any external short circuit to earth and of short circuits at the terminals of any winding for a period of 2 seconds. The short circuit level of the HV and LV system to which the subject transformers will be connected is 40kA for 1 second (sym,rms,3phase fault on 220KV) & 31.5KA for 1 second(sym,rms,3 phase fault on 132KV & 33 KV0.For transformer design purpose, the through fault current shall be considered limited only by the transformer self impedance.
- 1.7.10 The transformer shall be capable of being loaded in accordance with is:6600/IEc:60354 upto 150% of rated load. There shall be no limitation for overloading imposed by bushing, tap changer etc or any other associated equipment.
- 1.7.11 The transformer shall be free from any Electrostatic charging Tendency(ECT)i.e static electricity problem under all operating conditions when all oil circulation systems are in operation.
- 1.7.12 Dissolved gas analysis (DGA) of oil shall be periodically monitored by the Purchaser during the service of the transformer and the interpretation of DGA results will be as per Iec;60599.The Contractor may take separate samples for DGA during warranty period as it is the responsibility of the Contractor to make their own assessment regarding the overall health of the transformer during this period.
- 1.7.13 The equipment shall generally be designed and manufactured to have at least 30 years life under rated conditions.

1.8 FREQUENCY

Transformer shall be suitable for continuous operation with a frequency variation of +-5% from normal value of 50 Hz without the temperature rise exceeding the specified limit.

1.9 RADIO INTERFERENCE AND NOISE LEVEL

- 1.9.1 The transformer shall be designed with particular attention to the suppression of harmonic voltage, especially the third so as to minimize interference with communication circuit.
- 1.9.2 The noise level of transformer, when energised at normal voltage and frequency with fans and pumps running shall not exceed, when measured under standard condition, the values specified at relevant clauses.

1.10 THERMAL AND MECHANICAL STRESS

Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on an terminals. The maximum short circuit output current at any tertiary terminals shall be limited to make the transformer short circuit proof.

1.11 OVERFLUXING

Transformer shall withstand, without injurious heating combined voltage and frequency fluctuations which produce the following overfluxing conditions and give desired performance.

- a) 125% for 1 minute
- b) 140% for 5 seconds
- c) Bidder shall also indicate 150% and 170% over voltage withstand time.

The transformer shall provided with overfluxing protection device.

1.12 TERTIARY WINDING

- a) The tertiary winding shall be unloaded
- b) The tertiary winding shall be designed to withstand mechanical and thermal stresses due to dead short circuit on its terminals.

1.13 TEMPRATURE RISE

1.13.1 Transformers shall be capable operating continuously without exceeding temperature rise(Over maximum ambient temp. Of 45⁰ C) limits as specified :

a) Winding temperature 55⁰C
(Measured by resistance method)

b) Top oil temperature 55⁰C
(Measured by thermometer)

1.13.2. Transformers with taping ranges extending more than 5% below the nominal voltage shall meet the temperature rise limits specified in IS: 2026 on all tapping. They shall operate continuously without injurious heating. The loading of the transformers is to be accordance with IS: 6600 "Guide for loading of oil immersed transformers".

1.14 TRANSFORMER LOSSES

1.14.1 **The Bidder shall indicate the Guaranteed values of No load losses (Iron losses),load losses(copper losses) and auxiliary losses in his Bid. He shall indicate whether losses are firm or subject to tolerance. In case no ceiling is specified it will be taken as +10% as per IS:2026.**

1.14.2 Rationalisation of capitalization Formula for Transformer Losses

The rate of capitalization of transformer losses depends upon the rate of interest, rate of electrical energy per kwh, life of transformer and average annual loss factor. The annual loss factor takes into account the loading of transformer during the year. In computing the rate of capitalization of iron losses, copper losses and auxiliary losses, following realization assumptions have been made:

- i) Rate of interest (r): This may be taken as being adopted for other projects. This has been taken as 12%.
- ii) Rate of electrical energy (EC): it is the cost of energy per kwh at the bus to which the transformer is to be connected. This has been taken as Rs. 2.50 per KWH>
- iii) Life of the transformer (n): It is taken as 35 years.
- iv) The transformer is in service for a period of 350 days in a year (allowing 15 days for maintenance breakdown, etc.
- v) The cooling pumps remain in service for 40% of the time, the transformer is in service.
- vi) Annual loss factor: The annual loss factor has been worked out on the basis of the formula given below:

$$LS = 0.3LF + 0.7(LF)^2$$

Where: LS is the annual loss factor

LS is the annual loss factor

Assuming annual load factor as 60 percent, annual loss factor works out to 0.432

Capitalization Formula

Capitalization Cost of transformer = Initial cost + capitalized cost of annual iron losses + capitalized cost of annual copper losses + capitalized cost of annual auxiliary losses.

$$\text{Capitalized cost of iron losses per KW} = 8400 \times EC \times \frac{(1+r)^n - 1}{r(1+r)^n}$$

$$\text{Capitalized cost of copper losses per KW} = 8400 \times EC \times \frac{(1+r)^n - 1 \times LS}{r(1+r)^n}$$

$$\text{Capitalized cost of auxiliary losses per KW} = 0.4 \times 8400 \times EC \times \frac{(1+r)^n - 1}{r(1+r)^n}$$

The following capitalization rates shall be adopted:-

W_i, Iron loss = Rs. 1,71,685/-per KW

W_c, Copper loss = Rs. 74,168/-per KW

W_p, Aux. loss = Rs. 68,674/-per KW

1.14.3 Liquidated damage for excessive losses

On testing, if it is found that actual losses are more than the values quoted including maximum tolerance specified, if any, undisputed liquidated damages shall be recovered from the suppliers at the rates double of that calculated from above formula. For fraction of kilowatt, penalties shall be applied on prorated basis.

1.15 PARALLEL OPERATION

1.15.1 The transformers shall in general be suitable for parallel operation with the existing/being procured transformers.

a) The impedance, vector group, OLTC connection and range etc., of the transformer is to be matched with existing/being procured transformers.

b) Necessary provision is to be kept in the transformer control scheme for parallel operation with the existing/being procured Master/Follower/Independent/Off type OLTC control system

1.16 CLEARANCES

1.16.1 The clearances between two live conductive parts and a live conductive part to earthed structures shall be as follows for the transformers:

S.No.	Nominal Voltage	System	BIL (KV)	Clearance	
				Phase to phase (in mm)	Phase to Earth (in mm)
1)	220 KV		1050	2100	2100
2)	132 KV		650	1300	1300
3)	33 KV		170	320	320

The values in above refer to an altitude not exceeding 1000m. For an altitude above 1000m and upto 3000m following Table shall be referred:

S.No.	Nominal Voltage	System	BIL (KV)	Clearance	
				Phase to phase (in mm)	Phase to Earth (in mm)
1)	220 KV		1050	2232	2232
2)	132 KV		650	1382	1382
3)	33 KV		170	340	340

1.17 CONSTRUCTIONAL DETAILS

The features and construction details of each Power Transformer shall be in accordance with the requirement stated hereunder.

1.17.1 Tank and Tank accessories

1.17.1.1 Tank

(a) Tank shall be of welded construction and fabricated from tested Quality low carbon steel of adequate thickness. The quality of steel shall be per IS:2062.

(b) All seams and those joints not required to be opened at site shall be factory welded and wherever possible they shall be double welded. Welding shall conform to BS:5135. After completion of tank construction and before painting, dye penetration test shall be carried out on welded parts of jacking bosses, lifting lugs and all load bearing members. The requirement of post weld, heat treatment of tank/stress relieving shall be based on recommendation of BS:5500.

(c) Tank stiffeners shall be provided for general rigidity and these shall be designed to prevent retention of water.

(d) The transformer shall be preferably of bell type tank construction with belted/welded top cover. In case the joint is welded, it shall be provided with flanges suitable for repeated welding. The joint shall be provided with a suitable gasket to prevent weld splatter inside the tank. Proper tank shielding shall be done to prevent excessive temperature rise of the joint. Neoprene or equivalent gaskets shall be used to ensure perfect oil tightness.

(e) The tanks shall be designed to withstand:

- i) Mechanical shocks during transportation.
- ii) Full vacuum.
- iii) Continuous internal pressure of 35KN/Sq.m over normal hydrostatic pressure of oil.

- (f) Wherever possible the transformer tank and its accessories shall be designed without pockets wherein gas may collect. Where pockets cannot be avoided, pipes shall be provided to vent the gas into the main expansion pipes.
- (g) Adequate space shall be provided at the bottom of the tank for the collection of sediments/sludge.
- (h) The base of each tank shall be so designed that it shall be possible to move the complete unit by skidding in any direction without injury when using plates or rails.
- (i) Tank shields shall such that no magnetic fields shall exist outside the tank. They shall be of magnetically permeable material.
- (j) Suitable guides shall be provided in the tank for positioning the core and coil assembly.
- (k) Each tank shall be provided with
 - (i) Lifting lugs suitable for lifting the transformer when filled with oil without structural damage to any part of the transformer. Lifting eyes shall be provided on all parts of the transformer requiring independent handling. The factor of safety at any point shall be less than 2. The lifting lugs shall be so arranged and located so as to be accessible for use when the transformer is loaded on the transport vehicle.
 - (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.
- (l) the lid inside the tank shall be shaped to ensure efficient collection and direction of free gas to the Buchholz relay.

1.17.1.2 Tank cover

- (a) The tank cover shall be sloped to prevent retention of rain water and shall not distort when lifted.
- (b) At least two adequately sized inspection openings, one set at each end of the tank shall be provided for easy access to bushings and earth connections. The inspection covers shall not weigh more than 25Kg. The inspection covers shall be provided with two handles to facilitate lifting. The inspection covers shall be of bolted type.
- (c) The tank cover shall be fitted with pockets at the position of maximum oil temperature at maximum continuous rating for bulbs of oil and winding temperature indicators. It shall be possible to remove these bulbs without lowering the oil in the tank. The thermometer shall be fitted with a captive screw to prevent the ingress of water.
- (d) Bushings, turrets, covers of inspection openings, thermometer, pockets etc shall be designed to prevent ingress of water into or leakage of oil from tank.
- (e) All bolted connections shall be with weatherproof hot oil resistant gasket in between, for complete oil tightness. If gasket is compressible, metallic stops/other suitable means shall be provided to prevent over-compression. All gasket joints shall be

designed, manufactured and assembled to ensure long term leak and maintenance free operation.

(f) Gas venting

The transformer cover, and generally the internal spaces of the transformer and all pipe connections shall be so designed as to provide efficient venting of any gas in any part of the transformer to the Buchholz relay. The space created under inspection and manhole cover shall be filled with suitable material to avoid inadvertent gas pockets.

1.17.1.3 When the transformers are provided with separately mounted radiators, flexible joints shall be provided in the main oil pipes connecting the main transformer tank to the radiator tank to reduce vibration and facilitate erection and dismantling.

1.17.1.4 The transformer tank, fitting, radiators and all accessories shall be designed to withstand seismic events to the extent of static co-efficient of 0.3 gm.

1.17.1.5 Axels and Wheels

i) The transformer shall be mounted either on rollers or on concrete plinth foundation directly, as per Manufacturer's standard practice.

ii) **Roller Mounted Transformer**

a) The roller mounted transformer are to be provided with flanged bi directional wheels and axels. This set of wheels and axels shall be suitable for fixing to the under carriage of transformer to facilitate its movement on rail track. These shall be so designed as not to be deflect excessively to interfere with the movement of the transformer(under both direction of movement).Wheels shall be provided with suitable bearings, which shall be rust and corrosions resistant. Fittings for lubrication shall also be provided.

b) Suitable locking arrangement along side foundation bolts shall be provided for wheels to prevent accidental movement of transformer.

c) The wheels are required to swivel and they shall be arranged so that they can be turned through an angle of 90⁰.when the tank is jacked up to clear of rails. Means shall be provided locking the swivel movements in position parallel to and at right angles to the longitudinal axis of the tanks.

d) The rail track gauge shall be two(2) rails with 1676mm between adjacent rails on shorter axis as well as on longer axis.

iii) Bidder shall supply one set of trolleys for plinth mounted transformer.

1.17.1.6 Conservator and Oil preservation System

1.17.1.6.1 The supplier shall provide main conservator with air cell type constant oil pressure system to prevent oxidation and contamination of oil due to contact with moisture/air, and shall be fitted with magnetic oil level gauge at a convenient height for reading from ground level with low oil level potential free contacts.

1.17.1.6.2 Separate conservator tank shall be provided for OLTC. OLTC shall have conventional type conservator with prismatic oil level gauge unless otherwise approved.

1.17.1.6.3 **Conservator tank and pipe work**

The conservator tank shall have adequate capacity between highest and lowest visible levels (not less than 7.5% of the cold oil volume in the transformer and cooling equipment) to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment from minimum ambient temperature 100° C.

The capacity of the conservator tank shall be such that the transformer shall be able to carry the specified overload without overflowing of oil.

(b) The conservator shall be fitted with integral lifting lugs in such a position so that it can be removed for cleaning purposes. Suitable provision shall be kept to replace air cell and cleaning of the conservator as applicable.

(c) High and low level alarm contacts shall be provided together with the oil level indication.

(d) Conservator shall be provided in such a position as not to obstruct the electrical connections to the transformer.

(e) A double flange valve of preferably 50mm and 25mm size shall be provided to fully drain the oil from the main tank conservator and OLTC conservator respectively.

(f) To prevent oil filling into the air cell, the oil filling aperture shall be clearly marked.

(g) The transformer rating and diagram plate shall bear a warning statement that the conservator is fitted with an air cell.

(h) The conservator tank shall be stencilled on its underside with the words "Caution: Air cell fitted". Lettering of at least 150mm size shall be used in such a way to ensure clear legibility from ground level when the transformer is fully installed.

(i) The transformer manual shall give full and clear instructions on the operation, maintenance, testing and replacement of the air cell. It shall also indicate shelf life, live expectancy in operation, the recommended replacement intervals and the supplier.

(j) Pipe work connections shall be of adequate size for their duty and as short and direct as possible.

(k) The feed pipe to the transformer tank shall enter the transformer cover plate at its highest point and shall be straight for a distance not less than five times its internal diameter on the transformer side of the Buchholz relay, and straight for not less than 3 times that diameter on the conservator side of the relay.

(l) Pipe connecting the transformer tank with the oil conservator, through the Buchholz relay, shall be at a rising angle of not less than 5 deg.

(m) The feed pipe diameter for the main conservator shall be not less than 75mm.

(n) Gas venting pipes shall be connected to the final rising pipe to the Buchholz relay as nearly as possible in an axial direction, and preferably not less 5 times pipe diameters from the Buchholz relay, on the transformer side of the relay.

(o) Pipe work shall neither obstruct the removable of tap changers for maintenances nor the opening of inspection of man hole covers.

1.17.1.6.4 **Oil preservation equipment**

The requirement of air cell type oil sealing system are given below:

(a) Contact of the oil with atmosphere shall be prohibited by using a flexible air cell of nitrile rubber reinforced with nylon cloth.

(b) The temperature of oil in the conservator is likely to rise upto 100°C during operation. As such air cell used shall be suitable for operating continuously at least at 100°C.

(c) The conservator tank and piping shall be designed for complete vacuum filling of the main tank and the conservator tank. The provision must be made for equalising the pressure in the conservator tank and the air cell during vacuum filling operations to prevent the rupturing of the air cell.

(d) The connection of the air cell to the top of the reservoir is by an air proof seal permitting entrance of air into the cell only.

1.17.1.6.5 **Dehydration Filter Breather**

Conservator shall be fitted with a dehydrating filter breather. Connection shall be made to a point in the oil conservator not less than 50mm above the maximum working oil level by means of a pipe with a maximum diameter of 25mm. Breathers having a mass less than 10 kg may be supported by the connecting pipe, whereas units of 10 kg and above shall be supported independent of the connecting pipe. Connecting pipe shall be securely cleated to the transformer, or other structure supplied by the Contractor, in such a manner so as to eliminate undesirable vibration and noise. In a case where a breather of less than 10 kg is supported by the pipe, there shall be a cleat directly above the breather flange. It shall be so designed that:

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

(b) Silica gel is isolated from atmosphere by an oil seal.

(c) Moisture absorption indicated by a change in colour of the tinted crystals can be easily observed from a distance.

(d) Breather is mounted not more than 1200mm above rail top level.

(e) To minimise the ingress of moisture following shall be provided:

i) Three breathers (of identical size) shall be connected in series for main tank conservation.

ii) Two breathers (each of 2.5 litres minimum volume) shall be connected in series for OLTC tank conservator.

1.17.1.7 Pressure relief device (PRD)

Adequate no. of pressure Relief devices (at least 2 nos.) shall be provided at suitable locations. These shall be of sufficient size for rapid release of any pressure that may be generated in the tank and which may result in damage to the equipment. The device shall operate at a static pressure less than the hydraulic test pressure of transformer tank. It shall be mounted directly on the tank. One set of electrically insulated contacts per device be provided for tripping. Contractor shall recommend type of protection desired when pressure relief device operates. Discharge pressure relief device operates shall be properly taken through pipes and directed away from the transformer. Other equipment and this shall be prevented from spraying on the tank. The terminal box/boxes of PRD should conform to degree of protection as per IP-55 of IS: 13947.

Following normal routine tests shall be conducted on PRD:

- (a) Air pressure test
- (b) Liquid pressure test
- (c) Contact test
- (d) Leakage test
- (e) Dielectric test

1.17.1.8 Buchholz Relay

A double float type buchholz relay shall be provided in the connecting pipe between the oil conservator and the transformer tank with at least a distance of five pipe diameters between them. Any gas evolved in the transformer shall collect in this relay. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation and taking gas sample. A copper or stainless steel tube, shall be connected from the gas collector to a valve located about 1200 mm above ground level to facilitate sampling with the transformer in services. **The device shall be provided with two electrically independent ungrounded contacts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.**

The Buchholz relay shall not operate during starting/stopping of the transformer oil circulation pumps under any oil temperature conditions. The use of pipe or relay aperture baffles shall not be used to decrease the sensitivity of the relay. The relay shall not malfunction for through fault conditions or be influenced by the magnetic fields around the transformer during the external fault conditions.

1.17.1.9 Foundation and anti earthquake clamping device

To prevent transformer movement during earthquake, suitable clamping device shall be provided for fixing transformer to the foundation. The Bidder shall supply necessary bolts for embedding in the concrete foundation. The arrangements shall be such that the transformer can be fixed to or unfastened from these bolts as and when required. The fixing of the transformers to the foundations shall be designed to withstand seismic events to the extent of static co-efficient of 0.3 g. Special steps must be taken to prevent mal-operation of Buchholz relay in such conditions.

1.17.1.10 Centre of gravity

The Centre of gravity of assembled transformer shall be as low and as near the vertical line as possible. The transformer shall be stable with and without oil. The location of the centre of gravity relative to track shall be clearly marked in the outline drawing.

1.17.1.11 Temperature Indicators**(a) Oil Temperature Indicator (OTI)**

Transformers shall be provided with dial type thermometer of about 150 mm size or digital thermometer for top oil temperature indication. The thermometer shall have adjustable, **electrically independent ungrounded alarm and trip contacts**, maximum reading pointer and resetting device shall be provided in the OTI. A temperature-sensing element suitable located in a pocket on top oil shall be furnished. This shall be connected to the OTI by means of capillary tubing. **Accuracy class of OTI shall be $\pm 1.5\%$ or better.** The temperature indicator dials shall have linear gradations to clearly read at least every 2° C.

The setting of alarm & tripping contacts shall be adjustable at site and typical values are as given below:-

Alarm- 85° C

Trip - 95° C

(b) Winding Temperature Indicator (WTI)

A device for measuring the hot spot temperature of each of the windings (HV, IV and LV) shall be provided. It shall comprise of the following:

- (i) Temperature sensing element.
- (ii) Image coil.
- (iii) Auxiliary CTs, if required, to match the image coil shall be provided and mounted in the cooler control cabinet.

- (iv) 150 mm dia (approximately) local indicating instrument with maximum reading pointer and two adjustable electrically independent ungrounded contacts (besides that required for control of cooling equipment), one for high winding temperature alarm and one for trip. The temperature indicator dials shall have linear graduations to clearly read at least every 2⁰ C.
- (v) Calibration device.
- (vi) Accuracy class of WTI shall be $\pm 1.5\%$ or better.

The setting of alarm & tripping contacts shall be adjustable at site and typical values are as given below:-

Alarm- 100° C

Trip - 110° C

- (vii) In addition to the above, the following indication equipment shall be provided for remote indication of winding temperature for each of the winding:
 - (a) Signal transmitter details are given in Annexure-I of this Section.

(b) Remote Winding Temperature Indicator (RWTI).

It shall be suitable for flush mounting on Purchaser's panel [**may be Remote tap changer control (RTCC) panel which is to be decided during detailed engineering**]. This shall not be repeater dial of local WTI and shall operate by signal transmitter. The difference between local and remote WT indication at any given time shall not exceed 1 Deg C.

