

**OFFICE OF THE SUPERINTENDING ENGINEER, ELECTRIC PLANNING AND
DESIGN CIRCLE BEMINA SRINAGAR**

NOTICE INVITING TENDERS

Reference: 1. NIT NO. EPDC/NIT-10/PLG of 2011, Dated: - 27.07.2011

Sealed tenders affixed with Rs. 5/= revenue stamps are invited on behalf of Governor of Jammu and Kashmir State, from Registered Original Manufactures, for **DESIGN, MANUFACTURING , TESTING AT MANUFACTURER'S WORKS AND SUPPLY OF FOLLOWING EQUIPMENT/ MATERIAL** for various Grid stations in Kashmir Province of Jammu and Kashmir State. The Tenders should be addressed to Chief Engineer Electric Planning & Design Wing, (J & K), Srinagar and sent through Registered / Speed post /Courier. The tenders shall be opened on the date of tender or any subsequent day to the convenience of Chief Engineer Electric Planning & Design Wing, (J&K), Srinagar in presence of Tenderers or their authorized representative, who may desire to be present.

S. No	Description of Equipment	Approx. Qty.	Date issuance of tender document	Cost of tender document	Last Date for Receipt of tender
1	40/50MVA, 132/33KV ONAN/ONAF two winding, three phase power transformers with vector group YNyno with OLTC having variation of voltage from +5% to -15% in 16 equal steps with all accessories including first filling oil.	05 No.	From 01.08.2011 to 10.09.2011	Rs. 20,000/= (Note DD for this amount shall be enclosed with main offer (technical bid) in case tender document is down loaded from website: panddpdd.jk.in	15.09.2011 up to 2Pm.
2	16/20 MVA, 132/33KV ONAN/ONAF two winding, three phase power transformers with vector group YNyno with OLTC having variation of voltage from +5% to -15% in 16 equal steps with all accessories including first filling oil.	01 No.			

The tenders should be accompanied with a CDR/FDR/Bank Guarantee for an amount of Rs 22.00Lacs, pledged to the Chief Engineer Electric Planning & Design Wing Srinagar, J & K Power Development Department.

The complete set of Tender Document shall be available for sale in the office of the S.E. Electric Planning & Design Circle PDD Complex Bemina Srinagar on all working days against a non-refundable payment shown above in the shape of Bank Draft in favour of S.E P & D Circle Srinagar.

Sd/
**Superintending Engineer,
Electric Planning and Design Circle,
Srinagar.**

NO: EPDC/TS/NIT-10/

DATE:

Copy:

M/S -----

Government of Jammu & Kashmir



**POWER DEVELOPMENT DEPARTMENT
PLANNING AND DESIGN WING JAMMU**

**NIT No. EPDC/NIT-10/PLG of 2011 Dated: 27-07-2011
Tender Specification**

**PART-I (SECTION I&II)
GENERAL TERMS AND CONDITIONS
AND**

**PART-II (SECTION-III)
TECHNICAL SPECIFICATION
OF**

**40/50 MVA & 16/20 MVA, 132/33 kV
THREE PHASE POWER TRANSFORMER WITH OLTC FOR
GRID SUB-STATIONS, CHADURA, DANGIWACHA, WANPOH
AND KHREW (KASHMIR)**

**IN J&K STATE
COST OF DOCUMENT= Rs. 20,000/**

Issued By:

**SUPERINTENDING ENGINEER
ELECTRIC PLANNING & DESIGN CIRCLE
BEMINA, SRINAGAR KASHMIR**

July-2011

GOVERNMENT OF JAMMU AND KASHMIR

POWER DEVELOPMENT DEPARTMENT

**OFFICE OF THE SUPERINTENDING ENGINEER ELECTRIC
PLANNING AND DESIGN CIRCLE BEMINA SRINAGAR.**

M/S-----

No: EPDC/TS/ _____ Dated: _____.

Subject: Procurement of 5 No. 40/50 MVA& 1 No. 16/20 MVA, 132/33 KV three phase power transformer with OLTC for grid substations, Chadura, Dangiwacha, Wanpoh, and Khrew (Kashmir)

Reference; Your letter No. ----- Dated; -----

Dear Sir,

As desired vide letter referred above, please find enclosed the requisite tender document for NIT specification No. **EPDC / NIT-10 /PLG of 2011, dated, 27-07-2011.**The tenders duly completed in all respects should reach the OFFICE OF THE CHIEF ENGINEER, ELECTRIC PLANNING AND DESIGN WING,J&K Srinagar, PDD Complex Bemina Srinagar (Summer Capital) on or before 15-09-2011 up to 02-00 PM which shall be opened on the same day or any other convenient day

**Superintending Engineer,
Electric Planning and Design Circle
Srinagar.**

Copy to;

Chief Engineer Electric Planning & Design Wing (J&K) Srinagar for information.

GOVERNMENT OF JAMMU AND KASHMIR

POWER DEVELOPMENT DEPARTMENT

ELECTRIC PLANNING AND DESIGN CIRCLE BEMINA SRINAGAR

NOTICE INVITING TENDERS

FOR

**DESIGN, MANUFACTURING, TESTING AT MANUFACTURER'S WORKS AND
SUPPLY OF 5NO. , 40/50 MVA& 1 NO., 16/20 MVA, 3-PHASE, 132/33 KV**

**POWER TRANSFORMERS
FOR VARIOUS**

GRID STATIONS

IN KASHMIR REGION OF J&K STATE

NIT NO. EPDC/NIT-10/PLG of 2011

Dated:- 27.07.2011

**Last date and time for
Receipt of tender**

**15-09-2011
02.00 P.M.**

Price Rs. 20,000/=

Name of Firm

G.R. No.Date

Demand Draft No.Date

Tender Document No.

**Superintending Engineer,
Electric Planning and Design Circle
Bemina,Srinagar.**

SECTION-I

1 General Conditions

1.1 Invitation for Tenders

For and on behalf of the Governor of Jammu and Kashmir State, the Superintending Engineer Electric Planning and Design Circle Srinagar invites sealed tenders from original manufacturers for Design, Manufacturing, Testing and Supply of **40/50 MVA and 16/20 MVA, 132/33 kV Three Phase Power Transformers** as per terms, conditions, technical specifications and schedules thereto of this tender document

1.2 Instructions to the Tenderers

1.2.1 The tenders should be addressed to the Chief Engineer, Electric Planning and Design Wing, Jammu and Kashmir Power Development Department, PDD Complex Bemina Srinagar (J & K), which shall be received in his office on or before 15-09-2011 up to 2 P.M.

1.2. The tenders shall be opened on 15th September 2011 or any subsequent day to the convenience of the Chief Engineer, Electric Planning and Design Wing, Jammu and Kashmir Power Development Department in presence of the tenderers or their authorized representatives who may be present at the time of opening of tenders

1.2.3 In case the due date of receipt of tenders falls on holiday or the holiday being declared subsequently, the tenders will be received on next working day.

1.2.4 The tenderer shall furnish the check list, duly completed and authenticated, conforming the supply of essential information/documents without which the tender shall be deemed to be incomplete making it liable for outright rejection.

1.2.5 The tenders should be submitted in three parts viz. Part I, Part II and Part III as described in clause 1.3 below and each part should be in triplicate clearly marked Original, Duplicate and Triplicate, separately tagged and placed in separate envelopes duly superscribed as Part I/Part II/Part III, NIT No., Due Date and Name of the Tenderer. Then Part I, Part II and Part III should be placed in one cover which should be duly sealed and super scribed with NIT No., Due Date and Name of the Tenderer.

1.3 Submission of offer / tender

The offer/tender shall be submitted in three parts

1.3.1 Part I: (Commercial Bid)

1.3.1.1 Commercial Terms & Conditions. The tenderer shall furnish the information in accordance with the enclosed Schedule/Format

1.3.1.2 Earnest Money in the shape of Bank Draft / CDR / Bank Guarantee from Nationalized Scheduled Bank.

1.3.1.3 Proof of Permanent Registration with DGS&D, NSIC, Department of Industries Jammu & Kashmir Government.

1.3.1.4 Income Tax Clearance Certificate

1.3.1.5 List of orders received and executed during last three years giving reference to the order and the name of the purchasers

1.3.1.6 Capital Turnover of the tenderer for the last three years

1.3.1.7 Permanent Registration Certificate / Industrial license for material quoted along with monetary limits, production capacity etc

1.3.2 Part-II (Technical Details)

1.3.2.1 Technical details

1.3.2.2 Guaranteed Technical Particulars

1.3.2.3 Satisfactory Performance Certificate

1.3.2.4 Authenticated Photostat copies of test certificates in accordance with clause 3.10.2 from any of the Govt. Laboratories / Govt. approved test house

1.3.2.5 Catalogues, drawing, Photostat copies of registration of patent design etc

1.3.2.6 Check list conforming supply of essential information as per Schedule

1.3.3 Part-III (Price Bid)

1.3.3.1 Price bid strictly as per schedule annexed to this tender document

1.3.3.2 Delivery Period

1.3.3.3 Terms of payment

1.3.3.4 Additional Earnest Money, if any

1.4 On the date of opening of tenders, the Technical and Commercial Bids (Part I and Part II) shall be opened in presence of tenderers who may be present at the time of opening of tenders. The Price Bid (Part III) of the tenderers, who on scrutiny of (Part I and II) of the offer are found to have qualified for opening of the Price Bid, shall be opened on any subsequent date convenient to the tender opening committee.