- Auxiliary supply if required, in RTCC Panel, for Remote Winding Temperature Indicator (RWTI), shall be 220 V DC only.
- Any special cables required for shielding purpose, for connection between cooler control cabinet and Remote Winding Temperature Indicator (RWTI) control circuit shall be in Bidder's scope of work.
- Only one RWTI with a four point selector switch shall be provided for all the windings (HV, IV and/or LV).

1.17.1.12 Earthing Terminals

- (a) Two (2) earthing pads (each complete with two (2) nos. tapped holes, M 10 bolts, plain and spring washers) suitable for connection to 75x12 mm galvanized

steel grounding flat shall be provided each at position close to earth of the two (2) diagonally opposite bottom corners of tank.

- (b) Two earthing terminals suitable for connection to 75x12 mm galvanized steel flat shall also be provided on cooler marshalling box and any other equipment

1.17.2 Core

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

1.17.2.2 The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and production of flux component at right angles to the plane of laminations, which may cause local heating.

The temperature of any part of the core or its support structure in contact with oil shall not exceed 120° C under normal operating condition and 130° C under most extreme operating condition. Adequate temperature margin shall be provided to maintain the minimum life expectancy of 30 years for this material.

1.17.2.3 The insulation of core to bolts and core to clamps plates shall be able to withstand a voltage of 2 KV (rms) for one minute.

1.17.2.4 Core and winding shall be capable of withstanding the shock during transport, installation, and service. Adequate provision shall be made to prevent movement of core and winding relative to tank during these conditions and reduce vibrations to a minimum for all operation conditions.

1.17.2.5 All steel section used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding.

1.17.2.6 When core type construction is offered, suitable projecting guides shall be provided on core-assembly to facilitate removal from tank.

1.17.2.7 After shearing of laminations, the laminations shall be treated to remove all burrs. Each core lamination shall be insulated with a material that will not deteriorate due to pressure and hot oil. Paper and varnish insulation shall not be accepted. Nature of insulation shall be specified along with properties.

1.17.2.8 The supporting framework of core shall be so designed as to avoid presence of pockets which would prevent complete emptying of the tank through drain valve or cause trapping of air during oil filling.

1.17.2.9 The maximum flux density in any part of the core and yoke at rated MVA, normal voltage and frequency shall be such that under 10% over voltage condition it does not exceed 1.9 Tesla.

- 1.17.2.10 The bolts in the assembly of the core shall be suitably insulated and the clamping structure shall be so constructed that eddy currents are minimum.
- 1.17.2.11 Every care shall be exercised in the treatment and handling of core steel to ensure that the laminations are flat and that the finally assembled core is free from distortions.
- 1.17.2.12 Oil ducts shall be provided where necessary to ensure adequate cooling. The winding structures and major insulation shall not obstruct the free flow of oil through such ducts.
- 1.17.2.13 Adequate lifting lugs will be provided to enable the core & winding to be lifted.
- 1.17.2.14 The core shall be securely grounded directly to the tank in such a way that the ground connection can be detached, when required.**
- 1.17.2.15 In case core laminations are divided into sections by insulating barriers or cooling ducts parallel to the plane of the lamination, tinned copper bridging strips shall be inserted to maintain electrical continuity between sections. A drawing furnishing the details of the earthing design shall be included in the manual.
- 1.17.2.3 Windings**
- 1.17.3.1 The Supplier shall ensure that windings of all transformers are made in dust proof conditioned atmosphere. The Bidder shall furnish the details of the facilities available at his works along with the Bid.
- 1.17.3.2 The conductors shall be of electrolytic grade copper free from scales and burrs and shall have properly rounded corners to reduce electro-static flux concentration.
- 1.17.3.3 The insulation of transformer windings and connections shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically inactive in transformer oil during service. The insulation of coils shall be treated with a suitable insulating compound to develop the full electrical strength of windings.
- 1.17.3.4 Coil assembly and insulating spacers shall be so arranged as to ensure free circulation of oil and to reduce the hot spot of the winding.
- 1.17.3.5 Washers in contact with non-ferrous parts which carry current shall be of phosphor bronze.
- 1.17.3.6 The conductor shall be transposed at sufficient intervals in order to minimize eddy currents and to equalize the distribution of currents and temperature along the binding.
- 1.17.3.7 The windings shall be designed to withstand the dielectric tests specified.
- 1.17.3.8 Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratios.
- 1.17.3.9 The coils would be made up shaped and braced to provide for expansion and contraction due to temperature changes.

- 1.17.3.10 Individual loading of any winding should not exceed its rated capacity under any loading condition.
- 1.17.3.11 Air core reactance of the HV winding shall not be less than 20% and knee point voltage shall not be less than 1.1 per unit.
- 1.17.3.12 All permanent current carrying joints in the windings and the leads shall be made as per best manufacturing practice and shall be capable of giving trouble-free service.
- 1.17.3.13 The design of the power transformer shall ensure that the amplitude of surges transferred from the HV winding to the LV winding is effectively controlled well below the maximum limit admissible with the BIL of the LV winding.
- 1.17.3.14 In case the amplitude of transformed/transferred surges of the LV winding of the assembled transformers is found to be exceeding the safe limit and if considered desirable, the Contractor/ manufacture shall provide necessary surge protection for the LV winding and shall furnish the details of the surge protection arrangement during detailed engineering stage. Prices for surge protection arrangement shall be included in the prices of transformers; no extra payment on account of surge protection system shall be paid.
- 1.17.3.15 The barrier insulation including spacers shall be made from high-density pre-compressed pressboard to minimize dimensional changes.
- 1.17.3.16 All spacers shall have rounded edges and radially stepped spacers between winding disks will not be accepted.
- 1.17.3.17 The conductor insulations shall be made from high density paper having high mechanical strength.
- 1.17.3.18 Bracings of windings:**
- (a) All winding insulation shall be processed to ensure that there will be no detrimental shrinkage after assembly. All windings shall be presided before being clamped.
 - (b) Windings shall be provided with clamping arrangements, which will distribute the clamping forces evenly over the ends of the winding.
 - (c) The bracing of the windings and connections shall be such that these parts shall safely withstand the cumulative effects of stresses which may occur during handling, transportation, installation and service including line to line and line to line ground faults.
 - (d) Full details of the windings clamping arrangements, and their adjustment in or out of the tank together with relevant drawings and value, shall be submitted for evaluation and approval, and shall form part of the instruction manual.

1.17.3.19 Current carrying connections:

- (a) The mating faces of bolted connections shall be appropriately finished and prepared for achieving good long lasting, electrically stable and effective contacts.
- (b) All lugs for crimping shall be of the correct size for the conductors.
- (c) Connections shall be carefully designed to limit hot spot due to circulating eddy currents.

1.17.3.20 Winding terminations into bushings:

- (a) Winding termination interfaces with bushings shall be designed to allow for repeatable and safe connection under site conditions to ensure the integrity of the transformer in service.
- (b) The winding - end termination, insulation system and transport fixings shall be so designed that the integrity of the insulation system generally remained intact during repeated work in this area.
- (c) Allowances shall be made on the winding-ends for accommodating tolerance on the axial dimensions of the set of bushings and also for the fact that bushings may have to be rotated to get oil level inspection gauges to face in a direction for ease of inspection from ground level.
- (d) In particular, rotation or stringing of insulated connections shall be avoided during the fastening of conductor pads (or other methods) on the winding ends onto the termination surfaces of the bushing.
- (e) Suitable inspection and access facilities into the tank in the bushing oil-end area shall be provided to minimize the possibility of creating faults during the installation of bushings.

1.17.4 Insulating Oil

- 1.17.4.1 The quality of the transformer oil to be supplied with transformer shall conform to IS: 335 of latest edition with upto date amendments. The general parameters to which the oil shall conform and the test methods to be adopted are detailed in the table given below. However, wherever these differs from the latest edition of IS: 335 the parameters of IS: 335 (latest edition) shall prevail. The oil supplied with the transformer shall conform to all parameters specified below, while tested at supplier's premises. No inhibitors shall be used in the oil.

S No.	Characteristics	Requirement	Method of Test
1.	Appearance	The oil shall be clear and transparent and free from suspended matter or sediment.	A representative sample of oil shall be examined in a 100 mm thick layer, at ambient Temperature.
2.	Density at 29.5° C.	0.89g/cm ³ (Max.)	IS: 1448
3.	Kinematic viscosity at 27° C at 40° C	27 CST (Max.) Less than 9 CST (Max.)	IS: 1448
4.	Interfacial tension at 27° C (min.)	0.04 N/m	IS: 6104
5.	Flashpoint Penskey Marten (Closed) (Min.)	140° C	IS: 1448
6.	Pour point (Max.)	-6° C	IS: 1448
7.	Neutralization value (Total acidity) (Max.)	0.03 mg KOH/g	IS: 335 (Appendix 'A')
8.	Corrosive sulphur (in terms of classification of copper strip	Non-corrosive	IS: 1335 (Appendix 'B')
9.	Electric strength (breakdown voltage) (Min.) (a) New untreated oil (b) After treatment	30 KV (rms) (if the above value is Not attained, the oil shall be treated) 60 KV (rms)	IS: 6792
10.	Factor (tan delta) at 90° C	0.002 (Max.)	IS: 6262
11.	Specific resistance (resistivity) (Min.) (a) at 90° C (b) at 27° C	35x10 ¹² ohm-cm 1500x10 ¹² ohm-cm	IS: 6103
12.	Oxidation stability (a) Neutralisation value after oxidation (b) Total sludge after oxidation	0.4 mg KOH/gm (max.) 0.10% by weight (Max.)	
13.	Presence of oxidation Inhibitor	The oil shall not contain antioxidant Additives/inhibitors	IS: 335 (Appendix 'D')
14.	Water content (a) New untreated oil (b) after treatment	50 Ppm (Max.) 15 Ppm (Max.)	IS: 2362 IS: 1866
15.	Ageing characteristics After 96 hrs as per ASTM-D1934/IS:12177 With catalyst copper (a) Resistivity (i) at 27 ° C (ii) at 90 ° C (b) Tan delta at 90 ° C	2.5x(10) ¹² ohm cm (min) 0.2x(10) ¹² ohm cm (min) 0.2 (max.)	
	(c) Total acidity (d) Sludge content (e) PCB content	0.05 mg KOH/gm (Max.) 0.05% by weight (Max.) Less than 2 ppm	

1.17.4.2 At manufacture's works oil sample shall be drawn before, during and after heat run and dielectric test and shall be tested for the following:

- (a) Break Down Voltage (KV rms) 60 KV (min.)
- (b) Moisture content 15 ppm
- (c) Dissolved gas analysis(DGA):

Sample for DGA shall be taken from sampling device within 24 hrs prior to commencement of temperature rise test, during the test and after the test (as per approved plan). The acceptance norms with reference to various gas generation rates during the temperature rise test shall be as per IS: 10593 (based on IEC-60599)/CIGRE Guidelines.

1.17.4.3 Subsequently oil samples shall be drawn

- (a) Prior to filling the main tank at site and shall be tested for
 - i) BDV
 - ii) Moisture content
 - iii) Resistivity at 90°C.
 - iv) Tan delta at 90°C.
 - v) Inter facial tension

The acceptance norms for the above test shall be as per **Clause No. 1.17.4.1.**

- (b) Prior to engersization at site for following properties and acceptance norms:
 - i) Break Down Voltage (KV rms) 60 KV(min.)
 - ii) Moisture content 15 Ppm (max.)
 - iii) Tan delta at 90°C 0.05 (max.)
 - iv) Resistivity at 90°C 1x10¹² ohm-cm.(Min.)
 - v) Interfacial tension 0.03 N/m(Min.)

1.17.4.4 Sufficient quantity of oil necessary for maintaining required oil level in tank radiators and conservator, coolers along with 10% extra oil for topping up shall be supplied for Purchaser's use in non-returnable container suitable for outdoor storage.

1.17.4.5 Moisture content in the solid insulation

An oil/paper moisture equilibrium chart shall for the analysis of the moisture-in-oil results obtained from an oil sample taken after complete winding drying and oil filling in the tank at site. In order or ensure that equilibrium conditions are properly assessed, the sample shall be taken not earlier than 7 days after completing the oil and impregnation treatment. Recordings the temperature of transformer oil during sampling is essential.

With this sample it shall be demonstrated that the moisture content in the paper insulation body of the transformer is less than at least 0.5%.

1.17.4.6 Drying and Oil filling

1.17.4.6.1 Oil impregnation or drying under vacuum at site shall be done with the transformer and oil at a temperature not exceeding 80^o C.

1.17.4.6.2 The duration of the vacuum treatment shall be demonstrated as adequate by means of water measurement with a cold tap or other suitable method but shall generally not be less than 72 hours.

1.17.4.6.3 Vacuum shall not be broken until the transformer is oil filled up to the Buchholz relay. Whenever the active insulation or any paper insulation HV connections, especially those from the windings to the bushings are exposed, these shall be re-impregnated under vacuum along with the complete transformer. For this purpose the transformer shall first be drained to expose all insulation material.

1.17.4.6.4 Clear instructions shall be included in the maintenance manual regarding special precautionary measure which must be taken before applying the specified vacuum treatment. The maximum vacuum which the complete transformer/reactor can safely withstand without any special precautionary measures, shall also be stated in the maintenance manual.

1.17.4.6.5 The minimum safe level of oil filling (if different from the Buchholz level) to which transformer shall be oil filled under vacuum, shall be indicated in the manual.

1.17.4.6.6 Procedures for site drying, oil purification, oil fill etc. shall be submitted for approval and complete instructions shall form part of the manual.

1.17.5 Terminal Arrangement**1.17.5.1 Bushings**

1.17.5.1.1 The electrical and mechanical characteristics of bushing shall be in accordance with IS: 2099/IEC: 60137 and IS: 3347 (Part-III/Section-I)/DIN 42530.

1.17.5.1.2 245KV and 145KV bushings shall be hermetically sealed oil filled condenser type. 36KV bushing shall be solid porcelain or oil communicating type. Neutral bushing shall be of Porcelain. Dimensions of 36KV bushing shall conform to IS:3347 Part-V.

- 1.17.5.1.3 No arcing horns shall be provide on any bushings.**
- 1.17.5.1.4 Bushing shall be as per technical particulars furnished in **Clause no. 1 of Annexure-I: “ Auxiliaries”** off this section. Dimensions of bushing shall be furnished by the Contractor at detailed engineering stage.
- 1.17.5.1.5 Oil filled Condenser type bushings shall be provide with at least the following fittings:
- (a) Oil level gauge;
 - (b) Oil filling plug and drain valve if not hermetically sealed;
 - (c) Tap for capacitance/tan delta test.
- 1.17.5.1.6 Where current transformers are specified, the bushings shall be removable without disturbing the current transformers.
- 1.17.5.1.7 Bushings of identical rating shall be inter-changeable.
- 1.17.5.1.8 Porcelain used in bushing manufacture shall be homogenous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.
- 1.17.5.1.9 Glazing of porcelain and bushing shall be of uniform brown colour, free from blisters and burrs.
- 1.17.5.1.10 Special precaution shall be taken to exclude moisture from paper insulation during manufacture, assembly, transport and erection. The surface of all paper insulation shall be finished with non-hygroscopic varnish which can not be damaged easily.
- 1.17.5.1.11 Clamps and fittings shall be of hot dip galvanized steel and they shall be rust proof.
- 1.17.5.1.12 Bushings turrets shall be provide with vent pipes which shall be connected to route any gas collection through the Buchholz relay.
- 1.17.5.1.13 Bushings shall be robust and designed for adequate cantilever strength to meet the requirement of seismic condition, substation layout.
- 1.17.5.1.14 All details of the bushing shall be submitted for approval.
- 1.17.5.2 Terminal Connectors**
- 1.17.5.2.1 External terminals, clamps etc of the condenser type bushings and plain porcelain bushings shall be properly designed to avoid external corona during operation.
- 1.17.5.2.2 Bushing terminals shall be provided with terminal connectors of approved type and size for connection to external parts. Terminal connecters offered must have been successfully designed and type tested as per IS: 5561. The external current carrying contacts shall be silver plated/tinned adequately.

- 1.17.5.2.3 Terminal connectors for HV side shall be suitable for flexible conductor of required size which will be finalized during detailed engineering. These shall be suitable for either horizontal or vertical take off.
- 1.17.5.2.4 (a) All castings shall be free from blow holes, surface blisters and cavities. All sharp edges and corners shall be blurred and round off. The Aluminium alloy castings if used, shall conform to designation A6 of IS: 617.
- (b) No part of clamp shall be less than 10 mm thick.
- (c) All ferrous part shall be hot dip galvanized conforming to IS: 2633/ IS: 2629.
- (d) For bimetallic clamp, copper ally liner of minimum thickness of 2 mm shall be cast integral with aluminium body. Alternatively the bidder may offer bimetallic connector with losses terminal sleeves.
- (e) Flexible connections shall be made from tinned copper sheets.
- (f) Size of terminal/conductor for which the clamp is suitable and rated current under site conditions shall be embossed/punched on each component of the clamp, except hardware.
- (g) All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- (h) 245 KV clamps shall be corona controlled to achieve extinction voltage of 156 KV (rms).
- (i) The short time rating of terminal connector shall correspond to the short time rating of respective bushing.

1.17.6 Terminal Marking

The terminal marking and their physical position shall be in accordance with IS: 2026.

1.17.7 Bushing Current Transformers.

- 1.17.7.1 Current Transformers shall comply with IS: 2705/IEC: 60044-1.
- 1.17.7.2 It shall be possible to remove the turret mounted CT's from the transformer tank without removing the tank cover. Necessary precautions shall be taken to minimize the eddy currents and local heat generated in the turret.
- 1.17.7.3 Current Transformers secondary leads shall be brought to a weather proof terminal box near each bushing. These terminals shall be wired out to Cooler Control Cabinet/ marshalling boxes using separate cable for each core.

1.17.7.4 **Bushing CT parameters indicated in the specification are tentative and liable to change within reasonable limits. The Contractor shall obtain Purchaser's approval before proceeding with design of bushing CT's.**

1.17.7.5 Additional CT's shall be provided as may be required for winding temperature indicators for each winding and OLTC for parallel operation of the transformers. CT characteristics shall have to catch with protective relays, meters and instruments.

1.17.7.6 Technical parameters of BCT are detailed in Section-**" Specific Technical Requirements"**.

1.18 NEUTRAL EARTHING ARRANGEMENT.

1.18.1 The neutral terminal(s) of the star connected windings of three phase auto transformer shall be brought to the ground level by brass/tinned copper grounding bar through two independent paths, supported from the tank by porcelain insulation.

1.18.2 The end of the grounding bar of brass/tinned copper shall be brought to the bottom of the tank (to the ground level), at a convenient point, for connection to substation grounding mat through two(2) 75x12 mm galvanized steel flats at a single point to avoid any loop formation in the earthing circuit. The connection shall be made by using two bolted neutral grounding terminals with necessary accessories.

1.19 TAP CHANGING EQUIPEMENT.

1.20 AUXILIARY POWER SUPPLY FOR OLTC, COOLER CONTROL AND POWER CIRCUIT.

1.20.1 Duplicate (Main & Reserve) 415 volt, three phase, four (4) wire auxiliary Power Supplies shall be provided by the Purchaser at cooler control cabined for OLTC, cooler control and power circuit.

1.20.2 All loads shall be fed by one of the two feeders through an electrically interlocked automatic transfer switch housed in the cooler control cabinet for tap change control and cooler circuits.

1.20.3 Design features of the transfer switch shall include the following:

- (a) Provision for the selection of one of the feeders as normal source and other as standby.
- (b) Upon failure of the normal source, the loads shall be automatically transferred after an adjustable time delay to the standby source.
- (c) Indication to be provided at cooler control cabinet for failure of normal source and for transfer to standby source and also for failure to transfer.
- (d) Automatic re-transfer to normal source without any intentional time delay following – re- energization of the normal source.

- (e) Both the transfer & re-transfer shall be dead transfers and AC feeders shall not be paralleled at any time.

1.20.4 Power supply for OLTC circuits.

- (a) A.C. Feeder shall be brought to the locals OLTC control cabinet by the Bidder, after suitable selection at cooler control cabinet for which description is given in clause no. 1.21.2 & 1.21.3 above, for control power circuit of OLTC.
- (b) The Bidder shall derive AC power for OLTC control circuit from the AC feeder as mentioned above by using appropriately rated dry type transformers. IF the control circuit is operated by DC supply then suitable main & standby converters shall be provided by the Bidder to be operated from AC power source (Main & Standby).

1.20.5 Power supply for Cooler circuits.

- (a) Control and power supplies are to be given fro cooler circuit as mentioned in clause no. 1.21.2 & 1.21.3 above.
- (b) The Bidder shall derive AC power for Cooler control circuit from the Ac feeder as mentioned above. IF the control circuit is operated by DC supply then suitable main & standby then converters shall be provided by the Bidder to be operated from AC power source (Main & Standby).

1.20.6 Necessary isolating switches and HRC fuses shall be provided at suitable points as per Purchaser's approved scheme during detailed engineering.

1.21.1 General Requirements.

1.21.1.1 **In case of auto transformers, the On Load Tap Changer shall be provided on HV side with range +5% to -15% in steps of 1.25% (16 steps).**

1.21.1.2 OLTC gear shall be motor operated for local as well as remote operation. An external handle shall be provided for local manual operation. This handle shall be suitable for operation by a man standing at ground level.