- 1.5** The tender must be complete in all the respects. All the terms and conditions of the tender including technical specifications should be carefully studied for submitting complete and comprehensive tender. Failure to comply with any of the terms and conditions or instructions which are likely to render fair comparison of tenders, as a whole, impossible may lead to rejection even if it is competitive offer/ tender.
- 1.6** Tenders of such of the tenderers who have not purchased the tender documents from the office of the Superintending Engineer Electric Planning and Design Circle Srinagar shall not be entertained. However tender document downloaded from websites shall be acceptable if Demand Draft, in favour of Superintending Engineer Electric Planning and Design Circle Srinagar, on account of the cost of tender document is enclosed with part 1 of the tender. Any request by post, by hand, by fax or telegraphically for any modification, addition, deletion etc in the tender after last date of receipt of tenders shall not be considered
- 1.7** The tenders shall be prepared in a formal manner with all quotations written both in words and figures. The tender should be typed or written in ink and be legible. Any tender written with pencil shall be rejected. There shall be no erasures or over writings and if any corrections are made the same shall be neatly done and attested. A systematic form of totaling should be adopted to avoid any ambiguity. The detailed description of the material offered should be given. The rates so written must be secured with a transparent tape over them. Any ambiguity in this regard shall be dealt in accordance with departmental practices to suit the departmental interests only.
- 1.8** The rates/ prices must be quoted in Indian Currency alone and any mistake in converting foreign exchange component into Indian Currency will not justify the claim whatsoever of tenderer for increase in prices. Foreign exchange component if any shall have to be arranged by the tenderer. Bank charges if any on this account shall be to the account of the tenderer
- 1.9** In the price bid, the tenderer shall clearly indicate the breakup of their quoted rates/prices i.e. Ex Works Rate, Element of Taxes & Duties, Packing & Forwarding charges, Transit Insurance, Freight charges etc. In the event of failure, the elements on account of packing and forwarding, transit insurance and freight charges shall be loaded at the highest quoted rate for the purpose of comparison. The tenderer shall also clearly indicate the basic rates for purpose of calculation of excise duty. In case of failure to do so Excise Duty shall be presumed to be applicable on ex works rates plus packing and forwarding charges. The prices offered shall be on F.O.R. site basis. It shall be the responsibility of the supplier to deliver material/equipment at site in good condition.

- 1.10** The payment on account of Freight, Insurance, Taxes and Duties shall be made as per actual on production of documentary proof subject to the ceiling offered by the tenderer in the Price Bid.
- 1.11** No tenderer, unless otherwise specified in the terms and conditions of these specifications, shall be exempted from depositing Earnest Money.
- 1.12** No claim shall be laid against the Department either in respect of interest or depreciation in value for the amount of Security Deposit or Earnest Money. In case of bank deposits the department shall not be responsible for any loss on account of bankruptcy of the bank.
- 1.13 Qualification of Tenders**
- 1.13.1 Only such firms need to quote who can produce satisfactory evidence that they have relevant experience, adequate financial resources and established engineering organization to undertake such work to the satisfaction of the Department. Tenderers should clearly state their experience in design, manufacture and supply of **40/ 50 MVA and 16/20 MVA, 132/33 kV Three Phase Power Transformer**.
- 1.13.2 In addition to the qualifying requirement mentioned above the minimum qualification criteria, satisfactory fulfillment of which will enable participation of tenderer in the competition, shall also necessarily include the following.
- 1.13.2.1 The bidder should have designed, manufactured and supplied **40/50 MVA and 16/20 MVA, 132/33 kV Three Phase Power Transformer** to different State Electricity Boards/Departments and PGCIL etc
- 1.13.2.2 Notwithstanding anything stated above the department reserves the right to assess the bidder's capability and capacity to perform the work, if circumstances warrant such assessment in the overall interest of the department. The department may depute its representative to the works of the tenderer for on spot assessment.
- 1.13.2.3 Five years Satisfactory Performance Certificates of similar or high rated equipment of same voltage level from state electricity boards/departments certifying that the equipment supplied by the Firm is operating satisfactorily from last five years.
- 1.13.2.3.1 Chief engineer reserves the right to consider any of the tender not accompanied with satisfactory performance certificate after ascertaining the capability of the tenderer. The department may depute its representative to the works of the tenderer for on spot assessment.
- 1.13.2.4 Authenticated copies of Type Test Certificates from Government approved test house/laboratory in respect of equipment of similar or higher rating of same voltage level. In case bids are accompanied with type test certificates of higher ratings, the successful tenderer has to get the equipment type tested from approved test houses at his cost. Item wise charges for Type Tests shall also be quoted.

1.13.2.5 Every document should be placed in its relevant section viz performance certificate section, Type test certificate section, GTC and GTP section, section for purchase orders executed, drawing section and miscellaneous section. Sections should be arranged in aforesaid chronological order and should be segregated from each other with separators.

1.14 Earnest Money

1.14.1 The tender of local industrial units registered with Department of Industries, Government of Jammu and Kashmir shall accompany with earnest money the form and values as per direction of the State Government as applicable at the time of submission of tenders.

1.14.2 Tenders other than covered under Clause 1.14.1 including those registered / exempted by DGS&D / SSI shall be accompanied with Earnest Money equal to Rs 22.00 lacs in the shape of Bank Draft / CDR / Bank Guarantee from Nationalized Scheduled Bank pledged to the Chief Accounts Officer to Chief Engineer, Electric Planning and Design Wing Jammu and Kashmir and shall be valid for one year from the date of opening of Price Bid. In case 2% of prices offered exceed the aforesaid amount, the additional Earnest Money shall be accompanied with the Price Bid.

1.14.3 No tenderer, unless or otherwise specified in the terms and conditions shall be exempted from depositing earnest money. Tenders not accompanied with the requisite amount of earnest money shall be rejected

1.14.4 The earnest money of the tenderer (s) shall be forfeited if they withdraw their tender or revise the prices of their offer within the validity period or violate terms and conditions contained herein.

1.14.5 Earnest money deposit shall be released in favour of:

1.14.5.1 Unsuccessful tenderer (s) immediately after finalization of the contract.

1.14.5.2 Successful tenderer (s) after furnishing of required security deposit cum Performance Guarantee.

1.15 Security Deposit/Performance Guarantee

1.15.1 Earnest Money deposit shall be released in favour of successful tenderer after furnishing of requisite amount of security deposit. The tenderer shall be required to furnish security deposit equivalent to 10% of the value of the order in the shape of

Bank Guarantee from a Nationalized Scheduled Bank pledged to the Chief Accounts Officer to Chief Engineer, Electric Planning and Design Wing Jammu and Kashmir for successful execution of contract. The Successful tenderer (s) shall furnish security deposit within one month from the date of issuance of letter of acceptance to the letter of Intent or before expiry of earnest money deposit whichever is earlier. Failure to furnish the deposit within the stipulated period will make the tenderer liable for cancellation of contract together with forfeiture of earnest money. Security deposit shall be valid for entire period of execution of contract and entire guarantee period. Security deposit shall be released after providing certificate from the consignee regarding the successful execution of the contract and after guarantee period is over. The security deposit shall be forfeited in case of revision of prices or violating of terms and conditions within the validity of tender.

1.15.2 In case the supplier fails to rectify/replace the defective/damaged materials including transit damages / shortages within 3(Three) Months from the date of intimation of such shortage / damages, they shall have to pay interest to the Jammu and Kashmir Power Development Department @12% P.A on value of such materials from the date of payment.

1.16 Modifications Prior to Date of Tender Opening.

The Chief Engineer, Electric Planning and Design Wing, Jammu and Kashmir may revise or amend the specifications and terms and conditions prior to the date notified for receiving of the tenders. Such revision or amendments, if any, will be communicated to all prospective tenderers through the media. In such case, if considered necessary, the date of receiving of the tenders may also be extended at the discretion of the Chief Engineer.

1.17 Delivery / Completion

Delivery being essence of contract, tenderers shall quote shortest possible delivery period.

1.18 Validity

The tenders should be valid for a period of 365 days from the date of opening of the Price Bid during which no revision of offer shall be acceptable. During evaluation of tenders, tenderer shall immediately respond to the clarifications sought by the Department.

1.19 Award of Contract

- 1.19.1 The Chief Engineer, Electric Planning and Design Wing, Jammu and Kashmir reserves the right to reject any or all tenders without assigning any reason thereof.
- 1.19.2 Any effort on behalf of tenderer or his representative to approach/ influence any officer/ official of the Department or otherwise on any account shall render the tender liable for rejection.
- 1.19.3 Department reserves the right for placing the order in parts or full and/or split it among two or more tenderers.

1.20 Contract and Agreement

It will be obligatory on the part of successful tenderer to execute a legal agreement with the Chief Engineer Electric Planning and Design Wing, Jammu and Kashmir within 30 (Thirty) days of placement of formal purchase order. Sufficient copies of the Contract Agreement and specifications shall be supplied by the tenderer to the Chief Engineer, the cost thereof shall be deemed to have been included in the offered Prices.

1.21 Prices

The rates shall be quoted as per unit basis covering the cost of raw materials, designing, manufacturing, testing and supplying at F.O.R destination. The tenderer shall clearly indicate the breakup of their quoted rates/ prices i.e. Ex Works Rate, Element of taxes and Duties, Packing and Forwarding charges, Transit Insurance, Freight charges etc. Taxes and duties, freight and insurance shall be paid as per actual against documentary proof subject to the ceiling offered by the tenderer in the Price Bid. The rates quoted should be both in figures and words.

1.22 Price Variation

- 1.22.1 The prices shall be Firm/ Variable as per IEEMA in vogue.. The ceiling for the price variation shall be stated which will be taken into account while analyzing the offers. In case of variable prices, the basic cost of raw materials on which the quoted prices are based must also be specified. Base date for price variation must be mentioned in the price bid.
- 1.22.2 Statutory variation in duties and taxes on finished goods, if any, till award of purchase order, shall be allowed on production of documentary evidence subject to the terms and conditions of the tender.
- 1.22.3 Benefits of MODVAT / VAT shall be passed on to the department. This should be clearly mentioned in the offer.

1.23 Taxes and Duties

The rates of taxes and duties applicable against supply of material shall be quoted separately in relevant schedule of this NIT and shall be paid against documentary proof subject to the maximum quoted in the Price Bid and as per terms and conditions of the Tender.

1.24 Central Sales Tax.

As per standing rules, no Form C or D shall be provided by the department. As such CST/VAT is not payable on concessional rates against declaration of Form "C". The rate of CST/VAT applicable without form C or D must be quoted in the offer. If during the period of contract Form C/D is issued by the government, same shall be provided to the successful tenderer. For fair comparison of rates, ED, CST, VAT, Entry Tax, Toll Tax offered by the tenderer shall be loaded, however If the tenderer (s) have not quoted the tax rates , the highest rates offered by the tenderer (s) shall be loaded against unquoted item.

1.25 Income Tax Clearance

The tender shall be accompanied by the latest Income Tax Clearance certificate either in original (which shall be returned) or an attested photo copy.

1.26 Insurance and Freight

The insurance and freight charges are initially to be borne by the supplier and will be reimbursed as per actual against documentary proof subject to the maximum quoted in the Price Bid. All formalities in connection with settling of claims, if any, with the transport agency and insurance company shall be attended to by the supplier without any extra cost to the department. A certificate shall be submitted by the supplier with each bill to the effect that the consignment has been insured against all risks up to final destination. The rates for this are required to be quoted by the tenderer, however it is responsibility of supplier to deliver equipment at site in good condition without any damage or shortage in transient.

1.27 Terms and Mode of Payment

1.27.1 Payment for the material supplied shall be made in Indian Currency in the following manner

1.27.2 90% of payment shall be released against the delivery and verifications of the material in good condition at installation site and balance 10% after successful completion of the supplies in full.

1.27.3 Advance payment clause is not acceptable as it requires Government Sanction which is time consuming process.

1.27.4 Payment against letter of credit is not required as it requires Government sanction which besides time consuming is denied.

1.28 Consignee

The Consignees for the material shall be intimated with the purchase order. The consignees shall also be the paying authorities on account of cost of material and other allied services against the specified contract.

1.29 Inspection and Quality Assurance

1.29.1 The successful tenderer shall submit quality assurance plan to Chief Engineer, Electric Planning and Design Wing, Jammu and Kashmir within 15 days from issuance of letter of intent. The quality assurance plan will be approved by the Chief Engineer and shall form part of the Contract.

1.29.2 During the course of manufacture the Department or its nominated representative (CPRI, DGS&D, etc.) shall have the right to inspect the materials, workmanship and progress of manufacturing of the equipment and may reject any item which is found defective or which is not in accordance with the specifications. The Tenderer upon demand by the department or its representative shall rectify or replace such defective/ unsuitable material. The Tenderer shall provide all reasonable inspection facilities to the departmental inspector without any extra charges.

1.29.3 In addition to the aforesaid test and those included in the contract, the purchaser reserves the right to get material/ equipment inspected or tested at his expense.

1.29.4 The Supplier shall keep a record of all the tests carried out on the materials used for manufacturing and shall produce the same along with the invoices.

1.29.5 The tenderer shall give at least 15 days notice to Chief Engineer, Electric Planning and Design Wing, Jammu and Kashmir for inspection of the material and testing thereof so that the departmental representative is nominated to witness the tests. The equipment shall be dispatched after the dispatch instructions are issued from CPRI.

1.29.6 The tenderer shall offer the equipment of its patent type, already *type tested as per the relevant IS/IEC Specifications*, without any additional financial burden on account of type test charges.

1.29.7 In case the nominated representative CPRI etc shall inspect the equipment on behalf of the Department. The inspection charges shall be initially borne by the tenderer in the first instance which shall be reimbursed to the tenderer as per actual against documentary evidence.

1.30 Packing and Forwarding

1.30.1 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 tenderer 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.

1.30.2 The tenderer shall notify to the department, the date of dispatch of each consignment as well as the expected arrival at site. 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.

1.30.3 The marking shall be stenciled in indelible ink on all the packing's. Each package shall be accompanied with a packing list. All risks for transportation of equipment up to the installation site shall be the responsibility of the supplier.

1.30.4 The tenderer shall ensure that the packing and bill of material are approved by the Purchaser or his representative 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 Tenderer 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.

- 1.30.5 Weight of the transformer shall be so designed that the transformer can be transported by road.
- 1.30.6 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.
- 1.30.7 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.
- 1.30.8 Spare parts shall be packed separately and clearly marked.
- 1.30.9 Impact recorders shall be fitted with the Transformers to record the movements during transportation and storage during transit

1.31 Force Majeure

The Tenderer shall not be liable for any liquidated damages for delay or any failure to perform the contract arising out of force majeure conditions beyond his control including acts of God or the enemy of the Government viz. fires, floods, epidemic, quarantine restricted strikes, freight embargos and defaults of such contracts due to any such cause, provided that the Tenderer shall within ten days from the beginning of such delay notify to the department in writing the cause of delay supported with convincing evidence. The department once convinced shall extend the completion period by a suitable/reasonable margin. Electricity cuts shall not be considered in Force Majeure condition.

1.32 Penalty and Termination of the Contract

- 1.32.1 If the tenderer fails to fulfill any of the terms and conditions of this contract including failure to complete the contract within the stipulated period, the department shall without prejudice to other remedies available to it under law enforced in the State be competent to impose all or any of the following penalties on the tenderer in addition to the forfeiture of the security deposit.
- 1.32.2 Terminate the contract after 30 days clear notice and make risk purchase at the cost of the tenderer.
- 1.32.3 Impose penalty @½ % per week on the cost of the un-delivered portion of the material subject to maximum of 5% of the cost of Purchase order.

1.33 Arbitration

- 1.33.1 If at any time doubt, question, dispute or difference whatsoever arises between the tenderer and the Department, upon or in relation to or in connection with this contract, either of the parties may give the notice in writing of existence of such doubt, question, dispute or difference and same shall be referred to Jammu and Kashmir State Government for nominating the arbitrator under Jammu and Kashmir Arbitration Act. The decision of the arbitrator shall be final, conclusive and binding upon the parties.
- 1.33.2 The tenderer shall not delay the carrying out of the supplies by reasons of any reference to the arbitrator and shall proceed with the work with all due diligence and shall until the decision of the arbitrator abide by the decision of the Chief Engineer or his representatives, in charge of receiving the supplies duly conveyed to him.
- 1.33.3 The work under this contract shall if reasonably possible continue during arbitration proceedings and no payment due from or payable by the department shall be with held on account of such proceedings except to the extent which may be in dispute.

1.34 Court of Competent Jurisdiction

The Courts of Jammu and Kashmir State alone shall have the jurisdiction of deciding any dispute between the parties

1.35 General

- 1.35.1 The price of tender documents shall not be refunded under any circumstances whatsoever.
- 1.35.2 The tenderer shall be deemed to have carefully examined various stipulations in this NIT and also to have fully informed himself with all conditions local and otherwise affecting the execution of the contract. Failure to do so shall be at his risk and cost.
- 1.35.3 Procurement of steel, zinc and all other raw material shall be the sole responsibility of the tenderer. The tenderer shall take special note of this responsibility while furnishing their tenders.