1.21.1.3 Arrangement shall be made for securing and padlocking the tap changer wheel in any of the working positions and it shall not be possible for setting or padlocking the wheel in any intermediate position. The arrangement shall be such that no padlock key can be inserted unless all contacts are correctly engaged and switch set in a position where no open or short circuit is possible . An indicating device shall be provided to show the tap in use.

1.21.2 On Load Tap Changing Gear (OLTC)

- 1.21.2.1 Each three phase transformer shall be provided with tap changer for varying the effective transformation ratio (while the transformers are on load) without producing phase displacement.
- 1.21.2.2 The details of the method of diversion of the load current during tap changing, the mechanical construction of the gear and the control features for OLTC gear along with detailed drawings on inner view and the arrangement of connections shall be submitted with the bid. **Information regarding the service experience on the gear and a list of important users shall be furnished.**
- 1.21.2.3 The current diverting contacts shall be housed in a separate oil chamber not communicating with the oil in main tank of the transformer.
- 1.21.2.4 The contacts shall be accessible for inspection without lowering oil level in the main tank and the contact tips shall be replaceable.
- 1.21.2.5 The Bidder shall indicate the safeguards in order to avoid harmful arcing at the current diverting contacts in the event of operation of the OLTC gear under over-load conditions of the transformer. Necessary tools and tackles shall be furnished for maintenance of OLTC gear.
- 1.21.2.6 The OLTC oil chamber shall have oil filling and drain plug, oil sampling valve, relief vent and level glass. It shall also be fitted with a Buchholz relay, the outlet of which shall be connected to a separate conservator tank.
- 1.21.2.7 The diverter switch or arcing switch shall be so designed as to ensure that its operation once commenced shall be completed independently of the control relays or switches, failure of auxiliary supplies etc. To meet any contingency which may result in incomplete operation of the diverter switch, adequate means shall be provided to safeguard the transformer and its ancillary equipment.
- 1.21.2.8 Tap changer shall be so mounted that bell cover of transformer can be lifted without removing connections between windings and tap changer.
- 1.21.2.9 Local OLTC Control Cabinet shall be mounted on the tank in accessible position. It should be adequately ventilated and provided with anti condensation metal clad heaters. All contactors, relay coils and other part shall be protected against corrosion, deterioration due to condensation, fungi etc.
- 1.21.2.10 An ON-OFF tap changer control switch shall be provided in the local OLTC control cabinet for transformer. The tap changer shall be inoperative in the OFF position.

- 1.21.2.11 Operating mechanism for on load tap changer shall be designed to go through one step of tap changer per command. Subsequent tap changes shall be initiated only by a new or repeat command.
- 1.21.2.12 On load tap changer shall be equipped with a time delayed INCOMPLETE STEP alarm consisting of a Normally Open contact which closes, if the tap changer fails to make a complete tap changer, The alarm shall not operate for momentary loss auxiliary power.
- 1.21.2.13 The Selwyn units of approved equivalents shall be installed in the local OLTC control cabinet to provide tap position indication for the transformer. The Bidder shall also provide a loose set of instruments for tap position indication in the control room. Complete mounting details shall be included in the approved diagram.
- 1.21.2.14 Transformer on load tap changer shall be equipped with a fixed resistor network capable of providing discrete voltage steps for input to the supervisory system.
- 1.21.2.15 Limit switches shall be provided to prevent overrunning of the mechanism and shall be directly connected in the circuit of the operating motor. In addition, a mechanical stop shall be provided to prevent overrunning of the mechanism under any condition.
- 1.21.2.16 Limit switches may be connected in the control circuit of the operating motor provided that a mechanical –de-clutching mechanism is incorporated.
- 1.21.2.17 Thermal device to other means shall be provided to protect the motor and control circuit. All relays, switches, fuses etc. shall be mounted in the local OLTC Control Cabinet and shall be clearly marked for the purpose of identification.
- 1.21.2.18 A permanently legible lubrication chart, if required, shall be fitted within the local OLTC control cabinet.
- 1.21.2.19 Any ‘DROP DOWN’ tank associated with the tap changing apparatus shall be fitted with guide rod to control the movements during lifting or lowering.
- 1.21.2.20 A counter of at least five-digits shall be fitted to the tap changing equipment to indicate the number of operations completed and shall have no provision for resetting.
- 1.21.2.21 All relays and operating devices shall operate correctly at any voltage between the limits specified.
- 1.21.2.22 It shall not be possible to operate the electric drive when the manual operating gear is in use.
- 1.21.2.23 It shall not be possible for any two controls to be in operation at the same time.
- 1.21.2.24 **The equipments shall be suitable for supervisory control and indication with make before break multi-way switch, having one potential free contact for each tap position. This switch shall be provided in addition to any other switch/switches which may be required for remote tap position indication.**

- 1.21.2.25 Operation from the local or remote control switch shall cause one tap movement only until the control switch is returned to the off position between successive operations.
- 1.21.2.26 All electrical control switches and the local operating gear shall be clearly labelled in a suitable manner to indicate the direction of tap changing.
- 1.21.2.27 Transfer of source in the event of failure of one AC supply shall not affect tap-changing operation.

1.21.3 OLTC Control

1.21.3.1 Control of Three Phase Transformer

Each three-phase transformer shall be suitable for local and remote control. The control feature shall provide the following:

1.21.3.1.1 Local electrical control

(a) 'Local-remote' selector switch mounted in the local OLTC control cabinet shall

Switch control of all load tap changers as follows:

- (i) When the selector switch is in 'local' position, it shall be possible to operate the 'raise-lower' control switches specified in clause 2.22.3.1.1(b) below. Remote control of the raise lower functions shall be prevented.
- (ii) When the selector switch is in 'remote' position the local OLTC control cabinet mounted 'raise-lower' switch specified in clause 2.22.3.1.1(b) below shall be in-operative. Remote control of the raise/lower function shall be possible from the remote control panel. The local remote selection switch shall have at least two spare contacts per position, which are closed in that position but open in the other position.
- (b) A 'raise-lower' control switch/push button shall be provided in the local OLTC control cabinet. This switch shall be operative only when 'local remote' selector switch is in 'local' position.
- (c) An OFF-ON tap changer control switch shall be provided in the local OLTC control cabinet of the transformer. The tap changer shall be in-operative in the OFF position. Also the OFF-ON switch shall have at least one spare contact per position, which is closed in that position, which is closed in that position but open in the other position.

1.21.3.1.2 Manual control

The cranking device for manual operation of the OLTC gear shall be removable and suitable for operation by a man standing at ground level. The mechanism shall be complete with the following:

- (a) Mechanical tap position indicator which shall be clearly visible from near the transform.
- (b) A mechanical operation counter.
- (c) Mechanical stops to prevent over cranking of the mechanism beyond the extreme tap positions.
- (d) The manual control considered as back up to the motor operated load tap changer control shall be interlocked with the motor to block motor start up during manual operation. The manual operating mechanism shall be labelled to show the direction of position of operation for raising the HV terminal voltage and vice-versa.

1.21.3.1.3 Remote electrical group control

The OLTC control scheme offered shall have provision of remote electrical group control during the parallel operation of transformer. This is in addition to independent control of OLTC:

- (a) A four position selector switch having "Master", "Follower", "Independent" and "Off" position shall be provided in the remote OLTC control panel for each transformer. This shall be wired to enable operator to select operation of OLTC in "Master", "Follower" or "Independent" mode.
- (b) Out of step relays with timer contacts shall also be provided to give alarm and indication in case tap position in all the transformers under group control are not in same position.
- (c) **Master Position**

If the selector switch is in "Master" position, it shall be possible to control the OLTC units in the "Follower" mode by operating the control of the master unit. Independent operation of the units under "Follower" mode shall have to be prevented. However the units under "Independent" mode will be controlled independently.
- (d) **Follower Position**

If the selector switch is in "Follower" mode, control of OLTC shall be possible only from panel of the Master unit.
- (e) **Independent Position**

In this position of selector switch, control of OLTC of Individual unit shall only be possible.

1.21.4 The control circuit shall comply with following conditions:

- (a) An interlock to cut off electrical control automatically upon recourse being taken to the manual control in emergency.
- (b) Reinforcement of the initiating impulse for a tap change, ensuring a positive completion once initiated to the next (higher or lower) tap.
- (c) "Step by step" operations ensuring only one tap change from each tap changing impulse and a lock out of the mechanism if the control switch (or push button) remains in the "operate" position.
- (d) An interlock to cut-out electrical when it tends to operate the gear beyond either of the extreme tap positions.
- (e) An electrical interlock to cut-off counter impulse for reverse step change being initiated during a progressing tap change and until the mechanism comes to rest and resets circuits for a fresh position.
- (f) Tap change in progress indication shall be provided by means of an indicating lamp at the Purchaser's control panel. Necessary contacts for this and for remote tap position indicator at Purchaser's control panel shall be provided by the Bidder.
- (g) Protective apparatus, considered essential by the Bidder according to specialities of the gear.

1.22 COOLING SYSTEM AND ITS CONTROL**1.22.1 Type of Cooling**

The design of cooling system shall satisfy the performance requirement.

1.22.1.1 The transformer shall be of ONAN/ONAF/OFAF cooled type and shall be capable of delivering its full rated output under OFAF cooling. The ONAN rating of the transformers shall be guaranteed at 60% of the OFAF rating and rating under ONAF condition although un-guaranteed shall be about 80% of the OFAF rating.

1.22.1.2 The transformer cooling shall be effected by the use of 2x50% radiator banks or coolers. Each 50% bank shall have adequate number of fans and/pumps and standby fan and/pump. The required nos. of standby fans and/pumps of approximately 20% capacity shall also be provided with each radiator bank.

1.22.1.3 Each radiator bank shall have its own cooling fans, oil pumps, oil flow indicator, shut off valves at the top and bottom (at least 80 mm size), lifting lugs, top and bottom oil filling valves, air release plug at the top, a drain and sampling valve and thermometer pocket fitted with captive screw cap on the inlet and outlet.

1.22.1.4 Transformer shall be capable of operating at full load 10 minutes after failure of the oil circulating pumps and fans/blowers without the calculated winding hot spot temperature exceeding 150 deg C. Transformers shall be capable of operating for 20 minutes in the event of the failure of oil circulating pumps of blowers (or fans) associated with all cooler banks except one cooler bank, without the calculated winding hot spot temperature exceeding 150 deg C.

1.22.2 Oil Natural Air Forced Cooling (ONAF)

1.22.2.1 The transformer shall be fitted with tubular type detachable radiators fabricated from pressed steel of adequate thickness with built in AC motor driven fans for air blast cooling. The air force shall be well directed for uniform cooling over the radiator surface. The air force should not be directed to the main tank in any case.

1.22.2.2 Air blowers shall be complete with all necessary air ducting. Coolers shall be designed so that they operate with the minimum noise or drumming. In order to reduce the transmission of noise and vibration, the blowers shall be either mounted independent of the coolers or alternatively an approved frame of anti vibration mounting shall be adopted. The fans shall be provided with guards of close mesh wire netting for safety. It shall be possible to remove the blowers complete with motor without disturbing or dismantling the cooler structure framework. Fans shall have double (Mains + Standby) source of electrical power supply. Facilities and devices for automatic changeover from running source to standby source in the event of failure of running source shall be provided. The fans shall be so located to prevent ingress of rainwater.

1.22.2.3 A cooler control cabinet of weatherproof construction shall be provided at the transformer for housing control equipment for the fans. It shall be complete with hinged door and pad lock arrangement, thermostatically controlled space heaters to prevent condensation, cubicle light switch and cable terminal glands, air circuit breaker/MCCB of adequate capacity for the incoming supply and MCB for each fan motor.

1.22.2.4 The terminal connection of fan motors shall be accessible and the greasing possible without the need for removing any fan guards.

1.22.2.5 Moving parts of motor and pump, if provided, shall be readily removable without dismantling the coolers, without draining the oil in the transformer tank and with minimum slippage of oil.

1.22.2.6 Fans shall be so located that they are readily accessible for inspection and repair. Heat exchangers, fans and oil pumps shall be completely interchangeable.

1.22.3 Oil Forced and Air Forced Cooling (OFAF)

1.22.3.1 The transformer shall be equipped with circulating pumps, driving motors, fans and associated control gear, pipes, valves, flow indicators etc., so as to provide as complete independent oil forced and air forced type of cooling system for the transformer.

- 1.22.3.2 Each cooler/radiator bank shall be provided with two (2) nos. of a totally enclosed oil immersed 100% centrifugal or axial on line oil pump (out of which one pump shall be standby) with forced air-cooled heat exchangers and motors. Motors and pumps shall be enclosed in all oil tight containers with motor leads brought out through hermetically sealed bushings. Each cooler unit shall be arranged for detaching without draining the oil in the transformer tank. Moving parts of motor and pump shall be readily removable without dismantling the coolers and with minimum slippage of oil. Pump shall have impeller so as to permit oil circulation, when pump is idle. Fans shall be so located that they are readily accessible for inspection and repair. Heat exchangers, fans and oil pumps shall be completely interchangeable.
- 1.22.3.3 The oil pump motor shall be of low speed. Measures shall be taken to prevent maloperation of Buchholz relay due to surge caused by starting of all the oil pumps together.
- 1.22.3.4 The oil pumps shall be so designed that on failure of power supply to the pump motor, the pump impeller will not limit the natural circulation of oil by convection. Technical details for the oil pumps shall be submitted to Purchaser for approval.
- 1.22.3.5 Cooler units shall be designed to withstand pressure conditions specified for the tank but all components entering into the oil circuit shall be capable of withstanding an internal over pressure without leakage occurring at oil temperature of 100 deg. C.
- 1.22.3.6 Cooler units shall be so designed as to be accessible for cleaning and painting which prevent accumulation of water on outer surfaces, permit complete draining of oil in the tank and prevent formation of gas pockets when tank is being filled. Proper clearance shall be kept between all pipe works and live parts.
- 1.22.3.7 Cooler units shall be connected to tank by machined steel flanges welded to cooler units and tank provided with gaskets. At each cooler unit connection, two valves of 100 mm size shall be provided between the tank and cooler unit, which can be padlocked in either open or closed position. A separate oil tight blanking plate shall be provided for each tank connection for use when cooler unit is detached. The blanking plates when not in use shall be bolted to suitable structure on the tank. Each cooler unit shall have lifting eye, an oil drain valve at the bottom with plug and a vent valve with plug at the top. A valve for sampling oil shall also be provided at the bottom of cooling units.
- 1.22.3.8 An oil flow indicator with alarm contacts shall be supplied with each pump assembly to indicate normal pump operation and direction of oil flow. Disposition of flow indicator shall be shown in the schematic diagram of the cooling system. An indication shall be provided in the flow indicator to indicate reverse flow of oil/loss of oil flow.
- 1.22.4 Cooler Control**
- 1.22.4.1 Cooling system shall be suitable for automatic, local manual and remote operation and necessary devices for these modes of operations shall be provided. Each motor or group of

motors (for cooler fans and oil pumps) shall be provided with contractor and control gear of suitable design both for starting and stopping the motor manually and also automatically.

- 1.22.4.2 Automatic control operation of fans/pumps shall be provided (with temperature change) from the contacts of the Winding Temperature Indicator (WTI). Selector switches and push buttons shall also provided in the cooler control cabinet to disconnect the automatic control and start/stop the fans and pump manually.
- 1.22.4.3 Each cooling fan and oil pump motors shall be provided with thermal overload, short circuit and single phasing protection. MCB shall be provided for main supply and for supply to each fan and pump.
- 1.22.4.4 The Bidder shall recommend the setting of WTI for automatic change over of cooler control from ONAN to ONAF and then to OFAF. The setting shall be such that is no hunting (i.e. frequent start up operations for small temperature differences) do not occur. All control and indicating devices for the cooling system shall be supplied and mounted in transformer marshalling box or a separate control cabinet, if necessary.
- 1.22.4.5 The changeover to standby radiator bank oil pump in case of failure of any service oil pump shall be automatic.
- 1.22.4.6 All cooling fans and oil pump motors shall be suitable for operation on 415 1.22.4.1, 3 phase, 50 Hz a.c. supply system and shall confirm to latest edition of IS:325/IEC:34 as amended upto date except when specified otherwise.
- 1.22.4.7 When blowers and oil pumps are provided, the connections shall be arranged so as allow the motors or group of motors to be started up and shut down either collectively or individually.
- 1.22.4.8 Suitable manual control facility for cooler fans and oil pumps shall be provided.
- 1.22.4.9 Adequate warning/safety labels are required to indicate that the fans may start at any time
- 1.22.4.10 All settings shall be adjustable.
- 1.22.4.11 If any one group(s) is out of service and isolated, this shall not affect the automatic starting of the other radiator banks.
- 1.22.4.12 All motor contractors and their associated apparatus shall be capable of holding in and operating satisfactorily without overheating for a period of 10 minutes if the supply voltage falls for that period to 75 per cent of normal voltage at normal frequency. The motor contractor and associated apparatus shall also be capable of continuous operation with a supply voltage of 85 percent of normal value and at normal frequency. The terminals of the motors shall be marked.

1.22.4.13 Alarm & Indications

(a) The following alarm initiating devices shall be included in the transformer cooling system:

- i) 415 V cooler supply auto changeover
- ii) Cooling fan failure for each radiator bank
- iii) Oil pump failure for each pump

(b) The following indication shall be provided in cooler control cabinet:

- i) Cooling fans start
- ii) Oil pump start
- iii) Cooling system on automatic control
- iv) Cooling system on manual control
- v) Selector switch in auto or manual for each group of fan and pumps
- vi) No flow or reverse flow of oil for pumps
- vii) Cooler supply failure for each supply
- viii) Control supply failure for main and stand by
- ix) Cooling fan failure for each cooling fan
- x) Cooling pump failure for each pump
- xi) Common thermal overload trip

1.22.4.14 One potential free initiating contact for all the above conditions shall be wired independently to the terminal blocks of the cooler control cabinet exclusively for purchaser's use.

1.22.5 The cooler and its accessories shall preferably be hot dip galvanized or corrosion resistant paint should be applied to it.

1.22.6 Expansion joints shall be provided, on top and bottom cooler pipe connections as per requirement.

1.22.7 Air release device and oil plug shall be provided on oil pipe connections. Drain valves shall be provided in order that each section of pipe work can be drained independently.

1.23 LOCAL OLTC CONTROL CABINET, COOLER CONTROL CABINET AND REMOTE TAP CHANGER CONTROL PANEL (RTCC)

- (a) Each three-phase transformer unit shall be provided with local OLTC control cabinet, cooler cabinet and RTCC panel.
- (b) The sheet steel used for cooler control cabinet and local OLTC control cabinet shall be at least 2.5 mm thick. The degree of protection shall be IP:55 in accordance with IS:13947/IEC:947. The gaskets used shall be of neoprene rubber. All the separately mounted cabinets and panels shall be free standing floor mounted type and have sloping roof. All the control cabinets shall be provided with suitable lifting arrangement.
- (c) A space heater and cubicle lighting with ON-OFF switch shall be provided in each panel.
- (d) Necessary shorting of terminals shall be done at cooler control cabinet, local OLTC cabinet and remote OLTC panel. All the CT secondary terminals in the cooler control cabinet shall have provision for short-circuiting to avoid CT open circuit while it is not in use.

1.23.1 Local OLTC control cabinet

The local OLTC control shall house all necessary devices meant for OLTC control & indication.

The auxiliary devices for electrical control of the OLTC shall be housed in a weatherproof cabinet. The local OLTC control cabinet shall be complete with the following:

- (a) A circuit breaker/contractor with thermal overload devices for controlling the AC auxiliary supply to the OLTC motor.
- (b) Cubicle light with door switch.
- (c) Space heaters to prevent condensation of moisture.
- (d) Pad locking arrangement for hinged door of cabinet.
- (e) Cable terminal glands for power and control cables to the OLTC gear.

- (f) The following alarm initiating devices shall be provided on the local OLTC control cabinet:
- i) Failure of AC supply to OLTC control panel.
 - ii) Tap change in progress.
 - iii) Tap changers of all parallel operating transformers are not on the same tap.

1.23.2 Cooler Control Cabinet

- (a) The cooler control cabinet shall have all necessary devices meant for cooler control and local temperature indicators. All the contacts of various protective devices mounted on the transformer and all the secondary terminals of the bushing CTs shall also be wired upto the terminal board in the cooler control cabinet. All the necessary terminals for remote connection to Purchaser's C&R panel shall be wired upto the cooler control cabinet.
- (b) The cooler control cabinet shall have two (2) sections. One section shall have the control equipment exclusively meant for cooler control. The other section shall house the temperature indicators, aux. CTs and the terminal boards meant for termination of various alarm and trip contacts as well as various bushing CT secondary. Alternatively the two sections may be provided as two separate panels depending on the standard practice of the Bidder.
- (c) The Temperature indicators shall be so mounted that the dials are not more than 1200 mm from ground level. Glazed door of suitable size shall be provided for convenience of reading.
- (d) One cooler control cabinet of each type shall be tested for IP:55 protection in accordance with IS:13947.