SECTION-II

2 Climatic Conditions

2.1 The climatic conditions at the site of work are approximately as under. The equipment offered shall be suitable for continuous operation at full rated capacity under such conditions.

2.1.1	Maximum Ambient temperature	40 ⁰ C
2.1.2	Yearly average temperature	22 ⁰ C
2.1.3	Daily average temperature	35 ⁰ C
2.1.4	Minimum temperature	-20 ⁰ C
2.1.5	Height above sea level	1500 Mts.
2.1.6	Max. relative humidity	90%
2.1.7	Min. relative humidity	15%
2.1.8	Average No. of thunder storm days per year	54
2.1.9	Average rainfall	80 cm
2.1.10	Max. wind pressure	100 Kgs/m ²
2.1.11	Average number of rainy days per year	106

2.2 Communication and Transport

2.2.1 The nearest railway station is Jammu on the broad gauge line and is connected to the various sites by metallic roads. The equipment is required to pass en-route through Nandni and Jawahar Tunnels. The supplier shall ensure that the weight and dimensions of packages are suitable for transporting the material up to Srinagar.

2.2.2 The bidder shall dispatch the transformer in an atmosphere of Nitrogen. Necessary arrangement shall be ensured by the bidder to take care of pressure drop of nitrogen during transit and storage till completion of oil filling during erection. A gas pressure testing valve with necessary pressure gauge and adaptor valve shall be provided. The transformer shall also be fitted with sufficient number of impact recorders 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 in the factory and shall continue till the unit is received at the site of installation.

2.2.3 It shall be the sole responsibility of the bidder to transport the transformer to the specified sites. The bidder 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 bidder 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. Bill of quantity and relevant drawings of these items shall also be included in the manual. The transformers shall preferably be transported on Hydraulic Trailers so as to minimize the impact on winding etc during transportation. The scope of any necessary modification / extension / improvement to existing road, bridges, culverts etc. shall be included in the scope of the bidder.

2.3 Quantities

The quantities of the equipment are given in the schedule of requirement. The purchaser reserves the right to increase or decrease the final quantities by $\pm 40\%$, for which rates quoted/accepted shall be applicable subject to concurrence of the Purchase Committee.

2.4 Completeness of Tender

The tenders shall be complete in all respects and shall include all minor accessories. Any material and equipments not specifically stated in this specification but are mandatory for satisfactory operation of the equipment shall be deemed to be included in the offered price and shall be supplied without any extra cost.

2.5 Extra Material

The tenderer shall, when asked in writing by the Purchaser to furnish extra material not covered in this specification or included in the schedule but which may form inseparable part for satisfactory operation of the equipment. For such material supplied for which rates are not available in the contract schedule, payment shall be made at rates as mutually agreed upon between the purchaser i.e. committee constituted by concerned Chief Engineer and the tenderer. This shall, however, not apply to the minor accessories, for which no extra amount shall be payable.

2.6 Spares

The tenderer shall recommend the quantity of spare parts necessary for five years of successful operation of the equipment. The spare parts shall be in conformity with the standards and relevant specifications. The unit price of these additional spare parts shall be quoted separately. The prices of additional spare parts shall be firm and the Purchaser reserves the right to procure them at any time and in any quantity before the expiry of the Contract.

2.7 Standards

2.7.1 Unless otherwise specified, all material and equipments shall comply in all respects with the requirement of the latest addition of Indian Standards or International Electro-Technical Commission. If the tenderer offers equipment complying with any other internationally recognized standard, which ensures better quality. Full details of the difference between the Indian Standard specification and the specification actually adopted shall be clearly brought out in the tender. . A complete set of such standard specifications shall be furnished along with the tender. Any deviation in Commercial and General Terms and Conditions shall not be entertained except the technical deviations which shall be specifically brought out in the relevant section.

2.7.2 Some of the Indian Standards/ International Electro-Technical Commission specifications related to Power Transformer are:

- 2.7.2.1 IS-2026 (Part 1 to Part 4) - Power Transformers
- 2.7.2.2 IS-3347 (Part 1 to Part 8) - Dimensions for Porcelain transformer Bushings in lightly polluted atmospheres
- 2.7.2.3 IS-3639 - Fittings and Accessories for Power Transformers
- 2.7.2.4 IS-6600 - Guide for loading of Oil Immersed Transformers
- 2.7.2.5 IS-3737 - Gas operated relays
- 2.7.2.6 IS-6272 - Industrial cooling fans
- 2.7.2.7 IS-335 - Insulating Oils for Transformers
- 2.7.2.8 IS-6792 - Electric strength of insulating oil
- 2.7.2.9 IS-1886 - Installation and maintenance of transformers
- 2.7.2.10 IEC-60076 (Part 1 to 5) - Power Transformers
- 2.7.2.11 IEC-60214 - On-load Tap-Changers.
- 2.7.2.12 IEC-551 - Measurement of transformers noise level
- 2.7.2.13 IEC-60354 - Loading of oil - immersed Power Transformers
- 2.7.2.14 IEC-60076-10 - Determination of transformer Sound Levels
- 2.7.2.15 CBIP manual on Transformer

2.8 Interchangeability

All equipment of the same type and rating shall be physically and electrically interchangeable. Similar parts of the equipments shall also be interchangeable. All spare parts shall be made of the same materials and workmanship as that of corresponding parts of the equipment supplied under the specification and shall also be interchangeable.

2.9 Instruction Manuals

The bidder shall submit to the Purchaser, Instruction manuals for erection, testing and commissioning of the equipments well before commencement of supply of the first equipment. The Instruction manuals shall contain full details and drawings of the equipments, their erection, commissioning operation, testing and maintenance procedures. The Instruction manuals shall contain a detailed description of construction and operation, together with all relevant pamphlets, drawings and a list of parts with procedure for ordering spares. Maintenance instructions shall include charts showing lubrication checking, testing and replacement procedures to be carried out daily, weekly, monthly and at longer intervals to ensure trouble free operation. They shall give a step by step procedure for all operations likely to be carried out during the life of the equipment. Wherever applicable, troubleshooting locations charts shall be included to facilitate finding the cause of mal-operation or breakdown. The contract shall not be considered to be completed until such instructions and drawings have been supplied to the Purchaser. The bidder shall furnish nine hard copies and two soft copies of Instruction manuals to the purchaser within the offered price.

2.10 Drawings

2.10.1 In addition to any other drawings which the tenderer may like to supply, the following drawings/catalogues shall be submitted with the tender. The tender drawings shall show sufficient over all dimensions of all apparatus so as to enable the purchaser to determine the final design of the installation.

2.10.1.1 General outline drawing showing front, side elevation and plan views of the transformer and all accessories and external features with detailed dimensions, net and shipping weights, crane lift for unloading and/or erection/removal of bushings, size of lifting lugs and pulling eyes, HV and LV terminal clearances, quantity of insulating oil etc.

2.10.1.2 Sectional views showing the general construction features.

- 2.10.1.3 General outline drawing showing dimensions, wheel loading, weights of transformers, radiators, tap change gear, marshalling box, their shipping weights.
- 2.10.1.4 General arrangements for foundations and structure mounting. Crane requirements for assembling and dismantling of transformers.
- 2.10.1.5 Type test certificate and oscillogram.
- 2.10.1.6 Dimension of the largest parts to be shipped and the position in which these are to be transported.
- 2.10.1.7 General outline drawing showing details and dimensions of Bushing.
- 2.10.1.8 Technical and descriptive literature giving details of the equipment and accessories offered including bought out items.
- 2.10.2 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.
 - 2.10.2.1 General outline drawing of transformer showing.
 - a) Plan
 - b) Elevation
 - c) End view
 - 2.10.2.2 List of all accessories with detailed weights, quantity of insulating oil, dimensions clearances, spacing of wheels in direction, center of gravity, location of cooler etc.
 - 2.10.2.3 Loading details for transformer foundation
 - 2.10.2.4 Foundation Plan showing reaction at points of support, clamping arrangement and location of jacking pads
 - 2.10.2.5 Over fluxing withstand duration curve
 - 2.10.2.6 Schematic wiring diagram of OLTC
 - 2.10.2.7 Mounting Arrangement and wiring diagram of remote WTI
 - 2.10.2.8 Assembly drawings of HV and LV bushings
 - 2.10.2.9 Outline and General Arrangement of Cooler Control Cabinet
 - 2.10.2.10 Cooler Control cabinet schematic and wiring diagram
 - 2.10.2.11 Magnetization Characteristics Neutral CTs
 - 2.10.2.12 Hysteresis Characteristics of iron core
 - 2.10.2.13 Rating and Diagram Plate giving details of terminal marking and connection diagram
 - 2.10.2.14 Overall Transport dimension drawing of transformer
 - 2.10.2.15 Oil Flow Diagram