1.23.3 Remote Tap Changer Control (RTCC)

- (a) The Contractor shall supply a Remote Tap Changer Control (RTCC) panel for remote operation of On Load Tap Changing gear.
- (b) The RTCC panel shall be located in Purchaser's control room. The size and colour of the RTCC panel to be supplied by the Contractor shall match with Purchaser's Control panel. The matching details shall finalized during detailed engineering.
- (c) The RTCC panel shall house the actuating switch for electrical raise/lower control, tap position indicator, signal lamps for "Tap changer in progress" and "Tap changer out of step", switch for failure of AC supply to OLTC motor and other auxiliary devices for the remote electrical control of OLTC. **For tap position indicator, the dual**

output type OLTC transducer shall be provided in the RTCC panel. The one of the output of this transducer shall be used for local indication of tap position in RTCC panel and other output (0-10 mA or 4-20 mA) shall be used for RTUs/automation system.

- (d) “Auto-Manual” maintained contact selector switch for each transformer for parallel operation of transformer and “Master-Follower” maintained contact selector switch for each transformer for parallel operation of transformer shall be provided in RTCC Panel.

1.24 CONTROL CABINET/MARSHALLING BOX

1.24.1 All control cabinets, panels and marshalling boxes being supplied as transformer accessories except for remote control panels shall be suitable for outdoor operation.

1.24.2 Local control cabinets and marshalling boxes shall preferably be mounted on the transformer tank. In case, control cabinets cannot be conveniently mounted on the transformer tank, floor mounting type cabinets may be offered suitable for mounting on foundations near the transformers.

1.24.3 The external cables shall terminate at the central control cabinet for which necessary termination arrangement shall be provided. The central control cabinet shall be provided with adequate number of terminal strips. All the terminals for remote connection shall be wired upto the central control cabinet from the individual local control cabinet viz, cooler control cabinet. OLTC control cabinet etc.

1.24.4 Other requirements of control cabinets/marshalling box are given in clause No.2.0 of Annexure-1: Auxiliaries of this section.

1.25 BOLTS & NUTS

1.25.1 All bolts & nuts exposed to atmosphere shall be of hot dip galvanized steel.

1.26 FITTINGS AND ACCESSORIES

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

- (a) Conservator for main tank with oil filling hole and cap, isolating valves, drain valve, magnetic oil level gauge with low level alarm contacts, minimum – maximum – normal oil level indicator dehydrating breather with oil seal.
- (b) Conservator for OLTC with drain valve, oil surge relay, filling hole with cap, prismatic oil level gauge and silica gel breather.
- (c) Signal transmitter: as detailed in Annexure-I: Auxiliaries of this section
- (d) Pressure relief device with alarm/trip contact

- (e) Buchholz relay double float/reed type with one shut off/isolating valve (80 mm size) on both sides, bleeding pipe with test cock at the end to collect gases, alarm and trip contacts. (Rating: 1 Amp, 220 V DC), gas collection box and gas check valve at ground level.
- (f) Air release plug
- (g) Inspection openings and covers
- (h) Bushing with metal parts and gaskets to suit the termination arrangement.
- (i) Winding temperature indicators for local and remote mounting.
- (j) Oil temperature indicators.
- (k) Oil preservation equipment.
- (l) Oil flow indicator.
- (m) Cooling accessories.
- (n) Cover lifting eyes, transformer lifting lugs, jacking pads, towing holes and core and winding lifting lugs.
- (o) Protected type mercury or alcohol in glass thermometer.
- (p) The rating and diagram plates on transformers and auxiliary apparatus.
- (q) Two Earthing terminals
- (r) Flanged bi-directional wheels/trolley for movement
- (s) Cooler control cabinet
- (t) On load tap changing equipment and OLTC control cabinet/cooler control cabinet
- (u) Drain valves/plugs shall be provided in order that each section of pipe work can be drained independently.
- (v) Bushing CTs.
- (w) Insulating oil.
- (x) Terminal marking plate
- (y) Lifting bollards
- (z) Haulage lugs
- (aa) Weather proof marshalling box for housing control equipment and terminal connections

- (bb) Valve schedule plate
- (cc) Valves:
 - i) Oil valves between cooler and main tank
 - ii) Drain valve with padlocking arrangement (size:100mm)
 - iii) Two filter valves (size: 50 mm) on diagonally opposite ends-one at top and other at bottom with padlocking arrangement on bottom valve.
 - iv) Two sampling valves (size: 15 mm) at top and bottom of main tank.
 - v) Weather proof marshalling box for equipment & control terminal connections.

Note: The fittings listed above are only indicative and any other fittings, which generally are required for satisfactory operation of the transformer are deemed to be included at no extra cost to the purchaser.

1.27 MOTORS

1.27.1 Motors for fans, OLTC shall conform to IS:325 shall be of self ventilated type having totally enclosed fan cooled enclosures. Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment. Motor winding insulation shall be conventional class "B" type. Motors shall be provided with starter, thermal overload, short circuit and single phasing protection. Motors shall have hose proof enclosure equivalent to IP: 55 as per relevant IS.

1.28 INSPECTION, TESTING AND INSPECTION CERTIFICATES.

1.28.1 The Transformer equipment/material shall be offered for inspection in accordance with relevant clauses of **Section- "General Technical Requirements"**.

1.28.2 In accordance with the requirements stipulated in relevant clauses of Section-"General Technical Requirements", the transformer along with its accessories should have been successfully type tested as per IEC-60076/IS-2026 and shall subject to routine and acceptance tests as per IEC:60076/IS-2026.

1.28.3 The test reports of all type tests as per IEC: 60076/IS-2026, IS: 9921/IEC: 129, if not submitted with the bid or with the post bid clarification shall be submitted by the bidder during detailed engineering stage.

1.28.4 All additional type tests, additional routine tests and special tests listed in Clause No: 1.28.11.2, 1.28.11.4 and 1.28.11.5 shall be carried out in presence of Purchaser's representative.

1.28.5 Cabinet/Panel of each type should have been tested for IP-55 degree of protection in accordance with IS:13947/relevant IEC. Copy of these type test report shall be submitted by the contractor at detailed engineering stage.

1.28.6 The contractor shall furnish a comprehensive testing and inspection programme for inspection and testing of transformer during the manufacture of transformer. The type of the inspection envisaged by the Purchase/Owner is given in Clause no: 1.28.10. A typical test plan is given in Cl. No: 1.28.11. However this is not a comprehensive programme as it is contractor's responsibility to draw up and carry out such programme in the form of detailed quality assurance plan indicating customer hold points duly approved by the Purchaser/Owner for necessary implementation. The requirement of Quality Assurance Plan (QAP) are indicated in Section-"General Technical Requirements" of this document.

1.28.7 Bushings insulting oil and accessories shall comply with the requirements of type and routine tests specified in Clause No: 1.28.11.6 to 1.28.11.13.

1.28.8 No equipment/ material shall be despatched until the test report are duly approved by the purchase or his representative and Material Despatch Clearance Certificate (MDCC) is issued

1.28.9 **MANUFACTURING AND TESTING FACILITIES**

1.28.9.1 The Bidder shall submit details of test facilities available at the bidder's/ manufacturer's works for carrying out all the routine and type tests as specified. Any limitations shall be clearly stated by the Bidder.

1.28.9.2 In case the test facilities for any particular test are not available in the bidder's/Manufacturer's works, the proposed arrangement of carrying out of that test shall be clearly indicated. The supplier shall bear all additional costs related to tests which are not possible to carry out at his own works.

1.28.10 **INSPECTION**

1.28.10.1. **TANK AND CONSERVATORS**

- a) Certification of chemical analysis and material tests of plates.
- b) Check for flatness
- c) Electrical interconnection of top and bottom by braided tinned copper flexible.
- d) Welder's qualification and weld procedure.
- e) Testing of electrodes for quality weld base materials and coatings.
- f) Inspection major weld preparation.
- g) Crack detection of major strength of weld seams by dye penetration test.
- h) Measurement of film thickness of:
 - i) Oil insoluble varnish.
 - ii) Zinc chromate paint
 - iii) Finished coat
- i) Check correct dimensions between wheels, demonstrate turning of wheels, through 90 deg. C and further dimensional check.
- j) Check for physical properties of materials for lifting lugs, jacking pads, etc. All load bearing welds including lifting lugs welds shall be subjected to Non Destructive Testing (NDT).
- k) Leakage tests of the conservator.
- l) Certificate of all test results.

1.28.10.2 CORE

- a) Sample testing of core materials for checking specific loss, bend properties, magnetisation characteristics and thickness.
- b) Check on the quality of varnish if used on the stampings.
 - i) Measurement of thickness and hardness of varnish on stampings.
 - ii) Solvent resistance test to check that varnish does not react in hot oil.
 - iii) Check over all quality of varnish by sampling to ensure uniform shining colour, no bare spot, no over burnt varnish layer and no bubbles on varnished surface.
- c) Check on the amount of burrs.
- d) Bow check on stampings.
- e) Check for overlapping of stampings. Corners of the sheet are to be flat.
- f) Visual and dimensional check during assembly stage.
- g) Check for interlaminar insulation between core sections, before and after pressing.
 - h) Check on complete core for measurement of iron loss and check for any hot spot by exciting the core so as to induce the designed value of flux density in the core.
 - i) Visual and dimensional check for straightness and roundness of core, thickness of limbs and suitability of clamps.
 - j) High voltage test (2KV for one minute) between core and clamps.
 - k) Certification of all test results.

1.28.10.3 INSULATING MATERIAL:

- a) Sample check for physical properties of materials.
- b) Check for dielectric strength.
- c) Visual and dimensional checks.
- d) Check for reaction of hot oil on insulating materials.
- e) Dimension stability test at high temperature for insulating material.
- f) Tracking resistance test on insulating materials.
- g) Check for tensile strength.
- h) Certification of all test results.

1.28.10.4 WINDING

- a) Sample check on winding conductor for mechanical properties and electrical conductivity.
- b) Visual and dimensional checks on conductor for scratches, dent marks etc.
- c) Sample check on insulating paper for pH value, bursting strength, electric strength.
- c) Check for the reaction of hot oil on insulating paper.
- d) Check for bonding of the insulating paper with conductor.
- e) Check and ensure that physical condition of all material taken for winding is satisfactory and free of dust.
- f) Check for absence of short circuit between parallel strands.
- g) Check for brazed joints wherever applicable.
- h) Measurement of voltage ration to be carried out when core/yoke is completely restacked and all connections are ready.
- i) Conductor enamel tests for checking of cracks, leakage and pin holes.
- j) Conductor flexibility test.
- l) Heat shrink test for enamelled wire.
- m) Certification of all test results.

1.28.10.5 CHECKS BEFORE DRYING PROCESS

- a) Check condition of insulation on the conductor and between the winding.
- b) Check insulation distance between high voltage connection, cables and earth and other live parts.
- c) Check insulation distances between low voltage connection and earth and other parts.
- d) Insulation test of core earthing. Insulation of the core shall be tested at 2KV/Min. Between core to bolts and core to clamp plates.
- e) Check for proper cleanliness and absence of dust etc.
- f) Certification of all test results.

1.28.10.6 CHECK DURING DRYING PROCESS

- a) Measurement and recording of temperature, vacuum and drying time during vacuum treatment.
- b) Check for completeness of drying by periodic measuring IR and Tan delta.
- c) Certification of all test results.

1.28.10.7 ASSEMBLED TRANSFORMER

- a) Check completed transformer against approved outline drawings, provision for all fittings, finish level etc.
- b) Die penetration test shall be carried out after jacking test.
- c) Jacking test with oil on all the assembled transformers.
- d) Test to check effectiveness of shielding of the tank.

1.28.10.8 OIL

Site tests shall be performed on oil samples before and after filling in the transformer. Oil parameters shall conform to Clause- No: 1.17.4 prior to filling at site and oil samples taken from the tank top, bottom and cooling system (after filling) shall possess characteristics indicated in Clause- No: 1.17.4. The contractor shall warrant that oil furnished is in accordance with the specification as given under Clause. No: 1.17.4.

1.28.10.9 BOUGHT OUT ITEMS

The manufacturer's name/makes of all major bought out items shall be subject to purchaser's approval. The contractor shall also prepare a comprehensive inspection and testing programme for all brought out/sub contracted items(as per relevant IS) and shall submit the same to the Purchaser for approval. The purchaser reserves the right to insist for witnessing the acceptance, routine testing or waiving off of tests of the bought out item. Such programme shall include the following components:

- (a) Buchholz Relay.
- (b) Axles and wheel
- (c) Winding temperature indicators for local and remote counting.
- (d) Oil temperature indicators.
- (e) Bushings.
- (f) Bushings current transformers
- (g) Cooler control cabinet/OLTC control cabinet.
- (h) Cooling equipments

- (i) Fans/air Blowers
- (j) Oil pumps
- (k) Auxiliary motors and motor starting contact
- (l) On Load Tap change gear.
- (m) Pressure relief device
- (n) Terminal connect ors
- (o) Control devices
- (p) Oil level indicator
- (q) Radiator
- (r) Pressure gauges

The above list is not exhaustive and the Contractor shall also include other bought out items in his programmer.

The list of transformer accessories and routine test certificates required for them are given in **Annexure-II of this Section**. The Manufacturer's test report shall be submitted by the Contractor for approval of Purchaser/Owner.

1.28.11 TESTINGS

Atypical test plan is indicated below:

S. No.	Item	Test Category	First unit*	Other units
1.	Measurement of winding resistance	Routine	√	√
2.	Voltage ratio measurements	Routine	√	√
3.	Polarity test	Routine	√	√
4.	No-load loss and current Measurement	Routine	√	√
5.	Impedance voltage and load loss measurement	Routine	√	√
6.	Short duration heat run test	Routine	√	√
7.	Temperature rise test	Additional Type Test	√	(NA)
8.	Overload testing n short circuit method	Type	√	(NA)
9.	Measurement of insulation Resistance	Routine	√	√
10.	Measurement of insulation power factor and capacitance between winding and earth	c	√	√
11.	Lightning impulse test	Special Test	√	√
11 a.	Measurement of transferred surge on LV (Tertiary) due to HV lightning impulse lighting impulse (in case of transformer with tertiary winding).	Special Test	√	√
12.	Switching impulse test	NA	√	√
12 a.	Measurement of transferred surge on LV (Tertiary) due to HV Switching		√	√

	impulse and IV Switching impulse (in case of transformer with tertiary winding).			
13.	Separate source voltage withstand test	Special Test	√	√
14.	Induced over voltage test with partial Discharge measurement	Special Test	√	√
15.	Measurement of acoustic noise level	Special Test	√	NA
16.	Test of cooling device	Routine	√	√
17.	On load tap changer test	Routine	√	√
18.	Gas-in-oil analysis	Special Test	√	√
19.	Core assembly dielectric and earthing Continuity test	Routine	√	√
20.	Appearance, construction and dimension Check	Routine	√	√
21.	Measurement of harmonic level in no Load current	Special Test	√	√
22.	Magnetic balance test	Additional Routine Test	√	√
23.	Measurement of no load current with 415 V, 50 Hz AC on LV side.	Additional Routine Test	√	√
24.	Frequency Response analysis (RFA)	Additional Routine Test	√	√
25.	High voltage with stand test on auxiliary Equipment and wiring after assembly	Routine	√	√
26.	Over excitation test	Routine	√	√
27.	Oil leakage test on transformer tank	Routine	√	√
28.	Tank vacuum test	Routine	√	√
29.	Tank pressure test	Routine	√	√
30.	Measurement of power taken by fans and oil pumps of cooler banks.	Special Test	√	NA
31.	Transformer Tank (a) Vacuum Test (b) Pressure Test on completely assembled transformer	Additional Routine Test	√	NA
32.	Pressure Relief Device (PRD)	Additional Routine Test	√	NA
33.	Power Frequency Voltage withstand Test	Additional Routine Test	√	√

* means the first unit manufactured at each manufacturing plant.

NOTE: Additional type tests and additional routine tests shall be carried out in presence of Purchaser's representatives.

1.28.11.1 Type Tests

Type tests shall be carried out as per relevant IS/IEC. The test reports of all type test shall be submitted by the Contractor for the Purchaser's review.

1.28.12.2 Additional Type Test

Following additional type tests shall be conducted on one transformers.

(A) Temperature rise test as per IS: 2026 (Part-II).

Measurement of auxiliary losses shall also be made along with the test for calculation of temperature rise.

Gas chromatographic analysis on oil shall also be conducted before and after this test and the values shall be recorded in the test report. The sampling shall be in accordance with IEC 60567. For the evaluation of the gas analysis in temperature rise test, the procedure shall be as per IS: 9434 (based on IEC: 60567) and results will be interpreted as per IS: 10593 (based on IEC: 60599)

(B) One transformer tank of each size shall be subjected to full Vacuum. The tank designed for full vacuum (760 mm of mercury at sea level) shall be tested at an internal pressure of 3.33 kN/m² absolute (25 mm of Hg) for one hour. The permanent deflection of flat plates after the Vacuum has been released shall not exceed the values specified below and the performance of the transformers shall not be affected in any way.

Horizontal length of flat plate (mm)	Permanent deflection (mm)
Upto and including 750	5
751to 1250	6.5
1251 to 1750	8
1751 to 2000	9.5
2001 to 2250	11
2251 to 2500	12.5
2501 to 3000	16
Above 3000	19

(C) Pressure Test on completely assembled transformer one transformer tank of each size together with its active part as assembled for type test (i.e. including pipe work and cooling equipment and excluding PRD and conservator when air cell is provided) shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 KN/m² which ever is lower. The applied pressure shall be measured at the base of the tank and maintained for eight (8) hours. The permanent deflection of flat plates after excess pressure has been released shall not exceed the values specified in (a) above.

Before conducting the pressure test, the following are to be taken care of:

- i) Pressure relief valve/relief vent are to be remove and the opening blacked.
- ii) Transformer and tap changer conservators are to be disconnected.
- iii) Divertor switch compartment of tap changer to be connected with transformer tank for equalizing the pressure on both sides.
- iv) Oil should be completely filled and all trapped air released.

(C) Pressure Relief Device (PRD)

The pressure Relief Device of each size shall be subjected to increasing oil pressure. It shall operate before reaching the test pressure specified in the test at **Clause No. 1.28.11.2 (B) (b)**. The operating pressure shall be recorded. The device shall seal off after the excess pressure has been released. The routine tests mentioned in **Clause 1.17.1.7** shall be conducted on PRD

1.28.11.3

Routine Tests

All standard routine test in accordance with IS: 2026/IEC: 60076 shall be carried out on each transformer and complete test report shall b submitted to the purchaser after proper scrutiny and signing on each page by the test engineer of the bidder and purchaser's representative/CPRI.

1.28.11.4

Additional routine Tests

In addition to the routine test mentioned in IS: 2026 (part I) the following additional-test shall be carried out on each transformer.

- a) All welds shall be tested by the manufacturer for leakage by a standard practice like dye penetration test etc. and the factory test results shall be furnished.
- b) Oil leakage test on transformer tank:**
 - i) The tank shall be tested for oil tightness by being completely filled with air at a pressure corresponding to twice the normal head of oil or to normal pressure plus 35KN/m² whichever is lower. The pressure shall be maintained for a period of minimum one hour during which time no leakage shall occur. The equivalent air pressure corresponding to oil pressure calculated at the base of the tank to be considered for air pressure test. Permanent deflection of flat plates shall be measured on one tank of each design, after the excess pressure has been released and shall not excess the figures specified in **Clause No: 1.28.11.2(B) (a)** above.
 - ii) The conservator shall be tested for leakage by being completely filled with air at 35KN/m². The pressure shall be maintained for a period of one hour during which time no leakage shall occur.
 - iii) The radiator shall be tested for leakage by placing them horizontally in a tank filled with clean water and applying air pressure 2kg/m² for at least 15minutes during which time no leakage shall occur.

TRANSFORMER ASSEMBLY STAGE:

Oil pressure test to be conducted on tank with turret and all other accessories as assembled for routine test by filling completely with oil of a viscosity not greater than that of an insulating oil conforming to LS: 335 at the ambient temperature, at a pressure corresponding to twice the normal pressure plus 35KN/m², measured at the base of the tank, whichever is lower. The pressure shall be maintained for a period not less than twelve (12) hours during which time no leakage shall occur.

c) **Magnetic circuit test**

After assembly each core shall be tested for one minute at 2000volts between all bolts, side plates and structural steel work.

d) **Power frequency voltage withstand test.**e) **Measurement of exciting current, harmonics.**

Measurement of exciting current, excitation losses and harmonics in No-load current shall be carried at 85%, 90%, 100% and 105% of rated voltage as per IS: 2026 (Part-I) as amended up to date. Excitation losses given in the test report shall be those measured after the impulse tests are completed. Endeavour shall be made to carry out the measurement of exciting current beyond 105% of rated voltage by the method to be mutually agreed between the contractor and the purchaser. The contractor shall specify the method of such measurement and its limitations during detailed engineering stage.

f) **Frequency response analysis(FRA)**

g) Measurement of non-load current with 415V, 50Hz supply on LV side h) high voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.

1.28.11.5 Special Tests

Following special tests shall be conducted in presence of purchaser's representative on one transformer.

i) Dielectric tests

The following dielectric tests shall be carried out:

245kv winding

- a) Lightning impulse voltage(withstand) test on all the line terminals.
- b) Induced over voltage withstand test with partial discharge indication.

145kv winding

- a) Lightning impulse voltage(withstand) test on all the line terminals.
- b) Induced over voltage withstand test with partial discharge indication.

36kv winding

- a) Separate source voltage withstand test on all the line terminals.
- b) Lightning impulse voltage(withstand) test on all the line terminals.

- ii) Measurement of zero sequence impedance (for three phase transformer only) as per IS:2026/IEC:60076.
- iii) Measurement of acoustic noise level.
- iv) Measurement of the harmonics in the no load current.
- v) Measurement of the power taken by the fans and oil pumps.
- vi) Dissolved Gas Analysis before and after the temperature rise test.
- viii) One cooler control cabinet, oil surge relay, magnetic oil level gauge and all junction terminal boxes, PRD enclosure shall be tested for IP:55 protection in accordance with IS:13947.
- ix) Measurement of transferred surge on LV(Tertiary)winding due to HV lightning impulse and IV lightning impulse(for transformers with tertiary winding).

1.28.11.6 Tests on Transformer Bushings:

Transformer bushings shall comply in all respects with the type and routine tests laid down in IS:2099(as amended upto date).

1.28.11.7 Tests on insulating oil:

Samples of oil from each bulk consignment shall be tested in accordance with IS:335(as amended upto date) before any oil is dispatched.

1.28.11.8 Tests on On-Load Tap Charger:

On-Load tap changers shall comply in all respects with type and routine tests specified in IS:8468(As amended upto date).Manufacturers tests report shall be submitted by the Contractor.

1.28.11.9 Tests on Accessories:

Auxiliary wiring in all equipment connected thereto shall be subjected to a test voltage of 2000 Volts at 50Hz for one minute.

1.28.11.10 Tests on Buchholz relay:

The Buchholz relay when completely assembled and ready for mounting in service shall be subjected to the type and routine tests specified in IS:3637(as amended upto date).Where oil is referred to it shall have a viscosity at 27⁰ C not greater than that of insulating oil conforming to IS:335.In addition to the above each Buchholz relay shall conform to the following tests:

- i) The empty relay shall be tilted, as if mounted in pipe work rising from tank to conservator at an increasing angle until the gas collection contacts open. The angle of tilt shall then reduce to less than 13⁰ to the horizontal.

ii) With relay mounted at a falling angle of 16 to the horizontal and full of oil gas collection contacts shall be open.

The contractor shall carry out additional type tests or furnish type test reports to prove that the Buchholz relays offered by him, satisfy the above requirements during earthquakes and do not mal operate.

The correct functioning of all apparatus fitted with alarm or tripping contacts shall be checked with a buzzer.

1.28.11.11 Cooling plant:

Unless otherwise approved coolers shall be tested for pressure tests as per Clause No.2.30.10.2(B)(b).No leakage shall occur.

1.28.11.12 Oil Pumps, Pipe works and Valves:

All oils pumps and oil pipe work and valves work shall withstand hydraulic pressure of 1.41 kg/sqcm for 15 minutes. The testing medium shall be oil of viscosity not greater than that of insulating oil conforming to IS:335 at 27⁰C.Relevant routine and type test reports shall be furnished.

1.28.11.13 Other Auxiliary Equipments:

Equipment mentioned below shall conform in all respects to the requirements of IEC/IS standards mentioned against each:

a) Fans

* IS:2312 for propeller type AC ventilating fans.

b) Motors

* IS:325 for three phase induction motors.

* IS:996 for single phase small AC and universal motors.

c) Oil pumps

IS:5120 for rotor dynamics special special purpose pumps.

d) Switchgear

* IS:2607 for isolators with rated voltage not exceeding 1kV.

* IS:1882 or IEC:992 for motor starters.

* IS:2516 for circuit breaker for rated voltage not exceeding 1KV.

* IEC:337 for control switches.

For the equipments and auxiliaries for which no IEC or IS standard has been specially stipulated, the Contractor shall indicate details of the standards to which these conform.

1.28.11.14 Additional Tests:

The Purchaser reserves the right to have other reasonable tests carried out at his own expense either before dispatch or site to ensure that the transformer complies with the requirements of this specifications.

1.28.11.15 Preshipment check at Manufacturers works

(a) Check for interchange ability of components of similar transformers for mounting dimensions.

(b) Check for proper packing and preservations of accessories like radiators, bushings, explosion vent, dehydrating breather, rollers, buchholz 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.

(d) Gas tightness test to conform tightness.

(e) Determination of leakage rate and ensure the adequate reserve gas capacity.

1.28.11.16 Inspection and testing at site.

The supplier shall furnish a detailed supervision of inspection and testing programme for field activities, covering areas right from the receipt of material stage upto commissioning stage. An indicative programme of inspection as envisaged by the Purchaser is given below. This is however not intended to form a comprehensive programme as it is Contractors responsibility to draw up and carry out such a programme duly approved by the purchaser.

Site test shall be performed on oil performed on oil sample before and after filling in the transformer. Oil parameters shall conform to Clause no.2.17.4 prior to filling at site and oil samples taken from the tank top, bottom and cooling system (after filling) shall samples taken from the tank top, bottom and cooling system(after filling) shall possess characteristics indicated in clause no.2.17.4. The Contractor shall warrant that oil furnished is in accordance with the specifications as given under Clause no.2.174.

1.28.11.17 Receipt and storage checks.

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

(b) Check and record the gas pressure in the transformers tank as well as in the gas pressure cylinder.

(c) Visual check for wedging of core and coils before fillings up with oil and also check conditions of core and winding in general.

(d) Check and record reading of impact recorder at receipt and verify the allowable limits as per Manufactures recommendations.

1.28.11.18. Installation checks.

(a) Inspection and performance testing of accessories like tap changers, cooling fans, oil pumps etc.

(b) i) Check the direction of rotation of fans and pumps.

ii) Check the bearing lubrication.

(c) Check the whole assembly for tightness, general appearances etc.

(d) Oil leakage tests.

(e) Capacities and tan data measurement of bushing before fixing/connecting to the winding. The Contractor shall furnish these values for site reference.

(f) Leakage test on bushing before erection.

(g) Test on oil samples shall be carried out in accordance with clause no.1.17.4. Samples shall be taken only after the oil has been allowed to settle for 24 hours.

(h) Removal of blanking plates.

(i) Measure & record the dew point of Nitrogen or dry air in the main tank before assembling.

1.28.11.19 Commissioning Checks

(a) Check the colour of silica gel breather.

(b) Check the oil level in the breather, conservator tanks, cooling system, condenser bushing etc.

(c) Check the bushing for conformity of connection to the lines and tan delta test for bushings at 10kv(Min).

(d) Check for control correct operation of all protection devices and alarm.

i) Buchholz relay

ii) Excessive winding temperature.

iii) Excessive oil temperature

iv) Low oil flow

v) Low oil level indication.

vi) Fan & pump failure protection.

(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) Top changer motor and control
 - iii) Cooling system motor and control
 - iv) Main windings.
- (h) Check for cleanliness of the transformers and the surroundings.
- (i) Phase out and vector group test.
- (j) Ratio test on all taps.
- (k) Magnetising current test.
- (l) Capacitance & Tan delta measurement of winding & bushing.
- (m) Frequency Response Analysis (FRA)
- (n) Dissolved Gas Analysis (DGA) of oil just before commissioning and after 24 hours energization at site.
- (o) Continuously observe the transformer operation at no load for 72 hours.
- (p) 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, noise level etc.
- (q) Partial Discharge (PD) test at site at 1.0 or 1.1 p.u.. However, conduction of PD test shall be decided during detailed engineering in consultation with manufacturer.
- (r) Any other tests recommended by manufacturer.

The supplier shall prepare a comprehensive commissioning report including all commissioning test results & forward to Purchaser for future record.

1.28.12 TEST REPORTS

i) Five (5) copies of type test reports shall be furnished to the purchaser/Owner within one month of conducting the tests. One copy will be returned duly certified by Purchaser to the supplier within three weeks thereafter and on receipt of the same, Supplier shall commence with the commercial production of the concerned material.

ii) Five (5) copies of acceptance test reports shall be furnished to the Purchaser. One copy will be returned duly certified by the Purchaser and only thereafter shall the material be despatched.

ii) All records or routine tests shall be maintained by the Contractor at his works for periodic inspection by the Purchaser.

iv) All test reports for tests conducted during manufacturing shall be maintained by the Supplier. These shall be produced for verification as and when requested for by the Purchaser having following details.

a.) Complete identification data including serial number of the transformer/equipment tests.

b.) Method of application, where applied, during and interpretation of results of each test.

c.) Temperature dependent data corrected to 75deg.C.

Routine test reports shall also contain the following information.

i) Calculated values of regulation at unity, 0.9, 0.8 lagging and 0.8 leading power factors.

ii) Calculated values of positive, negative and zero phase sequence impedance of three-phase bank.

iii) Calculated values of efficiency of transformer at 50, 75 & 100% of rated capacity at 1.0 and 0.9 power factors.

1.29 OIL STORAGE TANK

1.29.1 General

This specification covers supply of oil storage tank of 15 cubic meter capacity along with complete accessories.

1.29.2 Standard

The oil storage tank shall be designed and fabricated as per relevant Indian standards e.g. IS:803 or other internationally acceptable standards.

1.29.3 Specifications

Transformer oil storage tanks shall be towable & rested on pneumatic tyres of adequate thickness. Size of the storage tank shall be as follows:

Diameter	:	2.5 meter
Capacity	:	15 cubic meter

The tank shall be designed for storage of oil at a temperature of 100⁰ C

1.29.3.1 The Bidder may further note that maximum height of any part of the complete assembly of the storage tank shall not exceed 4.0 meters above road top.

1.29.3.2 The tank shall be adequate number of jacking pad so that it can be kept on jack while completely filled with oil. The tank shall be provided with suitable Saddles so that tank can be rested on ground after removing the pneumatic tyres.

- 1.29.3.3 The Tank shall be fitted with manhole, outside & inside access ladder, silica gel breather assembly, inlet & outlet valve, oil sampling valve with suitable adopter, oil drainage valve, air vent etc. Pulling hook on both ends of the tank shall be provided so that the tank can be pulled from either end while completely filled with oil. Bidder shall indicate the engine end while completely filled with oil. Bidder shall indicate the engine capacity in horsepower to pull one tank completely fitted with oil. Oil level indicator shall be provided with calibration in terms of litre so that at any time operator can have an idea of oil in the tank. Suitable arrangement shall also be provided to prevent overflow in the tank. Four nos., suitable rubber hoses with couplers and unions each not less than 10 metre long shall be provide.
- 1.29.3.4 The internal & external surfaces to be paid be shot or sand blasted to remove all rust and scale of foreign adhering matter or grease. All steel surfaces in contact with insulating oil shall be painted with two coats of heat & oil resistant anti corrosive paint All steel surfaces exposed to weather shall be given a primary coat of zinc chromatic, second coat of oil& weather resistant paint of a colour distinct from primary and final two coats of glossy oil& weather resistant light grey paint in accordance with shade no.631 of IS:5.All paints shall be carefully selected to withstand heat & extremes of weather. The pain shall not scale off or crinkle or be removed by abrasion due to normal handling. The minimum thickness of outside painting of tank shall be 20 microns per coat, the total thickness shall be within 70 to 100 microns.
- 1.29.3.5 The tank shall contain a self-mounted centrifugal oil pump with inlet and outlet valves, with couplers-suitable for flexible rubber hoses and necessary switchgear for its control. These shall be no rigid connection to the pump. The pumps shall be electric motor driven, and shall have a discharge of not less than 6.0kl/hr, with a discharge head of 8.0m.the pump motor and the control cabinet shall be enclosed in a cubical with IP-55 enclosure.
- 1.29.3.6 The scope of oil storage tank shall be included in the bid price as per the quantity indicate in the bid price schedule.

1.30 OIL SAMPLING BOTTLE

- 1.30.1.1 Oil sampling bottles shall be suitable for collecting oil samples from transformers and shunt reactors, for Dissolved Gas Analysis. Bottles shall be robust enough, so that no damage occurs during frequent transportation of samples from site to laboratory.
- 1.30.1.2 Oil sampling bottles shall be made of stainless steel having capacity of 1 litre.
- 1.30.1.3 Oil sampling bottles shall be capable of being sealed gas tight and shall be fitted with cocks on both ends.
- 1.30.1.4 The design of bottles & seal shall be such that loss of hydrogen shall not exceed 5%per week.
- 1.30.1.5 An impermeable oil proof, transparent plastic or rubber tube of about 5mm diameter, and of sufficient length shall also be provided with each bottle alongwith suitable connectors to fit the tube on to the oil sampling valve of the equipment and the oil collecting bottles respectively.
- 1.30.1.6 The scope of oil sampling bottles shall be included in the bid price as per the quantity indicated in the bid price schedule.

1.31 ON LINE DISSOLVED GAS MONITOR

Each transformer shall be provided with on line dissolved gas monitor with proven field performance so that the purchaser can carry out conditioning monitoring of the transformer. The model and make of the equipment shall be submitted to the purchaser for approval during detailed engineering .

The scope of on line dissolved gas monitoring shall be included in the bid price as per the quantity indicated in the bid price schedule.

1.32. PACKING AND FORWARDING

1.32.1 The equipment shall be packaged in crates suitable for Vertical/horizontal transport as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The Bidder shall be responsible for any damages to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. Wherever necessary, proper arrangement for lifting such as lifting hooks etc. shall be provided. Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost. The replacement of damaged equipment will not be linked with settlement of insurance claim

1.32.2 Each consignment shall be accompanied by a detailed packing list containing the following information:

- (a) Name of the Consignee
- (b) Details of consignment.
- (c) Destination
- (d) Total weight of consignment
- (e) Sign showing top/bottom side of the crate.
- (f) Handling and unpacking instruction.
- (g) Bill of material indicating contents of each package.
- (h) Cost of consignment.

1.32.3 The Bidder shall ensure that the packing and bill of material are approved by the Purchaser before dispatch. Transformer has to be transported either oil Filled or filled with nitrogen gas according to the standard practice of the supplier. If the transformers are dispatched partly filled with oil, a suitable oil level gauge should be provided on the transformer tank to indicate oil level during transport Care shall be taken regarding weight limitation during transport and handling facility at site. If filled with inert gas, necessary arrangement shall be ensured by the Contractor to take care of pressure drop of Nitrogen during transit and storage till completion of oil filling during erection. Detailed instructions must be given for checking the tightness of gasket, as soon as transformer arrives at site.

1.32.4 Weight of the transformer shall be so designed that the transformer can be transported by road.

1.32.5 All removable external accessories and other components susceptible to damage if transported mounted on the equipment, shall be dismantled, adequately packed

and shipped separately. All openings thus resulted shall be sealed by means of temporary steel plates.

1.32.5.1 Packing shall be sturdy and adequate to protect all assembly components, auxiliary devices and accessories from injury by corrosion, dampness, heavy rain, breakage and vibration encountered at the plant site.

1.32.6 Spare parts shall be packed separately and clearly marked.

1.33 DELIVERY

1.33.1 The complete design, manufacture, assembly & delivery of the equipment will commence within six months from the date of issue of purchaser order & completed within three months thereafter.

1.33.2 Insulating oil shall be delivered at the time of delivery of transformers.

1.34 FIRE PROTECTION

1.34.1 All apparatus connections and cabling (Fire Retardant Low Smoke cable) shall be designed and arranged to minimize the risk of fire and any damage which may be caused in the event of fire.

1.35 SPARE PARTS

1.35.1 The mandatory spare parts are indicated under section "List of the mandatory Spares". The prices of mandatory spares shall be FIRM and indicated separately in the price bid and the same shall be considered for the purpose of tender evaluation. However, the actual quantities of spare parts to be procured shall be decided by the purchaser

1.35.2 The bidder may also recommended additional spare parts in addition to the Mandatory spares considered necessary for ten years of successful operation of the equipment. The prices of these additional spare parts shall be indicated separately in Schedule of recommended spares (schedule-D). However, these shall not be considered for bid evaluation. The prices of additional spares shall be FIRM and purchaser reserve the right to procure them any time and any quantity during the execution of the contract.

1.35.3 No recommended optional spare shall be supplied by the Contractor. No erection and maintenance tools/equipment shall be supplied by the Contractor.

1.36 ERECTION AND MAINTENANCE TOOLS/EQUIPMENT

The Contractor may indicate separately in his offer any special erection and maintenance tools required for installing the equipments offered. Prices of these shall be indicated separately in Schedule of Prices. Purchaser reserves the right to procure any quantity of any item at the rates specified any time during the period of contract.

1.37 TOOLS AND TACKLES

Each transformers shall be supplied each with a full kit of tools, spanners in all sizes, with a rack for holding them along with four hydraulic jacks for lifting the transformers, and for

changing the plane of rotations of wheels. All spanners shall be single ended and case hardened. Tirlors with wire rope and slings with grippers etc. for hauling the transformers to the plinth are to be deemed to have included the above items in the quoted price.

1.38 OPERATION, MAINTENANCE AND ERECTION MANUALS

Four months to dispatch of the equipment, five (5) copies of operation, maintenance and erection manuals shall be supplied to the purchaser. Manuals shall be bound volume and shall contain all the drawings and maintenance of the equipment supplied.

Other requirements regarding operation, maintenance and erection manuals are given relevant clause of Section-“General Technical Requirements”.

ANNEXURE-1**AUXILIARIES****1.0 BUSHINGS**

- 1.1 The bushings shall have high factor of safety against leakage to ground and shall be so located as to provide adequate electronic clearance between bushings of various voltage and between bushings and grounded parts. Bushing of identical voltage rating shall be interchangeable. All bushings shall be equipped with suitable terminals of approved type and size and shall be suitable for bimetallic connection.
- 1.2 Stresses due to expansion and contraction in any part of the bushings insulator shall not lead to development of any defects. Outdoor insulators and fittings shall be unaffected by atmospheric conditions e.g. Ozone, acid fumes, alkalize, dust and rapid changes of temperature. Stress shield, if provided shall be considered as an integral part of the bushing assembly.
- 1.3 Porcelain shall not engage directly with hard metal and where necessary, gaskets shall be interposed between the porcelain and the fittings. All porcelain clamping surface in contact with gaskets shall be accurately grounded and shall be free from glaze.
- 1.4 All fixing material used shall be of suitable quality and properly applied shall be not enter into chemical action with the metal parts or cause fracture by expansion in service or dissolve in oil.
- 1.5 All porcelain insulators shall be designed to facilitate natural cleaning.
- 1.6 Special precautions shall be taken to exclude moisture from paper insulation During manufacture, assembly transports and erection. The surface of all paper insulations shall be finished with non-hygroscopic varnish.
- 1.7 Each condenser porcelain bushing or insulator and paper bushing shall have marked upon it the manufacture's identification mark and such other marks as may be required to assist in the representative selection of batches for the purpose of sample tests etc.

- 1.8 Clamps and fitting made of steel or malleable iron shall be galvanized. All bolt threads shall be greased before erection.
- 1.9 The bushings flanges shall not be of re-entrant shape, which may trap air.
- 1.10 All outdoor type bushings through which the main winding and neutral leads are brought out shall be so located that the phase to ground clearance obtained are adequate to ensure availability of the full flash over strength of the bushing. Main terminals shall be of an approved design.
- 1.11 The main insulation provided by the bushings shall be so co-ordinate with transformer insulation that all flashovers will occur outside the tank.
- 1.12 All porcelain used in bushing shall be made by the wet process, shall be homogenous and free cavities or other flaws. The glazing shall be uniform in color (brown) and free blisters, burrs, and other defects. Porcelain shall be impervious to moisture. The bushings shall be capable of withstanding earthquake forces. Porcelain shall have a smooth surface to shed away rainwater.
- 1.13 All bushings shall have puncture strength greater than the dry flashover value.
- 1.14 Support insulator/bushings shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used. The tensional, tensile strength and parameters of insulator shall suit the requirements of the specification.
- 1.15 In accordance with the requirements stipulated under bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099,IS:2544,IEC:137,IEC:233.

2.0 CONTROL CABINETS/MARSHALLING BOX:

- 2.1 Control cabinets. Marshalling box, in general conform to IS: 5039.
- 2.2 Control cabinets shall be sheet steel/aluminum enclosed and shall be dust, water and vermin proof. Sheet. Steel used shall be at least 2.5 mm thick and properly braced to prevent wobbling.
- 2.3 The enclosure of the control cabinet shall provide a degree of protection equivalent to IP-55 as per IS: 13947.