- 2.10.2.16 Drawing showing typical sectional view of the windings with details of insulation, cooling circuit, method of cooling and core construction etc
- 2.10.2.17 Valve Schedule Plate drawing
- 2.10.2.18 Twin Bi-directional Roller
- 2.10.2.19 Connection Diagram of all protective devices of marshalling box
- 2.10.2.20 List of spares
- 2.10.2.21 Technical Literature of all fittings and accessories
- 2.10.2.22 Calculation to support short circuit withstand capacity of transformer
- 2.10.2.23 Calculation of hot spot temperature
- 2.10.2.24 Value of air core reactance
- 2.10.2.25 Oil sampling Bottle details
- 2.10.2.26 Typical heating and cooling curves
- 2.10.2.27 RTCC panel drawing
- 2.10.2.28 Transformer oil storage tank drawing
- 2.10.2.29 Complete bill of material
- 2.10.2.30 Customer inspection schedule
- 2.10.2.31 Test procedure of transformer
- 2.10.2.32 Type test reports of transformer
- 2.10.2.33 O & M manual for transformer
- 2.10.3 The supplier shall submit along with the tender all drawings as per the requirement of the technical specification.
- 2.10.4 Within fifteen days of the receipt of the order the supplier shall furnish to the purchaser free of cost, five sets of all contract drawings listed in schedule for approval of the purchaser. These drawings shall reveal that the equipment to be supplied conform the provisions and clauses of the specification. Subsequent revisions of these drawings, if any, shall also be submitted for approval of the purchaser in similar manner before manufacture.
- 2.10.5 Within 15 days from the date of receipt of the contract drawings and other descriptive pamphlets, the purchaser shall communicate his approval to the supplier.

- 2.10.6 After approval of the drawings by the purchaser, the supplier, shall, within 15 days furnish twelve sets of approved drawings together with one set of translucent print suitable for photocopying by direct contact method.
- 2.10.7 Upon approval by the purchaser, the drawings shall become the contract drawings and, thereafter, the supplier shall not depart from them in any way whatsoever except with written permission of the purchaser.
- 2.10.8 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 bidder on his behalf. Any mistakes or errors in drawings shall not form a basis for seeking extension of delivery period.
- 2.10.9 All drawings submitted by the Bidder including those submitted at the time of bid shall have sufficient detail to indicate the type, size, material description, bill of materials, weight of each component, break up for packing and shipment, dimensions, fixing arrangement required and any other information specifically requested in the specifications. Each drawing submitted by the bidder shall be clearly marked with the name of the Purchaser, the name of the Project and other requisite information. All titles, noting, marking and writings on the drawing shall be in English. The drawings shall be accurately drawn to scale and all dimensions should be in metric units.
- 2.10.10 All major drawings should be submitted in Auto CAD Version 2004 or better. The instruction manuals shall contain full details of drawings of all equipment being supplied under this contract. The drawings shall have complete instructions for storage, handling, erection commissioning, testing, operation, trouble shooting, servicing and overhauling procedures. The Bidder shall furnish to the Purchaser catalogues of spare parts
- 2.10.11 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the bidder's risk. The bidder may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the contract and such changes will again be subject to approval by the Purchaser. Approval of drawings by the Purchaser shall not relieve the bidder of any of his responsibilities and liabilities under the contract.

SECTION-III

3 Technical Particulars Of 50 MVA / 20 MVA, 132/33 Two Winding Three Phase Power Transformers

3.1 Scope

The scope covers the design, engineering, manufacture, testing, packing and forwarding, transportation, insurance, handling, delivering at site, supervision during erection testing and commissioning of the transformers of following rating in various substations of Kashmir valley complete with all materials, accessories and fittings, 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 specification.

Grid Substation	Rating	Quantity	Remarks
Chadura	50 MVA	1 No.	New Grid Substation
Dangiwachha	50 MVA	1 No.	New Grid Substation
Wanpoh	50+20 MVA	1 No. each	Parallel Operation
Khrew	50 MVA	2 No.	New Grid Substation

3.2 Technical Requirements

The technical particulars of the power transformers covered under this specification are as below:

3.2.1	Type	Three Phase, Two Winding, Transformers
3.2.2	Rating	
3.2.2.1	HV	50 MVA and 20 MVA
3.2.2.2	LV	50 MVA and 20 MVA
3.2.3	Cooling	ONAN/ONAF
3.2.4	Rating at different cooling	40 / 50 MVA and 16 / 20 MVA
3.2.5	System Voltage	132/33 kV
3.2.6	Frequency	50 Hz
3.2.7	Phases	Three
3.2.8	Impedance Voltage at Principal Tap	12 % and 12.38 % for existing Grid Substation Wanpoh

3.2.9	Service:	Outdoor		
3.2.10	Duty:	Continuous		
3.2.11	Temperature rise over max. ambient temperature			
3.2.11.1	- Top oil measured by Thermometer	55° C		
3.2.11.2	- Winding measured by resistance method	60° C		
3.2.12	Maximum ambient temperature	40° C		
3.2.13	Cooling Medium:	Mineral oil as per IS: 335		
3.2.14	Windings	132 KV	33 kV	
3.2.14.1	Fault level	31.5 kA for 1 Sec	31.5 kA for 1 Sec	
3.2.14.2	1.2/50 micro sec. lightning impulse withstand voltage	650 kVp	170 kVp	
3.2.14.3	One minute power frequency withstand voltage	275 kV (rms)	70 kV (rms)	
3.2.14.4	Winding connection	Star	Star	
3.2.14.5	Neutral	Solidly grounded	Solidly grounded	
3.2.15	Vector Group:	YNyn0		
3.2.16	Tap changer	ON Load Tap Changer		
3.2.16.1	Tap range	The tap changer shall be located on HV (132kV) side for achieving HV voltage variation from +5% to -15% in steps of 1.25% (16 steps).		
3.2.16.2	Tap control	Full capacity On Load Tap Changer suitable for group / independent, remote/local electrical and local manual operation and bi-directional power flow. The OLTC gear offered should be provided with automatic control to maintain the set voltage.		
3.2.17	Bushing	HV	LV	Neutral
3.2.17.1	Type	Oil filled Condenser	Solid Porcelain	Solid Porcelain
3.2.17.2	Rated voltage	145 kV	36 kV	36 kV
3.2.17.3	Rated current	800A	1250A	1250A
3.2.17.4	1.2/50 micro second impulse withstand voltage	650 kVp	170 kVp	170 kVp
3.2.17.5	One minute power frequency withstand voltage	275 kV (rms)	70 kV (rms)	70 kV (rms)
3.2.17.6	Minimum creepage distance	In accordance with the relevant IS for polluted atmosphere		

3.2.18	Bushing Terminal Details	
3.2.18.1	High voltage	The 145 kV oil filled condenser bushings (with test tap) shall be provided with bimetallic clamp suitable to receive flexible ACSR conductor
3.2.18.2	Low voltage	36 kV with terminals suitable to receive XLPE cable.
3.2.18.3	Neutral	Porcelain bushing with terminals suitable for copper or brass flat.
3.2.19	Noise level at rated voltage at principal tap	< 75 dB at ONAN and < 80 dB at ONAF on full load

3.3 Standards

Except where otherwise specified or implied herein, the transformers shall comply with the latest addition of IS: 2026 as amended up to date. If the transformers conform to any other internationally recognized standard, which ensures better quality, full details of the difference between the Indian Standard specification and the specification actually adopted shall be clearly brought out in the tender. The transformers and all their accessories shall comply in all respects with the requirements of the latest additions relevant standards.

3.4 Duty Requirement

- 3.4.1 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. The transformers would be used for bi-directional flow of rated power. The transformer shall be capable of being operated without danger on any tapping at the rated MVA with voltage variation of $\pm 10\%$ corresponding to the voltage of that tapping.
- 3.4.2 Transformers shall be capable of operating under the natural cooled conditions up to 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 as ONAF up to specified load. Cooling shall be so designed that during total failure of power supply to cooling fans, the transformer shall be able to operate at full load for at least ten (10) minutes.
- 3.4.3 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.