- 2.4 Control cabinets shall be provided with hinged doors with padlocking arrangement. The distance between two hinges shall not exceed 350 mm to ensure uniform sealing pressure against atmosphere. The gaskets used shall be of neoprene rubber.
- 2.5 To prevent internal condensation, space heater shall be provided. Heater shall be suitable for operation at 240V AC supply. An ON-OFF switch and fuse shall be provided with the heater.
- 2.6 For illumination of cabinet, switch controlled incandescent lamp shall be provided. The cabinet shall also be provided with fuse or MCB on incoming power supply and one 15 amp switch and socket.
- 2.7 All steel work shall be thoroughly cleaned to remove all rust scale, foreign matter, and grease and then applied with two coats zinc chromate primer and two coats of finishing synthetic enamel paint, both inside and outside. The color of the finishing paints shall be light grey in accordance with shade No.631 of IS5.
- 2.8 The incoming cable shall enter from bottom and the gland plate shall be less than 450 mm from the base of the cabinet. The gland plate and associated compartment shall be sealed in a suitable manner to prevent ingress of moisture from the cable trench or conduit. Gland plates shall have provision for more glands if needed to be provided in future. The glands shall have provision for securing armour of the cable separately and shall be provided with earthing lug.

3.0 TERMINAL BLOCK

- 3.1 All internal wiring to be connected to the external equipment shall terminate on blocks, preferably vertically mounted on the side of cabinet, junction box.
- 3.2 The terminal blocks shall be made of moulded, non-inflammable thermosetting plastic. The material of terminal block moulding shall not deteriorate because of varied condition of heat, cold humidity, dryness etc that would be anticipated at the location the equipment is proposed to be installed.
- 3.3 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The terminals shall be non-disconnecting stud type equipment to Elmex type CAT – M4. Washers, nuts and locknuts shall be provided.

- 3.4 The terminal blocks shall be extensible design.
- 3.5 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 3.6 The terminal blocks shall be 1100 v grade and shall be rated to carry continuously the maximum current that it expected to be carried by the terminals.
- 3.7 The terminal blocks shall be fully enclosed with removable covers of transparent, non-inflammable, non-deteriorating type plastic materials, and insulating barriers shall not hinder the operator from carrying out the wiring without removing the barriers. The barriers shall be mounded integrally.
- 3.8 The terminal shall be provided with the marketing tags for wiring identification. The terminal blocks shall have while marketing tags for circuit-identification.
- 3.9 The boxes shall be providing with 20% spare terminals unless otherwise specified.

Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of Purchaser's cable on each side:

- | | |
|--|---|
| a) All circuits except CT
And PT circuits | Min. One No.2.5 mm ² copper cable |
| b) All circuits | Min. of 4 nos. of .2.5 mm ² copper cable |
| c) All PT circuits | Min. 2 Nos.2.5 mm ² copper cable |

- 3.10 There shall be a minimum clearance of 250 mm between the first row of terminal block and the cable gland plate or side of the box. Also the clearance between two rows of terminal blocks shall be minimum 150 mm.
- 3.11 The arrangement shall be in such a manner so that it is possible to safety connected or disconnected terminals on live circuits and replace fuse links when the cabinet is live. Cabinet wiring should be suitable for 60⁰C temperature 10⁰ C higher than the ambient.
- 3.12 Terminal blocks for current transformer secondary leads shall be provided with test links and isolating facilities. Also current transformer secondary leads shall be provided with short-circuiting and earthing facilities.

3.13 Arrangements of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal is run parallel and in close proximity along each side of the wiring duct to provide for convenient attachment of internal panel wiring. The side of the terminal block opposite to the wiring duct shall be reserved for the Purchaser's external cable connection. All adjacent terminal blocks shall also share this field wiring corridor. A steel strip shall be connected between adjacent terminal block rows at 450 mm intervals for support of incoming cables.

4.0 CONTROL WIRING AND CABLING:

- 4.1 Supply, laying and termination of all cables and accessories required for proper termination from the control cabinet/marshalling box to make transformer/reactor functional shall be supplied by the Contactor.
- 4.2 Supplier shall also supply rigid GI conduits/ pipes and all accessories required for routing cable in ground and the concrete.
- 4.3 Flexible conduits with accessories made up of cold rolled annealed and electro galvanized mild steel wires shall be used for running cables in embedded pipe.
- 4.4 Wire terminations shall be made with solder less cramping type of tinned copper lugs, which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations.
- 4.5 All wires directly connected to grip circuit breaker shall be distinguished by the addition of a red coloured unlettered ferrule. Number 6 & 9 shall not be included for ferrules purpose.
- 4.6 In accordance with the requirement as stipulated under Section-“General Technical Requirement”, control cabinets, junction boxes and marshalling boxes shall conform to type tests and shall be subjected to routine tests in accordance with IS: 5039. In addition to the type tests, verification of the degree of protection, as per IS: 2147 for IP-55 shall be conducted. After protection degree tests on control cabinet, 2.0 KV rms for 1 minute, for checking insulation resistance shall be applied and functional test shall also be conducted.

- 4.7 All control wiring from transformer/reactor accessories to control cabinet/marshalling box shall be 1100 volts grade, PVC insulated 2.5 sq. mm stranded copper cable with armour.
- 4.8 Power cable (415 V) used transformer/reactor accessories to control /marshalling box shall be 1100 volts grade, PVC insulated armoured Aluminum conductor cables.
- 4.9 Compression type cable connector shall be provided for the termination of power and control cables.
- 4.10 All devices and terminal blocks with the control cabinet/marshalling box be clearly identified by symbols corresponding to those used on applicable schematic or wiring diagram.
- 4.11 All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks.
- 4.12 Engraved core identification plastic ferrules marked to correspond with schematic diagram shall be fitted at both ends of wires. Ferrules shall fit tightly on wires and shall not fall off when the wire is disconnected from terminal block.

5.0 SIGNAL TRANSMITTERS FOR EACH WINDING:

- 5.1 Signal Transmitter shall have additional facility to transmit signal for recording winding
Temperature at Purchaser's Data Acquisition System (DAS), for which duplex platinum RTD with nominal resistance of 100 Ohms at zero deg. C shall be supplied. The RTD shall be three wire ungrounded system. The calibration shall be as per SAMA (USA)/DIN standard or equivalent.

The RTD may be placed in the pocket in containing temperature sensing element and image coil for Winding temperature Indicator (WTI) system, which will be used for both remote WTI and DAS. Necessary equipment for sending the signal to remote WTI and DAS shall be provided. In lieu, separate RTD for each of the functions shall be provided.

6.0 LABELS

- 6.1 Labels shall be provided for all apparatus such as relays, switches, fuses contained in control cabinets/marshalling box.

- 6.2 Description labels for mounting indoor or inside control cabinets/marshalling box shall be such a material that will ensure permanence of lettering. A matt or satin finish shall be provided to avoid dazzle from reflecting light. Labels mounted on dark surface shall have white lettering on a black background. All plates be a material. Which will not get corroded?
- 6.3 Labeling shall be clear, concise adequate.
- 6.4 Labels shall be supplied as far as possible in the following four standard sizes.
- a) Label for fuses and links shall measure approximately 28 mm to 45 mm by 13 mm to 19 mm and lettering of 3 mm to 6 mm shall be used according to the amount of inscription required. The lettering shall have strokes of approximately 1 mm width.
 - b) Labels for relays, contactors, thermal devices and similar apparatus shall measure 65 mm by 20 mm and shall have lettering as specified in (a) above.
 - c) Labels for controllers and change over switches shall measure 70 mm by 30 mm and where practicable have lettering with 1.5 mm strokes.
 - d) Labels for the doors of junction boxes, marshalling boxes and similar equipment shall measure 125 mm X 50mm and have 13 mm lettering with 1.5 mm wide stokers.
- 6.5 The labels for mounting outdoor shall be weather and corrosion proof. The letters/diagrams thereon shall be formed by etching or any other such process which will be ensured performance of the lettering marketing.
- 6.6 Labels shall be attached to panels with brass screws or with steel screws, which have received rust preventive treatment.

7.0 JOINT AND GASKETS:

- 7.1 All gaskets used for making oil tight joints shall be of proven material such as granulated cork bonded with synthetic rubber.
- 7.2 Synthetic rubber, if used for gaskets for joints, shall be resistant to hot oil and ageing.

8.0 CLEANING AND PAINTING:

- 8.1 Before painting all un-galvanized parts shall be completely clean and free from rust, scale and grease, and all external surface cavities on castings, shall be filled by metal deposition.
- 8.2 The interior of transformer/reactor tanks and other oil filled chambers and internal structural steel work shall be cleaned of all scales and rust by sand blasting or other

approved method. These surfaces shall be painted with two coats of heat resistance oil insulating varnish or paint. Unexposed welds need not be painted.

- 8.3 Except for nuts, bolts and washers which may have be removed for maintenance purpose, all external surfaces ex[posed to weather shall receive a minimum of three coats of paint.
- 8.4 The primary coats shall be zinc chromate and applied immediately after cleaning. The second coat shall be of oil and weather resisting nature and of a shade or colour easily distinct from the primary coat. The final coat shall be applied after the primary coat has been touched up where necessary. The final coat at site shall be of a glossy oil paint which shall be corrosion resisting and non-fading, light grey in accordance with shade No.631 of IS: 5. the final coats shall be 20 microns and total thickness of all the three coats shall be minimum 80 microns. All paints selected shall withstand heat and extreme of weather.
- 8.5 Nuts, bolts and washers which may have to be removed for maintenance purposes shall receive a minimum of one coat of paint after erection.
- 8.6 All interior surfaces of mechanism chambers and boxes except those, which have received anti-corrosion treatment, shall receive three coats of paint, which shall be applied to the thoroughly cleaned metal surfaces. The final coats shall be light grey colour with anti corrosion mixture.
- 8.7 Any damage to paint work incurred during transport and erection shall be made good by thoroughly cleaning the damaged portion and playing the full number of coats of paint had been applied before damage was caused. Paint shall not scale off be removed by abrasion while handling.
- 8.8 One coat of additional paint shall be given at site. The Contractor shall supply the requisite quantity of paint.

9.0 VALVES:

- a) All valves upto and including 100mm shall be of gun metal or of cast steel or cast-iron. Larger valves 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. Alternatively, butterfly type of valves are also acceptable.
- b) Suitable means shall be provided for pad-locking the valves in the open and close positions. Provisions 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)** All valve flanges shall have machined faces.
- e)** All valves in oil line shall be suitable for continuous operation with transformer oil at deg.C.
- f)** 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.
- g)** The oil sampling point for main tank should have two identical valves to be put in series .Oil sampling valve shall have provision to fix rubber hose of 10mm size to facilitate oil sampling.
- h)** All hardware used shall be cadmium plated/electro galvanized.
- i)** A valve or other suitable means shall be provided to fix the on line dissolved gas monitoring system to facilitate continuous dissolved gas analysis. The location and size of the same shall be finished detailed engineering stage.
- j)** Suitable small bore(8mm copper) piping with an appropriate valves shall be provided to take sample of oil from the OLTC chamber during operation of the transformer.

ANNEXURE-II**LIST OF TRANSFORMER ACCESSORIES AND TEST CERTIFICATES REQUIRED FOR THEM.**

S.No	Accessory	Ref Std.	Test Certificates required
1)	Condenser Bushing	IS: 2099	<ol style="list-style-type: none"> 1. Appearance, construction and dimensional check 2. Test for leakage of internal filling at a pressure Of 1.0kg/cm² for 12h. 3. Insulation resistance measurement with 2000V Megger. 4. Dry power frequency voltage withstand test. 5. Dry power frequency voltage withstand test tap Insulation. 6. Partial discharge measurement 1.5Un/ 3kV. 7. Measurement of tangent delta and capacitance.
2)	Porcelain Bushings	IS: 2099	<ol style="list-style-type: none"> 1. Appearance, construction and dimensional Check. 2. Insulation resistance measurement with 2000V Megger. 3. Dry power frequency voltage withstand test.
3)	OLTC	IS: 8468	<ol style="list-style-type: none"> 1. Oil tightness for the diverter switch oil chamber At an oil pressure of 0.5kg/cm² at 100^oC for 1h. 2. Mechanical operation test. 3. Operation sequence measurement. 4. Insulation resistance measurement using 2000 V Megger. 5. Power frequency voltage withstand test on diverter switch to earth and between even and odd contacts.

6. Power frequency voltage withstand test on tap Selector between stationary contacts, between max And min. taps, between phases and supporting frames, between phases.
7. Operation test of complete tap changer.
8. Operation and dielectric test of driving mechanism.
- 4) winding
Temperature
Indicator
1. Calibration test
 2. Dielectric test at 2 KV for one minute.
 3. Accuracy test for indication and switch setting Scales.
 4. Test for adjustability of switch setting.
 5. Test for switch rating
 6. Measurement of temperature rise with respect to the heater coil current
- 5) Oil temperature Indicator
1. Calibration Test
 2. Dielectric test at 2 KV for one minute.
 3. Accuracy test for indication and switch setting scales.
 4. Test for adjustability of switch setting.
 5. Test for switch rating.
- 6) Pressure relief Valve
1. Functional test with compressed air to check bursting pressure, indication flag operation and switch Operation.
 2. Dielectric Test at 2 KV for one minute.
 3. Switch contact testing at 5 A, 240 V AC.
- 7) Cooling Fan IS:2312
1. Insulation resistance Measurement.

2. Dielectric test at 2 KV for one minute.
 3. Operation Check
 4. Appearance, construction and dimensional check.
- 8) Transformer Oil Pump IS:325 & IS: 9137
1. Insulation resistance Measurement.
 2. Cold resistance measurement at ambient temperature.
 3. Motor efficiency at full load
 4. No load voltage, current, Power Input, frequency and speed.
 5. Locked rotor readings of voltage, current and power input.
 6. Water pressure test for pump Casting at 5 Kg/ sq.cm for 10 minutes at ambient temperature.
 7. Transformer Oil Pressure test for the pump set assembly at 2 KG/sq. cm for 30 minutes at 80 deg. Celsius.
 8. Measurement of head, discharge, current, power input to motor and overall efficiency of the pump set at rated voltage.
 9. Appearance, construction and dimensional check.
- 9) Oil flow indicator/Water flow Indicator
1. Observation of flow with respect to requirement.
 2. Switch contact test at 5 A 240 V AC.
 3. Dielectric test at 2 KV for one minute.
 4. Appearance, construction and dimensional check.
- 10) Buchholz/Relay IS:3637
1. Leak test with transformer oil at a pressure of 3 Kg/sq.cm for 30 minutes at ambient temp. for relay casing

2. Insulation resistance measurement with 500 V Megger.
 3. Dielectric test at 2 KV for one minute
 4. Elements test at 1.75 kg/cm² for 15 min. using transformer at ambient temp.
 5. Loss of oil and surge test.
 6. Gas volume test.
 7. Mechanical strength test.
 8. Velocity calibration test.
 9. Appearance construction and dimensional check.
- 11) Oil level indicator
1. Test for oil Levels.
 2. Switch operation for low level alarm.
 3. Switch contact test at 5 A
240 V AC
 4. Dielectric Test at 2 KV
for 1 minute.
 5. Appearance construction
and dimensional check.
- 12) Pressed steel Radiator
1. Air Pressure Test at 2
Kg/sq.cm under water
minutes.
 2. Appearance construction
and dimensional check.

13) OLTC Control Cubicle/cooler control cubicle

1. Appearance construction and dimensional check.
2. Electrical Operation.
3. Insulation resistance measurement using 50 V Megger at ambient temperature.
4. Dielectric test at 2 kV for one minute.

14) Bushing Current Transformer IS:2705

1. Appearance construction and dimensional check.
2. Polarity check.
3. Measurement of insulation resistance.
4. High voltage power frequency test.
5. Determination of ratio error and phase angle of measuring and protection BCTs.
6. Determination of turns ratio error for PS class BCT.
7. Inter turn insulation withstand test.
8. Exciting current characteristic test.
9. Secondary winding resistance measurement.
10. Knee point voltage, measurement for PS class BCT.

15) Oil to water heat exchanger

1. Test Certificates for the materials for construction.

16) Pressure Gauges/Differential Pressure Gauges.

2. Manufacturers in process inspection records for all parts, sub assemblies, accessories and complete assembly.

3. Shell side pressure test at 10 Kg/sq. cm with transformer oil at a temperature of $70^{\circ}\text{C} \pm 10^{\circ}\text{C}$ for 6 h.

1. Appearance construction and dimensional check

2. Calibration Test.

3. Alarm contact setting test.

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List Of Mandatory Spares

(Power Transformer (160 MVA))

S.NO.	Description	Quantity
1.	Bushing with metal parts & gaskets of each rating including Neutral Bushing.	1 set
2.	Local and remote winding temperature indicator complete with sensing device & contacts.	1 set
3.	Oil Temperature Indicator with contacts & sensing device.	1 set
4.	Pressure relief device	1 no.
5.	Magnetic Oil gauge with low level alarm contacts.	1 no.
6.	Oil flow indicator with low level alarm contacts	1 no.
7.	Oil cooler pump with motor.	1 set
8.	Cooler fan with motor	1 no.
9.	Set of valves (complete set for one transformer)	1 set
10.	Set of pressure gauge (1 no. each type and rating)	1 set
11.	Set of pressure switch (1 no. each type and range).	1 set
12.	Set of starter, contactor, relays and switch for electrical control panels.(1 set of each type & range)	1 set
13.	Breather Assembly (one of each type)for conservator and OLTC	1 no.
14.	Buchholz relay complete with floats & contacts	1 no.
15.	Tap position indicator (local & remote)	1 no. each
16.	Tap Changer diverter switch contacts	1 no.

17.	Bushing C.Ts of each type and ratio.	1 set
18.	Fuses (complete set for one transformer)	1 set
19.	Indicaing Lamps (one set consisting of complete replacement for one transformer)	1 set
20.	Air Cell for main conservator	1 set
21.	Termianl connector (complete set for one transformer)	1 set
22.	Oil surge relay for OLCT	1 no.
23.	Drive motor for OLTC with gear Assembly.	1 no.
24.	Oil sampling Bottles (one litre capacity)	10 nos.
25.	Oil storage tank (15 KL)	2 nos.

PART –II

SECTION-II

TECHNICAL SPECIFICATIONS

PART-II SECTION-II

ANNEXUERS AND SCHEDULE		Page No.
ANNEXURE-III	Technical PARTICULARS OF 160 MVA,220/132/11 KV, THREE PHASE AUTO TRANSFORMERS WITH OLTC	83
ANNEXURE-IV	SCHEDULE OF REQUIREMNTS	89
SCHEDULE A1	DIMENSIONS OF LARGEST PACKAGE AND WEIGHT OF HAVIEST PACKAGE FOR TRANSFORMERS FOR JAMMU REGION	89(a)
SCHEDULE-A	SCHEDULE OF GUARANTEED TECHNICAL AND ADDITIONAL TECHNICAL PARTICULARS	90
SCHEDULE-B	SCHEDULE OF GENERAL TERMS CONDITIONS	103
SCHEDULE-C	SCHEDULE OF PRICES	111
SCHEDULE-D	SCHEDULE OF REQUIREMENT,PRICE AND DELIVERY PERIOD OF SPARE PARTS	114
SCHEDULE-E	SCHEDULE OF TESTS TO BE CONDUCTED ON EQUIPMENT	117
SCHEDULE-F	SCHEDULE OF TOOLS AND SPECIAL ERECTION TOOLS	118
SCHEDULE-G	SCHEDULE OF CHARGES ON ACCOUNT OF SUPERVISION OF ERECTION, TESTING AND COMMISSIONING OF EQUIPMENT	119
SCHEDULE-H	SCHEDULE OF DEVIATIONS	120
SCHEDULE-I	SCHEDULE FOR PRICE ADJUSTMENTS	121
SCHEDULE-J	SCHEDULE OF DRAWINGS AND TECHNICAL LITERATURE	122
SCHEDULE-K	SCHEDULE OF ORDERS EXECUTED/ROUTINE,TYPE AND SPECIAL TESTS/PERFORMANCE CERTIFICATES	123
SCHEDULE –L	SCHEDULE OF DOCUMENTS IN RESPECT OF FINANCIAL RESOURCES/CAPABILITY OF THE TENDERER	125

Guaranteed and other technical particulars.