- 3.4.4 The transformers and all its accessories 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 3 seconds. The short circuit level of the HV and LV system to which the subject transformer will be connected is 31.5 KA for 1 second for 3 phase fault on 132 kV and 33 kV. For transformer design purpose, the through fault current shall be considered limited only by the transformer self impedance.
- 3.4.5 The transformer shall be capable of being loaded in accordance with IS: 6600 / IEC: 60354 up to 150% of rated load. There shall be no limitation for overloading imposed by bushing, tap changer etc or any other associated equipment.
- 3.4.6 Dissolved Gas Analysis (DGA) of oil shall be periodically monitored by the bidder during warranty period and it is the responsibility of the bidder to make their own assessment regarding the overall health of the transformer during this period.
- 3.4.7 The equipment shall generally be designed and manufactured to have at least 35 years life under rated conditions
- 3.4.8 Transformer shall be suitable for continuous operation with a frequency variation of $\pm 5\%$ from normal value of 50 Hz without the temperature rise exceeding the specified limit
- 3.4.9 The transformer shall be designed with particular attention to the suppression of harmonic voltage, especially the third harmonic so as to minimize interference with communication circuit.
- 3.4.10 The noise-level of transformer, when energized at normal voltage and frequency with fans running shall not exceed, when measured under standard condition, the values specified at relevant clauses.
- 3.4.11 Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any terminals.
- 3.4.12 Transformer shall withstand, without injurious heating combined voltage and frequency fluctuations which produce the following over fluxing conditions and give desired performance.
- 3.4.13 The transformers shall be capable of operating continuously without exceeding the below mentioned temperature over maximum ambient temperature.

Winding temperature (Measured by resistance method)	60 Deg. C
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Top Oil temperature (Measured by thermometer)	55 Deg. C
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3.5 Transformer Losses

3.4.1 The bidder shall indicate the Guaranteed values of No load losses, load losses and auxiliary losses in his bid.

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. In computing the rate of capitalization of iron losses, copper losses and auxiliary losses, following realization assumptions have been made:

- i) Rate of interest ($r = 12.5\%$)
- ii) Rate of electrical energy ($EC = \text{Rs. } 7/\text{kWh}$)
- iii) Life of the transformer ($n = 35 \text{ Years}$)
- iv) Average annual loss factor ($LS = 0.432$)
- v) Annual load factor ($LF = 60$)

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

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

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

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

3.5.2 The measured losses of each transformer shall not exceed the value in the tender, by more than the tolerance admissible as per IS: 2026. The losses need to be very low.

3.5.3 The No load loss in Kilo watts at rated voltage and rated frequency shall be guaranteed. The excess of difference between test values of total losses and No load losses in 'Kilo-watt' over corresponding guaranteed losses shall be recovered. In case of fraction of KW, the penalties shall be applied for full KW.

3.5.4 The quoted prices shall be enhanced by capitalization of transformer losses on the basis of capitalization formula for the purpose of bid comparison.

3.6 Liquidated Damage for Excessive Losses

On testing, if it is found that actual losses are more than the values quoted including maximum tolerance, the undisputed liquidated damages shall be recovered from the bidder at the rates double of that calculated from above formula.

3.7 Parallel Operation

50 MVA and 20 MVA, 132/33 kV Three Phase Power Transformers required for Wanpoh Grid Substation shall operate in parallel with existing transformers whose percentage impedance is 12.38 at normal tap with voltage step at 1.25% (1 to 17). In addition to all mandatory conditions for parallelization the following parameters of the transformer should match with the existing transformer.

- a) The impedance, vector group, OLTC connection and range etc.
- b) Physical dimension, orientation etc. to facilitate interchangeability with the existing transformers
- c) Necessary provision is to be kept in the transformer control scheme for parallel operation with the existing Master/Follower/Independent OLTC control scheme.
- d) The parameters of transformer shall comply with the enclosed name plate of existing transformers and shall be in conformity with the requirements of IS: 2026 clause L3 and L3.1” Parallel Operations”

3.8 Clearances

3.8.1 The clearances between two live conductive parts and a live conductive part to earthed structures shall be as follows

	System Voltage	Phase to Phase Clearance	Phase to Earth Clearances
3.8.1.1	132 kV	1382 mm	1382 mm
3.8.1.2	33 kV	340 mm	340 mm

3.9 Constructional Details

The features and construction details of Power Transformer shall be in accordance with the latest additions of relevant IEC/IS specification and as stated hereunder.

3.9.1 Transformer Tank

3.9.1.1 Tank shall be of welded construction and fabricated from tested quality low carbon steel of adequate thickness. The quality of steel shall be as per IS: 2062.

3.9.1.2 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 knobs, lifting lugs and all load bearing members.

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

- 3.9.1.4 The transformer shall preferably have belted 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.
- 3.9.1.5 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.
- 3.9.1.6 Adequate space shall be provided at the bottom of the tank for collection of sediments/sludge.
- 3.9.1.7 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.
- 3.9.1.8 Tank shields shall be such that no magnetic fields shall exist outside the tank. They shall be of magnetically permeable material.
- 3.9.1.9 Suitable guides shall be provided in the tank for positioning the core and coil assembly.
- 3.9.1.10 Each tank shall be provided with 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 not be less than 2.
- a) Mechanical shocks during transportation
 - b) Full vacuum
 - c) Continuous internal pressure of 35 KN/Sq. m over normal
 - d) Hydrostatic pressure of oil
 - e) Short circuit forces
- 3.9.1.11 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. 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. Suitable haulage holes shall be provided
- 3.9.1.12. The lid inside the tank shall be shaped to ensure efficient collection and direction of free gas to the buchholz relay.

3.9.2 Tank Cover

3.9.2.1 The tank cover shall be sloped to prevent retention of rain water and shall not distort when lifted.

3.9.2.2 At least two adequately sized inspection openings, one 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 25 kg. The inspection covers shall be provided with two handles to facilitate lifting. The inspection covers shall be of bolted type.

3.9.2.3 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.

3.9.2.4 Bushings, turrets, covers of inspection openings, thermometer, pockets etc. shall be designed to prevent ingress of water into or leakage of oil from the tank.

3.9.2.5 All bolted connections shall be fitted 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.

3.9.2.6 All gasket joints shall be designed, manufactured and assembled to ensure long life and maintenance free operation.

3.9.3 Gas Venting

3.9.3.1 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

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

3.9.3.3 The transformer tank, fittings, radiators and all accessories shall be designed to withstand seismic events of required static co-efficient.

3.9.4 Axles and Wheels

3.9.4.1 The roller mounted transformers are to be provided with flanged bi-directional wheels and axles. This set of wheels and axles 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 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 corrosion resistant. Fittings for lubrication shall also be provided.

3.9.4.2 Suitable locking arrangement alongside foundation bolts shall be provided for wheels to prevent accidental movement of transformer.

3.9.4.3 The wheels are required to swivel and they shall be arranged so that they can be turned through an angle of 90 deg. when the tank is jacked up to clear of rails. Means shall be provided for locking the swivel movements in positions parallel to and at right angles to the longitudinal axis of the tank.

3.9.5 Conservator and Oil Preservation System

The Tenderer 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. Separate conservator tank shall be provided for OLTC.

3.9.6 Conservator Tanks and Pipe Work

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

3.9.6.2 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.

3.9.6.3 Contact of the oil with atmosphere shall be prohibited by using a flexible air cell.

- 3.9.6.4 High and low level alarm contacts shall be provided together with the oil level indication.
- 3.9.6.5 Conservator shall be provided in such a position as not to obstruct the electrical connections to the transformer.
- 3.9.6.6 A double flange valve of preferably 50 mm and 25 mm size shall be provided to fully drain the oil from the main tank conservator and OLTC conservator tank respectively.
- 3.9.6.7 The transformer rating and diagram plate shall bear a caution statement that the conservator is fitted with an air cell.
- 3.9.6.8 The conservator tank shall be stenciled on its underside with the words "Caution: Air cell fitted". Lettering of at least 150 mm size shall be used in such a way to ensure clear legibility from ground level when the transformer is fully installed.
- 3.9.6.9 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, life expectancy in operation, the recommended replacement intervals and the supplier.
- 3.9.6.10 Pipe work connections shall be of adequate size for their duty and as short and direct as possible.
- 3.9.6.11 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 three times that diameter on the conservator side of the relay.
- 3.9.6.12 The pipe connecting the transformer tank with the oil conservator, through the Buchholz relay, shall be at a rising angle of not less than 5 degrees.
- 3.9.6.13 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 than five times pipe diameters from the Buchholz relay, on the transformer side of the relay.
- 3.9.6.14 Pipe work shall neither obstruct the removal of tap changers for maintenance nor the opening of inspection of manhole covers.
- 3.9.6.15 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

3.9.6.16 The temperature of oil in the conservator is likely to rise up to 100⁰ C during operation. As such air cell used shall be suitable for operating continuously at 100⁰ C at least.

3.9.6.17 The conservator tank and piping shall be designed for complete vacuum filling of the main tank and conservator tank. Provision must be made for equalizing the pressure in the conservator tank and the air cell during vacuum filling operations to prevent rupturing of the air cell.

3.9.7 Joints and Gaskets

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

3.9.8 Valves

3.9.8.1 All valves up to and including 100 mm 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.

3.9.8.2 Suitable means shall be provided for pad-locking the valves in the open and close positions. Provision is not required for locking individual radiator valves.

3.9.8.3 Each valve shall be provided with the indicator to show clearly the position of the valve.

3.9.8.4 All valve flanges shall have machined faces.

3.9.8.5 All valves in oil line shall be suitable for continuous operation with transformer oil at 115 deg. C.

3.9.8.6 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.

3.9.8.7 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 10 mm size to facilitate oil sampling.

3.9.8.8 All hardware used shall be cadmium plated/electro galvanized.

3.9.8.9 A valve or other suitable means shall be provided to fix the on line dissolved gas-monitoring system to facilitate continuous dissolved gas analysis.

3.9.8.10 Suitable small bore piping with an appropriate valve shall be provided to take sample of oil from the OLTC chamber during operation of the transformer.

3.9.9 Dehydrating 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 50 mm above the maximum working oil level by means of a pipe with a minimum diameter of 25 mm. Connecting pipes shall be securely cleated to the transformer, or other structure, in such a manner so as to eliminate undesirable vibration and noise. In the case where a breather is supported by the pipe, there shall be a cleat directly above the breather flange. It shall be so designed that:

3.9.9.1 Passage of air is through a dust filter and silicagel

3.9.9.2 Silicagel is isolated from atmosphere by an oil seal.

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

3.9.9.4 Breather is mounted not more than 1200 mm above rail top level

3.9.9.5 To minimize the ingress of moisture following shall be provided.

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

b) Two breathers shall be connected in series for OLTC tank conservator.

3.9.10 Pressure Relief Device (PRD)

Adequate number 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 of 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 shall be provided for tripping. Tenderer shall recommend type of protection desired when pressure relief device operates. Discharge of pressure relief device 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

3.9.11 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 relay shall not maloperate for through fault conditions or be influenced by the magnetic fields around the transformer during the external fault conditions.

3.9.12 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 of required static co-efficient. Special steps must be taken to prevent mal-operation of Buchholz relay in such conditions.

3.9.13 Earthing Terminals

3.9.13.1 Two earthing pads suitable for connecting 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.

3.9.13.2 Two earthing terminals suitable for connecting 75x12 mm galvanized steel flat shall also be provided on cooler marshalling box and other equipment mounted separately

3.9.14 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 shall be clearly marked in the outline drawing.

3.9.15 Temperature Indicators

3.9.15.1 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 suitably 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 and tripping contacts shall be adjustable at site and typical values are as given below:

Alarm at 85° C

Trip at 95° C

3.9.15.2 Winding Temperature Indicator (WTI)

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

- a) Temperature sensing element.
- b) Image coil.
- c) Auxiliary CTs, to match the image coil shall be provided and mounted in the cooler control cabinet.
- d) 150 mm dia 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 gradations to clearly read atleast every 2° C.
- e) Calibration device.
- f) Accuracy class of WTI shall be $+ 0.5\%$ or better.

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

Alarm at 100° C

Trip at 110° C

3.9.15.3 In addition to the above, the Remote Winding Temperature Indicator (RWTI) shall be provided for remote indication of winding temperature for each of the winding. The difference between local and remote WT indication at any given time shall not exceed 1° 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

3.9.16 Signal Transmitters

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 RTD may be placed in the pocket 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.

3.9.17 Core

3.9.17.1 The core shall be constructed of high quality non-ageing cold rolled, grain oriented, silicon steel laminations having high permeability and low hysteresis loss. Laminations shall be free of burrs and each sheet has a durable oil proof heat resistant, insulating coating.

3.9.17.2 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.

3.9.17.3 The temperature of any part of the core or its support structure in contact with oil shall not exceed 120⁰ C under normal operating condition and 130⁰ C under most extreme operating condition. Adequate temperature margin shall be provided to maintain the minimum life expectancy of 30 years for this material.

3.9.17.4 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.

- 3.9.17.5 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.
- 3.9.17.6 All steel sections used for supporting the core shall be thoroughly sand blasted after cutting, drilling and welding.
- 3.9.17.7 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.
- 3.9.17.8 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.
- 3.9.17 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.
- 3.9.17.9 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
- 3.9.17.10 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.
- 3.9.17.11 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.
- 3.9.17.12 Adequate lifting lugs shall be provided to enable lifting of the core and winding.
- 3.9.17.13 The core shall be securely grounded directly to the tank in such a way that the ground connection can be detached, when required.
- 3.9.18 **Windings**
- 3.9.18.1 The Tenderer 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.
- 3.9.18.2 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 ground faults.

- 3.9.18.3 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.
- 3.9.18.4 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.
- 3.9.18.5 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.
- 3.9.18.6 Washers in contact with non-ferrous parts which carry current shall be of Phosphor bronze.
- 3.9.18.7 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 winding.
- 3.9.18.8 The windings shall be designed to withstand the dielectric tests specified
- 3.9.18.9 Tapings shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratios.
- 3.9.18.10 The coils would be shaped to provide for expansion and contraction due to temperature changes.
- 3.9.18.11 Individual loading of any winding should not exceed its rated capacity under any loading condition.
- 3.9.18.12 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.
- 3.9.18.13 The barrier insulation including spacers shall be made from high - density pre-compressed pressboard to minimize dimensional changes. All spacers shall have rounded edges.
- 3.9.18.14 The conductor insulations shall be made from high density paper having high mechanical strength.
- 3.9.18.15 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.

- 3.9.18.16. All winding insulation shall be processed to ensure that there will be no detrimental shrinkage after assembly. All windings shall be pre-sized before being clamped.
- 3.9.18.17 The mating faces of bolted connections shall be appropriately finished and prepared for achieving good long lasting, electrically stable and effective contacts.
- 3.9.18.18 All lugs for crimping shall be of the correct size.
- 3.9.18.19 Connections shall be carefully designed to limit hot spot due to circulating eddy currents.
- 3.9.18.10 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.
- 3.9.18.21 The winding - end termination, insulation system and transport fixings shall be so designed that the integrity of the insulation system generally remain intact during repeated work in this area.
- 3.9.18.22 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.
- 3.9.18.23 In particular, rotation or stringing of insulated connections shall be avoided during the fastening of conductor pads on the winding ends onto the termination surfaces of the bushing.
- 3.9.18.24 Suitable inspection and access facilities into the tank shall be provided to minimize the possibility of creating faults during the installation of bushings.
- 3.9.19 Insulating Oil

The quality of the transformer oil to be supplied with transformer shall conform to latest edition of IS: 335. The general parameters to which the oil shall conform are detailed in the table given below. However, wherever these parameters differs from the latest edition of IS: 335, the values of IS: 335 shall prevail. The oil supplied with the transformer shall conform to the below specified parameters also.

	Characteristics	Requirement	Specifications
3.9.19.1	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 temp.
3.9.19.2	Density at 29.5° C	0.89 g/cm ³ (Max.)	IS: 1448
3.9.19.3	Kinematic viscosity	Kinematic viscosity	IS: 1448
	a) At 27° C	27 CST (Max.)	
	b) At 40° C	< 9 CST	
3.9.19.4	Interfacial tension at 27° C (Min.)	0.04 N/m	IS: 6104
3.9.19.5	Flashpoint (Min.)	140° C	IS: 1448
3.9.19.6	Neutralization value (Max.)	0.03 mg KOH/g	IS: 335
3.9.19.7	Corrosive Sulphur	Non-corrosive	IS: 335
3.9.19.8	a) New untreated oil	30 KV (rms)	IS: 6792
	b) After treatment	60 KV (rms)	
3.9.19.9	Tan delta at 90° C	0.002 (Max.)	IS: 6262
3.9.19.10	Specific resistance (Min.)		
3.9.19.11	a) at 90° C	35 x10 ¹² ohm-cm	IS: 6103
	b) at 27°	1500 x10 ¹² ohm-cm	
3.9.19.12	Oxidation stability		
3.9.19.13	a) Neutralization value after oxidation.	0.4 mg KOH/gm (max.)	
	b) Total sludge after oxidation	0.10 % by weight (Max.)	
3.9.19.14	Water content		
3.9.19.15	a) New untreated oil	50 ppm (Max.)	IS: 2362
	b) After treatment	15 ppm (Max)	
3.9.19.16	Ageing Characteristics after 96 hrs		IS: 12177

3.9.19.17 Resistivity

- a) at 27° C 2.5×10^{12} ohm cm (min)
- b) at 90° C 0.2×10^{12} ohm cm (min)
- c) Tan delta at 90° C 0.2 (max.)
- d) Acidity (Max) 0.05 mg KOH/gm
- e) Sludge content 0.05% by weight (Max.)
- f) PCB content Less than 2 ppm

3.9.19.18 At manufacturer's works oil sample shall be drawn before, during and after heat run and shall be tested for the following:

- a) Break Down Voltage (KV rms)
- b) Moisture Content (ppm)
- c) Dissolved Gas Analysis (DGA).

3.9.19.19 Sample for DGA shall be taken from sampling device within 24 hours prior to commencement of temperature rise test, during the test and after the test. The acceptance norms with reference to various gas generation rates during the temperature rise test shall be as per IS: 10593.