Annexure-III

A. TECHNICAL PARAMETERS OF 160 MVA,220 KV/132 KV/11 KV Three phase Auto transformer.

a) Type	Three phase Auto transformers (Constant Ohmic impedance type).
b) Rating	
HV	160 MVA
IV	160 MVA
LV (tertiary)	53.33 MVA (Reactive) and 2 MVA (Active)
	Continuous thermal rating shall be at least of 2 MVA active loading.
c) Cooling	ONAN/ONAF/OFAF with 2x 50 % radiator banks.
d) Rating at different cooling	60%/80%/100% (96/128/160 MVA)
e) Type of transformer	Constant ohmic impedance type.
f) Voltage ratio	$\frac{220}{\sqrt{3}} / \frac{132}{\sqrt{3}} / 11 \text{ KV}$
g) Frequency	50 HZ
h) Phases	Three
i) a) Impedance HV-IV at normal Tap No.-5	10.2% ± 10% TOL.
b) Impedance HV-IV at Tap No.- 1 (Highest Transformer Ratio)	10.3% ± 15% TOL.

c) Impedance HV-IV at Tap No.- 17 (Lowest Transformer Ratio)	10.0% ± 15% TOL.		
d) Impedance HV-LV at normal Tap No. 5	36% ± 20% TOL.		
e) Impedance IV-LV	24% ± 20% TOL.		
j) Air core reactance of HV winding (min.)	20 % (Knee point voltage not less than 1.1 p.u)		
k) Service:	Outdoor		
l) Duty:	Continuous		
m) Max. flux density in any part of core and yoke at rated MVA and frequency and 110 % rated voltage	1.9 Tesla		
n) Over load capacity	As per IS: 6600/IEC-60354		
o) Temperature rise over max. Ambient temp. of 45 deg			
- Of top oil measured by thermometer:	50 ⁰ C		
- Of winding measured by resistance method:	55 ⁰ C		
Maximum ambient temperature	45 ⁰ C		
p) Cooling Medium:	Mineral oil as per IS: 335		
q) Windings	High	Intermediate	Low
	Voltage	Voltage	Voltage
	(220 KV)	(132KV)	(11KV, but designed for 33KV class insulation)
i) Fault Level	40 KA for 2sec	31.5KA for 2 sec	25KA for 2 sec

ii) 1.2/50micro sec lightning impulse withstand voltage	1050 KVp	650 KVp	170 KVp
iii) One minute power frequency withstand voltage	460 KV(rms)	275 KV(rms)	70 KV(rms)
iv) Winding Connection	Auto Star	Auto Star	Delta
v) Neutral	Solidly grounded	Solidly grounded	
vi) Insulation	Graded	Graded	Uniform

r) Vector group : YNa0d11

s) Tapping A) Range	+5% to -15%
B) No. of steps	16 @ 1.25%
C) ON 220 KV winding	For HV voltage 220 KV variation
D) Type	On load Tap Changer

t) Bushing	HV	IV	Neutral	LV
i) Type	Oil filled Condenser Type	Oil filled Condenser Type	Solid Porcelain or oil communi- -cating	Solid Porcelain or oil communi- -cating

.....Without Arcing Horns.....

KV is generally 12500 mm centre to centre. The height of the buses will be about 11 meters in 220 KV and 9.2 meters in 132 KV. The height will be finalised during detailed engineering. The tenderer are requested to note the above in the design of transformer size.

y) Bushing Current transformer parameter for the three phase 160 MVA auto transformers.

	On each phase Connection		
	HV side	IV side	Neutral Side
i) Ratio			
Core 1	1000/1 A	1000/1 A	1000/1 A
Core 2	500/1 A	1000/1 A	
ii) Minimum Knee point voltage & Accuracy class			
Core 1	1000 V	1000 V	1000 V
	Class -PS	Class -PS	Class -PS
Core 2	0.2 Class	0.2 Class	-
	30 VA, ISF<5	30 VA, ISF<5	
iii) Max. CT resistance			
Core -1	2.5 ohms	2.5 ohms	2.5 ohms
Core -2	-	-	-
iv) Application			
Core 1(Nearer the winding)	Restricted Earth	REF	REF
	Fault(REF)		
Core 2	Metering	Metering	Metering
v) Max. Magnetisation current(at knee point voltage) for Core-1	30 mA	30 mA	30 mA

Note:

1. Accuracy Class PS as per IS: 2705.
2. Class(for the relevant protection and duties) as per IEC: 60044-1.
3. It shall be possible to remove the CTs from the transformer tank without removing the transformer cover.
4. CT secondary leads shall be brought to a weatherproof terminal box near bushings.
5. **CT characteristics are tentative and are liable to change within reasonable limits. Bidder/ Manufacturer shall take Purchaser's approval before proceeding with the design of bushing CTs.**
6. Parameters of WTI CT for each winding shall be provided by the contractor/ manufacturer.

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S.E.

ANNEXURE-IVSCHEDULE OF REQUIREMENTS

QUANTITY	S.NO.	DESCRIPTION OF EQUIPMENT	QUANTITY
1. a		160MVA,220/132/11KV,,3-Phase,ONAN/ONAF/OFAF Cooling 50 cycles/sec. Auto transformer vector group YNaodII with tertiary winding for stabilization complete With On load tap changer and other accessories, terminals Connectors etc.as stipulated in the specifications(read along With part-II sec-1&Annex.III of part-II).	3 NOs. Grid /Stn. Udhampur=2 nos Grid /Stn. Barn=1no. (Both grid/stns. are in jammu region).
	b.	Set of fittings and accessories.(As per part-II- of technical section)for each transformer	One set of fittings/ Accessories for each of 3Nos. transformers.
	c.	Remote tap changer cubical(RTCC) for above accommodating equipment as per NIT specification.	3Nos.
	d.	No. of connected cooler banks/ No. of standby cooler Banks.	As per requirement refer clause 1.22 of technical specification(part-II)
2.		Transformer oil in non-returnable.Epoxy coated drums. required for initial filling of transformer plus 10% extra)for 3 no.transformers.	10%extra for each of 3 Nos.
3.		Set of spare parts.	As per schedule D/list of Mandatory spares.

AEE

Executive Engineer,
Elect.P&D Divn-III

Superintending Engineer,
Elect.Planning&Design Circle,
Jammu.

SCHEDULE-A1

DIMENSIONS OF LARGEST PACKAGE AND WEIGHT OF HAVIEST PACKAGE FOR TRANSFORMERS FOR JAMMU REGION.

Regarding transportation of 3 nos. transformers to be installed in Jammu region (refer clause 2.2 Section-II), the following details with regard to tunnels/roads enroute

SHALL BE CAREFULLY NOTED.

1. The Jawahar/Nandni tunnels on Jammu Srinagar Highway have sectional dimension of 4.5 mts. as height and 3.2 mts. as width.
2. The culverts/bridges on Jammu Srinagar Highway as designed for CL-70R, except Bali Nallah Bridge near Nagrota which is designed for CL-40R.

The weight of heaviest package and the dimensions of largest package for these transformers shall be restricted to limits keeping above note in view.

SCHEDULE-A

GUARANTEED TECHNICAL AND ADDITIONAL TECHNICAL PARTICULARS

I. Guaranteed Technical Particulars (To be signed & furnished by the manufacturer)

(Under mentioned figures are subject to tolerance as per IS:2026(Part-I)-1977 with amendments valid(at the time of quotation)

1. Name of the Manufacturer and country of origin.
2. Installation Indoor/Outdoor.
3. Reference standard:
4. Continuous ratings under conditions specified in IS:2026(Part-I)1977 Clause No.3
 - (a) Type of cooling:
 - (b) Rating(MVA) :HV IV LV
 - (i) With ONAN cooling:
 - (ii) With ONAF cooling:
 - (iii)With OFAN cooling.
 - (iv) With OFAF cooling:
 - (v) With OFWF cooling:
 - (vi) With ODAN cooling:
 - (vii)With ODAF cooling:
 - (viii)With ODWF cooling:
 - (c) Rated Voltage:
 - (i) HV KV:
 - (ii) IV KV:
 - (iii)LV KV:
 - (d) Rated frequency Hz:
 - (e) Number of Phases:

- (f) Current at rated no load voltage and on principal tap:
 - (i) HV Amps:
 - (ii) IV Amps:
 - (iii) LV Amps:
- 5. Connections:
 - (i) HV:
 - (ii) IV:
 - (iii) LV:
- 6. Connection Symbol:
- 7. Temperature rise:
 - (a) Temperature rise of oil above reference peak ambient temperature (By thermometer)(°C):
 - (i) At full ONAN rating(°C):
 - (ii) At full OFAF/ODAF/OFWF/ODWF rating (°C).
 - (b) Temperature rise of winding above reference peak ambient temperature(By Residence method)(°C)
 - (i) At full ONAN rating:
 - (ii) At full OF/ODAF/OFWF/ODWF rating:
 - (c) Limit of hot spot temperature for which the transformer is designed(°C).
- 8. Type of Tap changing switch:
 - (i) Off circuit switch/links:
 - (ii) On load:
- 9. Tapings on windings HV/IV/LV for:
 - (i) Constant flux/variable flux/combined regulation:
 - (ii) Location (Line/Central/ Neutral) end of winding:
 - (iii) Number of steps:

- (iv) Range of tapping for variation(HV/IV/LV):
10. (i) No load loss at rated voltage and frequency at principal tap(KW):
 (ii) No load loss at the voltage corresponding to the highest tap(KW):
 (iii) Tolerance, if any, on the above values:
 11. (a) Load loss at rated output, rated frequency and corrected for 75 °C winding
 Temperature at:
 (i) Principal tap(KW):
 (ii) Highest tap (KW):
 (iii) Lowest tap (KW):
 (b) Tolerance, if any, on the above values.
 12. (a) Auxiliary losses at rated output, normal ratio, rated voltage, rated frequency
 and ambient temperature(KW):
 (b) Tolerance, if any, on the above values.
 13. Total losses at normal ratio inclusive of auxiliary equipment losses (KW):
 14. Positive sequence impedance on rated MVA base at rated current and frequency
 At 75 °C winding temperature at: HV-IV HV-LV IV-LV
 (i) Principal Tap percent:
 (ii) Highest Tap percent:
 (iii) Lowest Tap percent:
 15. Zero sequence impedance at reference temperature of 75 °C at principal tap
 Percent:
 16. Reactance at rated MVA base at rated current at frequency percent:
 17. Regulation at full load and 75 °C winding temperature expressed at a percentage
 of normal voltage:
 (i) At Unity Power Factor percent:
 (ii) At 0.8 Power Factor (Lagging) percent:

18. Efficiency at 75 °C winding: Unity power factor 0.8 power factor
Temperature as derived
from guaranteed loss figures and at
- (a) At full load percent:
 - (b) At $\frac{3}{4}$ load percent:
 - (c) At $\frac{1}{2}$ load percent:
19. (i) Maximum efficiency percent:
(ii) Load at which maximum efficiency occur(percent of full load):
20. Time in Minutes for which the transformer can be run at full load without exceeding the maximum permissible temperature at reference ambient temperature when:
20. (a) Supply to fans is cut off but the oil pumps are working:
(b) Supply to oil pumps is cut-of but fans are working:
(c) When supply to both fans and pumps is cut off:
21. Short time rating for 2 seconds of:
- (a) HV winding:
 - (b) IV winding:
 - (c) LV winding:
22. Permissible over loading:
- (a) HV winding:
 - (b) IV winding:
 - (c) LV winding:
23. Terminal arrangement:
- (i) High voltage(HV):
 - (iii) Intermediate voltage(IV):
 - (iii) Low voltage (LV):

- (iv) Neutral-HV/IV/LV:
- (v) Tertiary:
- 24. Insulating and cooling medium:
- 25. Test Voltage: HV IV LV
 - (i) Lightning impulse withstand test voltage(KV peak):
 - (ii) Power frequency with-stand test voltage (dry and wet) (for 1 minute) (KV ms):
 - (iii) Switching impulse withstand test voltage (KV peak):
- 26. Partial discharge level at 1.5Um cube root KV ms(PC):
- 27. Noise level when energized at normal voltage and frequency without load(db):
- 28. External short circuit withstand capacity (MVA) and duration (seconds).
- 29. Over flux withstand capability of the transformer:

II. Additional Technical Particulars

(These figures are indicative only. These shall not form the basis for upward or Downward revision of prices).

1. Details of core:
 - (a) Type of core constructions:
 - (b) Type of core joints:
 - (c) Flux density at rated voltage and frequency and at principal tap tesla:
 - (d) Magnetising current at normal ratio and frequency:
 - (i) 85 percent at rated voltage:
 - (ii) 100 percent of rated voltage:
 - (iii) 105 percent of rated voltage:

(In case KVA ratings of windings are different, this may be specified in terms of Magnetizing KVA):

 - (e) Power factor of magnetizing current at normal voltage ratio and frequency:

- (f) (i) Material of core laminations:
- (ii) Thickness of core laminations(mm):
- (g) (i) Whether core construction is without core bolts:
- (ii) Insulation of core bolt:
- (iii) Insulation of core bolt washers:
- (iv) Insulation between core laminations:
- (v) Core bolt insulation withstand voltage for 1 minute(KV ms):
- (vi) Are the core bolts grounded. If so how:
- (h) (i) Material of core clamping plate:
- (ii) Thickness of core clamping plate:
- (iii) Insulation of core clamping plate:
- (i) Describe location/Method of core grounding:
- (j) Details of oil ducts in core:

2. Details of windings: HV IV LV

- (a) Type of winding:
 - (b) Material of the winding conductor:
 - (c) Maximum current density of windings
(at rated current) and conductor area
- | | Current
density
(A/cm square) | Conductor
area
(cm square) |
|------------------|-------------------------------------|----------------------------------|
| (i) H.V: | | |
| (ii) I.V: | | |
| (iii) L.V: | | |
| (iv) Regulating: | | |
- (d) Whether HV windings are interleaved:
 - (e) Whether winding are preshrunk:

- (f) Whether adjustable coil provided for HV and LV windings:
 - (g) Whether steel rings used for the windings if so, whether they are split:
 - (h) Whether electro-static shields are provided to obtain uniform voltage distribution in the HV windings:
 - (i) Insulating material used for :
 - (i) HV winding:
 - (ii) IV winding:
 - (iii) LV winding:
 - (iv) Regulating winding:
 - (j) Insulating material used between:
 - (i) HV and IV winding:
 - (ii) IV and LV winding:
 - (iii) LV winding:
 - (iv) Regulation winding and earth:
 - (k) Type of axial coil supports:
 - (i) H.V. winding:
 - (ii) I.V. winding:
 - (iii) L.V. winding:
 - (l) Type of Radial Coil supports:
 - (i) H.V. winding:
 - (ii) I.V. winding:
 - (iii) L.V. winding:
 - (m) Maximum allowable torque on coil clamping bolts
3. Bushings: HV IV LV Neutral
- (a) Make and type:
 - (b) (i) Rated voltage class KV:

- (ii) Rated current (Amps):
- (c) Lightning impulse withstand test voltage
(1.2*50 microsecond) (KV peak):
- (d) Switching surge with-stand test voltage (KV peak):
- (e) Power frequency with-stand test voltage:
 - (i) Wet for 1 minute (KV ms)
 - (ii) dry for 1 minute (KV ms)
- (f) Visible corona discharge voltage(KV ms)
- (g) Partial discharge level
- (h) Creepage distance in (mm)
- (i) Creepage distance (protected)
- (j) Whether test tap is provided
- (k) Quantity of oil bushing and specification of oil used (kg)
- (l) Weight of assembled bushing(kg)
- (m) Minimum clearance height for removal of bushing (mm)

4. Minimum clearance (mm):

	In Oil		In Air	
	Between	Phase to	Between	Phase to
	Phases	Ground	Phase	Ground
(i) HV :				
(ii) IV				
(iii) LV				

5. Approximate weight:

- (a) Core with clamping : kg :
- (b) Coil with insulation : kg :
- (c) Core and winding : kg :

- (d) Oil required for first filling : kg :
- (e) Tank and fittings with Accessories : kg :
- (f) Untanking weight : kg :
- (g) Total weight with oil and fittings : kg :
6. Details of Tank :
- (a) Type of tank :
- (b) Approximate thickness of sheet :
- (i) Sides (mm) :
- (ii) Bottom (mm) :
- (iii) Cover (mm) :
- (iv) Cooling Tubes/Radiators (mm) :
- (c) Vacuum recommended for hot oil circulation (torr) :
- (d) Vacuum to be maintained during oil filling in transformer tank (torr) :
- (e) Vacuum to which the tank can be subjected without distortion (torr) :
- (f) No. of bi-directional wheels provided :
- (g) Track gauge required wheels provided Transverse Axis Longitudinal Axis
- (h) Type of gauge required for the wheels :
- Vent and pressure at which it operates
7. Conservator:
- (a) Total volume (Litres) :
- (b) Volume between the highest and lowest visible oil levels(Litres) :
- (c) Power required by heaters(if provided) (kv) :
8. Oil Quality:
- (i) Governing standard:

- (ii) Specific Resistance at (Ohms-cms)
- 27° C :
- 90° C :
- (iv) Tan delta :
- (v) Water content (ppm) :
- (vi) Dielectric strength(Breakdown voltage)(KV) :
- (vi) Characteristic of oil after ageing test as per ASTM D-1934 :
- (a) Specific Resistance at (ohm-cms)
- 27 ° C :
- 90° C :
- (b) Tan delta :
- (c) Sludge content :
- (d) Neutralisation Number :
- (vii) Details of oil preserving equipment offered :

9. Radiator

- (i) Overall dimensions 1*b*h(mm) :
- (ii) Total weight with oil (kg) :
- (iii) Total weight without oil (kg) :
- (iv) Thickness of Radiator tube (mm) :
- (v) Types of mounting :
- (vi) Vacuum withstand capability :

10. Cooling system : Fan Motor Pump Motor

- (a) Make and type :
- (b) No. of connected units :
- (c) No. of standby units :
- (d) Rated power input :

- (e) Capacity (cu m/min.) or (litres/min.) :
- (f) Rated voltage (Volts) :
- (g) Locked rotor current(Volts) :
- (h) Efficiency of motor at full load(Percent) :
- (i) Temp.rise of motor at full load (Percent) :
- (j) BHP of driven equipment :
- (k) Temperature range over which control is adjustable(°C) :
- (l) Whether the fan and/or pumps suitable for continuous operation
At 85 percent of their rated voltage :
- (m) Estimated time constant in hours for :
- (i) Natural cooling :
- (ii) Forced air cooling :
11. Gas and oil operated relay Make and type :
12. Temperature Indicators Oil temperature : Winding
Indicator temperature
Indicator
- (i) Make and type :
- (ii) Permissible setting ranges for alarm and trip :
- (iii) Number of contacts :
- (iv) Current rating of each contact :
- (v) Whether remote indicators provided. If so, whether equipment
Required at purchasers control room is included.
13. Approximate overall dimension
- (a) Length : mm
- (b) Breadth : mm
- (c) Height : mm

14. (i) Minimum clearance height for lifting core and winding from tank : mm :
- (ii) Minimum clearance height for lifting tank cover : mm :
15. Shipping details
- (a) Approximate weight of heaviest package : kg :
- (b) Approximate dimension of largest package : kg :
16. Transformer will be transported with oil/gas
17. Size of rail recommended for the track
18. Details of bushing current transformers (HV IV LV Neutral)
- (i) Quantity :
- (ii) No. of Cores :
- (iii) Ratio: :
- (iv) V.A. burden :
- (v) Accuracy class :
- (vi) Knee point voltage :
- (vii) Magnetising current at knee point voltage :
- (viii) Secondary resistance :
19. Lifting jacks :
- (i) Governing standard :
- (ii) No. of jacks in one set :
- (iii) Type and make :
- (iv) Capacity (tones) :
- (v) Pitch (mm) :
- (vi) Lift (mm) :
- (viii) Mean diameter of thread(mm)
20. Marshalling kiosk :
- (i) Make and type :
- (ii) Details of apparatus proposed to be housed in the kiosk. :
21. Details of anti-earth-quake device provided, if any :
22. Separate conservator and Buchholz relay provided :
23. Tap Changing Equipment (These details refer to the basic rating of O.L.T.C. as guaranteed by O.L.T.C. manufactures) :
- (a) Make :
- (b) Type :
- (c) Power flow-unidirectional/bi-directional/restricted bi/directional :
- (d) Rated voltage to earth (KV) :
- (e) Rated current (Amps) :
- (f) Step voltage(Volts) :

- (g) Number of steps :
- (h) Control-manual/Local Electrical/Remote Electrical :
- (i) Voltage control –Automatic/Non-Automatic :
- (j) Line drop compensation provided/Not provided :
- (k) Parallel operation :
- (l) Protective devices :
- (m) Auxiliary supply details :
- (n) Time for complete tape change(one step)Sec. :
- (o) Diverter selector switch transient time(cycles) :
- (p) Value of maximum short circuit current (Amps) :
- (q) Maximum impulse withstand test voltage with 1.2/50 micro-seconds. :
- (r) Maximum power frequency test voltage between switch assembly and ground (KV peak) :
- (s) Maximum impulse withstand test voltage with 1.2/50 microseconds across :
- (t) Approximate over all dimensions of tab changers(in case of separate tank type)(mm) :
- (u) Approximate overall weight (In case of separate tank type)(kg) :
- (v) Approximate mass of oil (In case of separate tank type)(kg) :
- (w) Particulars of O.L.T.C. control panel for insulation in the control room :

24. Driving mechanism box

- (i) Make and type :
- (ii) Details of apparatus proposed to be housed in the box. :

Date:

Signature:

Place

Name and Status:

Authorized attorney of tendering company

Name of the tendering company

SCHEDULE-B**SCHEDULE OF TERMS AND CONDITIONS FINANCIAL AND COMMERCIAL**

(TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER)

The tenderer shall refer to relevant clauses in Part-I before filling)

The tenderer is required to furnish terms and conditions for equipment /spares/services etc. strictly as per following format to make the process of evaluation simpler without any confusion or to avoid likely slips in evaluation process if relevant information is provided in the tender in bits/vague terms/printed material.

DETAILS OF TERMS AND CONDITIONS**A: FINANCIAL TERMS AND CONDITIONS**

S.NO.	PARTICULARS OF ITEMS	160MVA/ONAN/ONAF/OFA F, 220/132/11KV ,3- PHASE AUTO TRANSFORMER WITH FITTINGS/ACCESSORIES INCL. OLTC/RTCC AS PER ANNEX. III&IV	10% EXTRA OIL FOR EACH TRANSFORMER UNIT	SPARES	TESTING OF EQUIPMENT	DEPUTATION OF SUPERVISORY STAFF FOR SUPERVISING ERECTION, TESTING & COMMISSIONING OF EQUIPMENT AT SITE.
1.	2.	3	4	5.	6.	7.
	The tenderer must specify each item of terms and conditions given in column 2, here under , at respective space under each column 3 to 7 for equipment/Toil/ spares/testing/supervision etc.					

<p>1.</p> <p>I)</p> <p>II)</p> <p>III)</p>	<p><u>PRICES:</u></p> <p>(The tenderer MUST Refer relevant clause of part-I &II Before quoting)</p> <p>Quoted prices shall be upto destination i.e.Udhampur/Barn G/Stn (Ex-works prices must also be specified for computing ED/CST components etc.</p> <p>The prices shall be preferably FIRM</p> <p>MODVAT Benefits</p>					
<p>2</p>	<p>Rebate on Ex-Works (EWP)</p> <p>State under each column Rebate offered on EWP, if any.</p>					
<p>3</p> <p>i).</p> <p>a</p> <p>b</p>	<p>Duties/Taxes/Levies (The tenderer must refer to clause 1.16 of part-I before quoting)</p> <p>State under each column if</p> <p>ED extra/not Applicable/included in EWP.</p> <p>If extra or included in EWP, Give percentage rate chargeable or at which rate ED included in EWP.</p>					

<p>ii)</p> <p>a)</p> <p>b)</p> <p>iii)</p> <p>4.</p> <p>a)</p> <p>b)</p>	<p>Sale Tax(Central or state, ST)</p> <p>State under each column if</p> <p>ST extra/not applicable/included in EWP.</p> <p>If extra or included in EWP,given percentage rate chargeable or at which ST included in EWP.</p> <p>Any other levy chargeable</p> <p>Freight:</p> <p>Give Freight chargeable up to consignee's store.</p> <p><u>Insurance</u> (Refer to clause 1.14 of part-I before quoting)</p> <p>It is the responsibility of the Supplier to deliver goods at consignee's stores in good condition. For this, if the supplier deems necessary, May get the goods insured .Any charges on account of</p>					
--	--	--	--	--	--	--

c)	insurance of goods, therefore shall not be payable by the Deptt. Mode of Transport					
----	---	--	--	--	--	--

B.GENERAL TERMS AND CONDITIONS.

S.No	Particular of item	Terms and conditional offered
1.	2.	3.

The tenderers shall give details of below given general terms and conditions in specific terms without reference to phrases such as 'clause –agreed to' or 'As per clauses-'etc.

5.Price variation clause

In case prices are variable(not FIRM)state:

i-PV Formula/circular applicable

ii-Base date of price/indices of raw material/labour

iii-Ceiling in PV(must be specified)

PV to be calculated from above details as per

Departmental procedure till the other is placed.

6.Earnest money

Give particulars of Bank

Guarantee/CDR equivalent to

2% of the Ex-works cost of equipment pledged to chief Engineer, Electrical Planning &

Design Wing, Jammu. The B.G., should be valid for 12 months from the date of opening of tenders.(Refer clause 1.6 of part-1)

7.Validity:

(The tenderer MUST refer to clause 1.9 of part –I before quoting)

The tender shall be unconditionally valid for a period

Of 12 months from Due date of opening of tenders.

8.Terms of payment:

(Refer to clause 1.12 of part-I before quoting.)

- a) 90% payment with taxes and duties shall be made against receipt and verification of material along with despatched documents at consignees site after material is despatched by road transport after satisfactory inspection and 10% after successful commissioning of the equipment at site.

b) Advance payment/payment against LOC are not acceptable because of procedural complications involved. Besides, evaluation of bid in such cases is affected.

9. Delivery period/completion period

Specify delivery period

(Refer to clause 1.10 or part-I and 1.33 of part-II before quoting)

- i) The tenderer shall commence the supply within six months of Issue of order and Complete within 3 months thereafter
10. Damages or penalty for delay/negligence in Execution Of order (refer clause- 1.1 of part-I).
11. i) Warranty/Guarantee(refer 1.13 of part-I)
 ii) Failure to meet GTP and specifications (clause 2.14 of part-I)
12. Cancellation (clause 1.21 of part-I).
 Additional quantities/extra(clause 1.23 of part-I and 2.5/2.7 of part-I)
13. Civil suit/legal remedy(clause 1.24 of part-I).
14. Arbitration(clause 1.25 of part-I)
15. Inspection and testing(clause 2.15 of part-I)
 Besides comments to accept
 Inspection &testing clause,
 State facilities/capability to
 Conduct test as per IS
16. Patent rights(clause 2.20 of part-I).
17. Conditions of contract(clause 2.23 of part-I).
18. Deviations:
- i) a) Deviation in specification as stipulated in NIT.(refer schedule-H)
 - b) Variation(clause 1.27 of part-I).

19. Training of staff

The purchaser intends to trained minimum two Engineers at the manufactures works for a period of two weeks in Assembly operation and maintenance of transformer. However, the duration of training. No. of engineers shall be finalised after placement of Order. The boarding, lodging, local transport etc. for Engineers sent for training shall be borne by the supplier.

20. Observance of regulations safety requirements

The tenderer shall state if regulatory/ statutory restrictions and safety statutory restrictions and safety requirements in respect of earthing arrangements, danger and other label air clearance, provisions of anti-earthquake arrangements, pressure relief devices, defence and highway/Railway norms for transportation of equipment etc. have been taken care of in design offered for the desired equipment.

21. Capability of firm manufacture-

Equipment of similar/higher rating. While furnishing information/Documents in this regard, the Emphasis is laid on rating/Voltage level of equipment required.

- i) In this, state facilities to manufacture desired equipment. Standing of the firm as designer and manufacture of the equipment covered by specifications be enumerated.
- ii) List of orders executed.
- iii) Copies of type/routine/special test certificate from recognized test houses in the country/outside.
- iv) Performance certificate for a minimum period of 3 years from SEBs/NTPC/NHPC/Govt. Departments etc. Specially in respect of same/high rating of same voltage level.

22. Financial resource and experience(clause 2.19 of part-I)Enclose following reports.

- i) Banker's report.
- ii) I.T.C.C(Income Tax Clearance certificate)
- iii) Sale Tax Clearance Certificate.
- iv) Annual balance sheet/report for the preceding five financial years.

23. Additional General terms and conditions for;

- i) Spares
- ii) Testing
- iii) Supervision/services

24. Any other terms conditions not covered above.

Dated:

Signature:

Name and Status:

Place:

Authorized attorney of tendering company.
Name of the tendering company.

NOTE: The tenderers are requested to take note of the following instructions while making offers in respect of terms conditions of the equipment/spares/services:-

1. As emphasized above, the terms and condition shall be Quoted in above format/sequence to make. The process of evaluation more uniform, simpler, concise, specific and confusion free, in unambiguous terms.
2. No printed general terms and conditions enclosed with the tender shall be accepted.
3. The tender shall give categorical and complete information in each column(3 to 7), such as:
 - i) Ex-works prices.
 - ii) Ceiling in price variation.
 - iii) ED/CST/ any other levy applicable etc. each for equipment, spares & tests etc.
 - iv) Freight etc. as asked for therein against each item of the particulars.
4. The prices shall be preferably FIRM

Any ambiguity in this regard(such as, vague or no mention or contradiction etc.)shall be interpreted as per departmental practice to suit the departmental interest so far as evaluation of bid/placement of order is concerned.

SCHEDULE-C**SCHEDULE OF PRICES**

(TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER)

(The tenderer should refer to relevant clauses in Part-I and Part-II)

The tenderer is required to furnish prices for equipment/spares/services etc. strictly as per following format to make the process of evaluation simpler without any confusion or to avoid likely slips in evaluation process if relevant information is provided in the tender in bits/vague terms/printed material.

DETAILS OF PRICES OFFERED IN RESPECT OF EQUIPMENT/SPARES/TESTS/SUPERVISION**JOB:**

A: PRICES FOR UDHAMPUR/BARN SITE:

S.No	Particulars of item	16MVA/ONAN/ONAF/ OF AF,220/132/11kV,3- phase AUTOTRANSFORMER WITH FITTINGS/ACC- ESSORIES INCL.OLTC/RTCC AS PER ANNEX.III&IV.	10%EXTRA OIL FOR EACH TRANSFORM -ER	COST OF TESTS ON EQUIPMENT AS PER SCHEDULE 'E'	SUPERVISION CHARGES ON ACCOUNT OF ERECTION, TESTING COMMISSIONING, OF TRANS. AT SITE AS PER SCHEDULE 'G'
1.	2.	3.	4.	6.	7.
1.	Unit Ex-works Price(EWP)				
2.	Rebate on EWP if any.				

3.	Duties/Taxes(refer clause 1.16 of part-I before quoting)				
i)	Excise duty(State percentage ED rate along with certificate from Superintendent of concerned range)				
ii)	S.T(CST or state S.T)(state percentage S.T. rate also)				
iii)	Any other levy Chargeable.				
4.	Unit Freight charges upto site (For insurance, item 4a of schedule B be referred to)				
5.	Unit prices Upto site.				
6.	TOTAL				

B-COMPUTED SITE COSTS

S.NO.	PARTICULARS OF ITEM	AMOUNT
1.	2.	3.

1.	2.	3.
----	----	----

7. Unit cost component on account of

i)Equipment/Insulation. Oil(as per column 3&4)

ii)Spares(as per column 5)

iii)Testing(as per column 6)

iv)Supervision of Erection/testing/commissioning of equipment.(Column-7)

v)Capitalization of losses.

vi)Any other item

8. Computed unit price upto site, Udampur/Barn.

9. Quantity.

10. Total computed price upto site.

Dated:

Signature:

Place:

Name and Status:

Authorized attorney of the

tendering company.

Name of the Tendering Company.

SCHEDULE-D**SCHEDULE OF REQUIREMENT,PRICE AND DELIVERY PERIOD OF SPARE PARTS.**

(TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER).

(The tenderer shall refer clauses 2.8 and 2.6 part-I before filling)

The tenderer is required to fill in here spare parts as per following list/or any other spare parts he recommends for ten years operation. The purchaser reserves the right to purchase such of the quantity/lies as he finally decides upon at the prices filled in below.

s.no	Description	Quantity	Ex-works prices	Amount
1.	Bushing with metal parts & gaskets of each Rating including Neutral bushing.	1 set		
2.	Local and remote winding temperature indicator complete with sensing device & contacts.	1 set		
3.	Oil temperature indicator with contacts & sensing device.	1 set		
4.	Pressure relief device	1 set		
5.	Magnetic oil gauge with low level alarm contacts.	1 set		
6.	Oil flow indicator with flow level alarm contacts	1 set		
7.	Oil cooler pump with motor	1 set		
8.	Cooler fan with motor	1 set		
9.	Set of valves (complete set for one transformer).	1 set		
10.	Set of pressure gauge (1 No. of each type and range)	1 set		
11.	Set of pressure switch (1 No. of each type and range)	1 set		
12.	Set of starter, contactor, relays and switch for electrical control panels (1 set of each type and	1 set		

	range)			
13.	Breather assembly(one of each type) for conservator and OLTC	1 set		
14.	Buchholz relay complete with floats &contacts	1 set		
15.	Tap position indicator(local and remote)	1 set		
16.	Tap changer diverter switch contacts	1 set		
17.	Bushing CTs of each type and ratio	1 set		
18.	Fuses(complete set for one transformer)	1 set		
19.	Indicating lamps (one set consisting of complete replacement for one transformer)	1 set		
20.	Air cell for main conservator	1 set		
21.	Terminal connector (complete set for one transformer)	1 set		
22.	Oil surge relay OLTC	1 set		
23.	Drive motor for OLTC with gear assembly	1 set		
24.	Oil sampling bottles (one litre capacity)	1 set		
25.	Oil storage tank(15KL)	1 set		
26.	Any additional spare parts recommended for transformer/OLTC/cooler bank as recommended by the tenderer.	1 set		
27.	TOTAL EX-WORKS COST OF SPARES			

The rebate/ED/Taxes/F&I etc applicable on the ex-work prices/other terms& conditions in reference to supply of spares, be given in schedule-B..

Dated: Signature

Place: Name and status:

Authorized attorney of the tendering company.

Name of the tendering company.

- NOTE
- i- The mandatory spare parts are indicated under section"List of the mandatory spares"(Page-79).The prices of mandatory spares should be FIRM-shall be indicated separately in the price bid and the same shall be considered for the purpose of tender evaluation. However, the actual quantities of spare parts to be procured shall be decided by the purchaser.
 - ii- The bidder may also recommended additional spare parts in addition to the mandatory spares considered necessary for five years of successful operation of the equipment. The prices of these additional spares parts shall be indicated separately in schedule of recommended spares(schedule-D).However, these shall not be considered for bid evaluation. The prices additional spares shall be **FIRM** and purchaser reserve right to procure them any time and any time any quantity during the execution of the contract.

SCHEDULE-E

THE SCHEDULE OF TESTS TO BE CONDUCTED ON EQUIPMENT

(TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER

The tenderer shall refer clauses 2.14.2,15,(part-I)&1.28(Part-II)

The tenderer is required to give (fill in the following format)the tests as are necessary to be conducted on the equipment for acceptance/before dispatch as per relevant standards/NIT specifications:

S.No	Description of tests	Charges, if any	Remarks
1.	2.	3.	4

1

2

3

4

5

6

7

Total charges on account of tests:

The rebate/ED/Taxes/F&I etc. applicable on test charges.

The applicable terms and conditions in regard tests/duties etc shall be given in schedule

B for terms and conditions.

Dated:

Signature:

Place:

Name and status:

Authorized attorney of the tendering company

Name of the tendering company.

SCHEDULE –F

SCHEDULE OF TOOLS AND SPECIAL ERECTION TOOLS

(TO BE FILLED IN / FURNISHED AND SIGNED BY THE TENDERER)

The tenderer shall refer clauses 1.19(g)-Part-I & 1.37-Part-II

The tenderer is requested to fill in here such maintenance tools and special Tools as he recommends for the erection and maintenance of the transformers. The quantities and tools as be finally decided upon at the unit prices filled in below:

S. NO.	Description.	Quantity Recommended	Unit Ex-Works prices	Amount
1.	2.	3.	4.	5.
1				
2.				
3.				
4.				
5.				
-				
-				

Total cost of tools:

The rebate/ED/Taxes /F&I etc. applicable on quoted Ex-works price .

Terms and conditions in this regard, shall be given in schedule –B for terms and conditions. The cost of tools and tackle referred in clause 3.27 (part-II) and 1.19 (part-I) is deemed to be indicated in the price bid.

Dated: Signature

Place: Name and status.

Authorised attorney of the tendering company.

Name of the tendering company.

SCHEDULE-G

**SCHEDULE OF CHARGES ON ACCOUNT OF SUPERVISION OF ERECTION,
TESTING AND COMMISSIONING OF EQUIPMENT
TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER**

The tenderer shall refer clauses 1.19g of NIT(Part-I) before filling

S.No.	Item of Work	**Details of supervisory staff		***
	* No of days	required Daily		Estimated
	estimated for	-----		charges on
	supervision	Category	charges per	account of
	job for one unit		day per	supervision
			category	job per unit.

1.	2.	3.	4.	5.	6.
----	----	----	----	----	----

i)Erection/Commissioning Engineer.

ii)Any other category(such as technician etc.)

* The number of days, required for complete job of erection, testing and commissioning of unit to be executed departmentally under the supervision of erection/commissioning engineers of the firm, to be assured at this end.

** The tenderer shall furnish the category and rate per day for each category of supervising the job of erection, testing and commissioning of the equipment at site.

*** The charges on account supervision job for comparison Purposes to be worked out as per column3 and column 4/5(Col.6=Col.3x.Col.5)

The applicable terms and conditions, if any shall be mentioned in this schedule.

Daed:

Signature:

Place:

Name and Status.

Authorized attorney of the tendering company

Name of the tendering Company.

SCHEDULE-H**SCHEDULE OF DEVIATION FROM CONDITIONS AND SPECIFICATIONS**

(TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER)

Refer clause 1.2.6.2.11 and 2.14 of NIT-(part-I)

I/We have carefully gone through the technical specifications and General Conditions

Of contract and have satisfied myself/ourselves and hereby confirm that my/our offer

Strictly conforms to the requirements of the technical specifications of the NIT except for the Technical Deviations which are given below:

A. Description	Stipulation in specification	Deviation	Remarks
----------------	------------------------------	-----------	---------

Dated:

Signature

Place:

Name and Status.

Authorised attorney of the

Tendering company

Name of the Tendering

Company.

SCHEDULE-I

SCHEDULE FOR PRICE ADJUSTMENT

(TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER)

The tenderer shall refer relevant clauses before filling

In case prices are variable(not FIRM) state:-

1. PV formula/circular applicable
2. Base data of price/indices of raw material/labour
3. Ceiling in PV(must be specified)

The relevant details with regard to price variation shall also be given in schedule-B for terms and conditions.

Dated:

Signature

Place:

Name and Status.

Authorised attorney of
the tendering companyName of the tendering
Company

SCHEDULE-J**SCHEDULE OF DRAWINGS AND TECHNICAL LITERATURE.****(TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER****(The tenderer shall refer clauses 2.17.1 of part-1 of NIT and 1.5 of part-II Of NIT also before filling)****A TENDER DRAWINGS:**

- i General outline drawings showing dimensions and shipping weights.
- ii Sectional views showing the general construction features.
- iii General arrangement of foundation and structure mounting/drilling plan.
- iv Type test certificates and osoilograms.
- v Crane requirement for assembling and dismantling of equipment, if any.
- vi Dimension of the largest parts to be shipped and the position in which these are to be transported.
- vii Bushing drawing.

B COMPLETION OF DRAWINGS:

All drawing listed above should corrected in accordance with the works as actually executed at site.

C. CONTRACT DRAWINGS:

- i) General outline drawings front side elevation and plan of the equipment with detailed dimensions.
- ii) Foundation drawings.
- iii) Drawing of each type of bushing giving dimensions/clearance between HT and LT and terminal and ground, quantity of insulating oil, name plates details etc.
- iv) Control and wiring diagrams and drawings showing temperature indicated alarm circuit etc.
- v) Drawing showing construction and mounting details of marshalling boxes(cooler and drive mechanism)/RTCC. In addition to the above, the drawings and documents mentioned in clauses 1.5.2 of section-I, part-II.

D. TECHNICAL LITERATURE:-

- i) Nine copies of the instructions books/operation and maintenance manuals and spare parts bulletins.
- ii) Description literature and data on equipment construction, winding, bushing etc.

E. Any other drawings that the bidder deems necessary to be submitted.

Dated:

Signature

Place:

Name and Status.

Authorised attorney of the company.

Name of the tendering company

SCHEDULE-K

SCHEDULE OF ORDERS EXECUTED/ROUTINE TYPE SPECIAL TESTS/PERFORMANCE CERTIFICATES IN RESPECT OF EQUIPMENT OF SAME HIGHER RATING.

(TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER)

(The tenderer shall furnish the following information/certificate/documents to Establish his capability to manufacture the equipment.

S.NO. CERTIFICATES

*1 LIST OF ORDERS EXECUTED

The tenderer shall furnish the list of orders executed in the Following format.

S.NO.	Description of Equipment	Name of Elect. Board/Purchaser.	Purchase order no. and Date.
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1.	2.	3.	4.
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Status of Supply	Commissioning date	Performance Remarks
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5.	6.	7.
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*2 ROUTINE TEST CERTIFICATES

*3 TYPE/SPECIAL TEST CERTIFICATES.

(Give list of test certificates from recognized test houses of National Or International repute for equipment of similar or higher rating of Same voltage level. In this Connection/relevant clauses pertaining To TESTS in Part-I& part-II of NIT may please be referred to).copies Of test certificates be attached.

4 PERFORMANCE CERTIFICATE/DOCUMENTS

(Give list of performance certificate from state Electricity Boards for Equipment with similar or higher rating of the same voltage level of Equipment, or any other certificate/documents which must establish Performance of such equipment beyond doubts. Otherwise the offer of The firm is likely to be rejected. Copies of performances reports be Attached

* While furnishing the above certificate/documents the emphasis shall be Laid on rating and capacity of the equipment required.

Dated:

Signature:

Place:

Name and Status.

Authorised attorney of the

Tendering company.

Name of the tendering

Company

SCHEDULE-I

SCHEDULE OF DOUCMENTS IN RESPECT OF FINANCIAL RESOURCES/CAPABILITY OF THE TENDERER

(TO BE FILLED IN/FURNISHED AND SIGNED BY THE TENDERER

(The tenderer shall refer relevant clauses before filling)

The tenderer shall attach along with this schedule the following documents to

Establish his financial resources:-

1. Banker's Report
2. I.T.C.C.I (Income Tax clearance certificate)
3. Sales Tax clearance certificate.
4. Annual Balance sheet/report for the last five years.
5. Certificate from the superintending, Excise Duty Range connected, in Support of ED rate quoted as applicable.

Dated:

Signature

Place:

Name and Status.

Authorised attorney of the

Tendering company.

Name of the tendering company.