3.9.19.20 Sufficient quantity of oil necessary for maintaining required oil level in tank radiators and conservator, coolers along with 15% extra oil for topping up shall be supplied for Purchaser's use in non-returnable container suitable for outdoor storage.

3.9.20 Bushings

3.9.20.1 The electrical and mechanical characteristics of bushings shall be in accordance with the latest additions of IS: 2099/IEC: 60137 and IS: 3347 and relevant international standard.

3.9.20.2 Oil filled bushings shall be provided with oil level-indicator, oil filling plug and drain valve if not hermetically sealed and tap for capacitance/tan delta test. The bushings shall be fitted with the end shields, if required.

3.9.20.3 The bushings shall have high factor of safety against leakage to ground and shall be so located as to provide adequate electrical clearance between bushings of various voltage and between bushings and grounded parts. Bushings 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.

- 3.9.20.4 Stresses due to expansion and contraction in any part of the bushing insulator shall not lead to development of any defects. Outdoor insulators and fittings shall be unaffected by atmospheric conditions e.g. Ozone, acid fumes, dust and rapid changes of temperature. Stress shield, if provided shall be considered as an integral part of the bushing assembly.
- 3.9.20.5 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.
- 3.9.20.6 All fixing material used shall be of suitable quality and properly applied and shall not enter into chemical action with the metal parts or cause fracture by expansion in service or dissolve in oil. Cement thickness shall be as small and even as possible and proper care shall be taken to locate individual parts correctly during cementing.
- 3.9.20.7 All porcelain insulators shall be designed to facilitate natural cleaning.
- 3.9.20.8 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.
- 3.9.20.9 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.
- 3.9.20.10 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. Bushings of identical rating shall be interchangeable
- 3.9.20.11 All porcelain used in bushing shall be made by the wet process, shall be homogenous and free from cavities or other flaws. The glazing shall be uniform in colour (brown) and free from blisters, burrs, and other defects. Porcelain shall be thoroughly vitrified and shall be impervious to moisture. The bushings shall be capable of withstanding earthquake forces. Porcelain shall have a smooth surface to shed away rainwater.

- 3.9.20.12 The insulation provided by the bushings shall be so co-ordinate with transformer insulation that all flashovers will occur outside the tank. The BIL of bushings should be one step ahead of corresponding winding.
- 3.9.20.13 Support insulator/bushings shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used. The tensile strength and parameters of insulator shall suit the requirements of the specification.
- 3.9.20.14 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 and IS: 2544

3.9.21 Terminal Connectors

The bushings shall be equipped with terminal connectors/clamps of suitable size. The bushing terminals/clamps shall be designed to avoid external corona during operation. The external current carrying contacts shall be silver plated/tinned adequately. No part of clamp shall be less than 10 mm thick. All ferrous part shall be hot dip galvanized. Rated current shall be embossed/ punched on each component of the clamp. All current carrying parts shall be designed and manufactured to have minimum contact resistance. The short time rating of terminal connector shall correspond to the short time rating of respective bushing

3.9.22 Terminal Marking

Each terminal including the neutral shall be distinctly marked on both primary and secondary side in accordance with IS: 2026 and drawings furnished with the transformers.

3.9.23 Neutral Earthing Arrangement

The neutral terminals of the star connected windings shall be brought to the ground, one directly and other through NCT, by tinned copper grounding bar through two independent paths supported by porcelain insulators. The grounding bar shall be connected to substation grounding mat through 75x12 mm galvanized steel flats

3.9.24 Tap Changing Equipment

On Load Tap Changer shall be provided on HV winding for achieving voltage variation from +5% to -15% in steps of 1.25%. It shall be of constant flux voltage

variation type as per clause 3.2 of IS: 2026. 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. 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.

3.9.25 On Load Tap Changing Gear

- 3.9.25.1 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.
- 3.9.25.2 The current diverting contacts shall be housed in a separate oil chamber not communicating with the oil in main tank of the transformer.
- 3.9.25.3 The contacts shall be accessible for inspection without lowering oil level in the main tank and the contact tips shall be replaceable
- 3.9.25.4 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.
- 3.9.25.5 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.
- 3.9.25.6 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 parts shall be protected against corrosion, deterioration due to condensation, fungi etc.
- 3.9.25.7 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.

- 3.9.25.8 Operating mechanism for on load tap changer shall be designed to go through one step of tap change per command. Subsequent tap changes shall be initiated only by a new or repeat command.
- 3.9.25.9 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 change. The alarm shall not operate for momentary loss of auxiliary power.
- 3.9.25.10 The Bidder shall provide a loose set of instruments for tap position indication in the control room. Complete mounting details shall be included in the approved diagram.
- 3.9.25.11 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.
- 3.9.25.12 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.
- 3.9.25.13 Limit switches may be connected in the control circuit of the operating motor provided that a mechanical-de-clutching mechanism is incorporated.
- 3.9.25.14 Thermal device or 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.
- 3.9.25.15 A permanently legible lubrication chart shall be fitted within the local OLTC control cabinet.
- 3.9.25.16 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
- 3.9.25.17 All relays and operating devices shall operate correctly at any voltage between the limits specified
- 3.9.25.18 It shall not be possible to operate the electric drive when the manual operating gear is in use.
- 3.9.25.19 It shall not be possible for any two controls to be in operation at the same time.

- 3.9.25.20 The equipment 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.
- 3.9.25.21 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.
- 3.9.25.22 All electrical control switches and the local operating gear shall be clearly labeled in a suitable manner to indicate the direction of tap changing.
- 3.9.25.23 Transfer of source in the event of failure of one AC supply shall not affect tap-changing operation.
- 3.9.26 OLTC Control
- Transformer shall be suitable for local and remote control. The control feature shall provide the following:
- 3.9.26.1 Local Electrical Control
- Local-remote' selector switch mounted in the local OLTC control cabinet shall switch control of all load tap changers as follows:
- 3.9.26.1.1 When the selector switch is in 'local' position, it shall be possible to operate the 'raise-lower' control from. OLTC control cabinet Remote control of the raise lower functions shall be prevented.
- 3.9.26.1.2 When the selector switch is in 'remote' position the local OLTC control cabinet mounted 'raise-lower' switch 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.
- 3.9.26.1.3 A 'raise-lower' 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.
- 3.9.26.1.4 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 but open in the other position.

3.9.26.2 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:

- 3.9.26.2.1 Mechanical tap position indicator which shall be clearly visible from near the transform
- 3.9.26.2.2 A mechanical operation counter.
- 3.9.26.2.3 Mechanical stops to prevent over cranking of the mechanism beyond the extreme tap positions.
- 3.9.26.2.4 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 labeled to show the direction of operation for raising the HV terminal voltage.

3.9.26.3 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:

- 3.9.26.3.1 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.
- 3.9.26.3.2 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.

3.9.26.4 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.

3.9.26.5 Follower Position

If the selector switch is in “Follower” mode, control of OLTC shall be possible only from panel of the Master unit

3.9.26.6 Independent Position

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

3.9.26.7 An interlock to cut off electrical control automatically upon recourse being taken to the manual control in emergency.

3.9.26.8 Reinforcement of the initiating impulse for a tap change, ensuring a positive completion once initiated to the next (higher or lower) tap.

3.9.26.9 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.

3.9.26.10 An interlock to cut-out electrical control when it tends to operate the gear beyond either of the extreme tap positions.

3.9.26.11 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.

3.9.26.12 Protective apparatus shall be considered essential according to specialty of the gear.

3.9.27 Cooling System and its Control

Type of Cooling

The transformer shall be of ONAN/ONAF cooled type and shall be capable of delivering its full rated output under ONAF cooling. The ONAN rating of the transformers shall be guaranteed at 80% of the ONAF rating. The required nos. of standby fans of approximately 20% capacity shall also be provided with each radiator bank. Transformer shall be capable of operating at full load for 10 minutes after failure of cooling system/fans.

3.9.27.1 Oil Natural Air Forced Cooling (ONAF)

3.9.27.1.1 The transformer shall be fitted with tubular type detachable radiators fabricated from pressed steel of adequate thickness. The air force shall be well directed for uniform cooling over the radiator surface.

- 3.9.27.1.2 Air blowers shall be complete with all necessary air ducting. Coolers shall be designed so that they operate with the minimum noise or drumming. The fans shall be provided with guards of close mesh wire netting for safety. 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.
- 3.9.27.1.3 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, thermostatic controlled space heaters to prevent condensation, cubicle light switch and cable terminal glands, MCCB of adequate capacity for the incoming supply and MCB for each fan motor.
- 3.9.27.1.4 The terminal connection of fan motors shall be accessible and the greasing possible without the need for removing any fan guards.
- 3.9.27.1.5 Fans shall be so located that they are readily accessible for inspection and repair. Fans shall be completely interchangeable.
- 3.9.27.2 Cooler Control
- 3.9.27.2.1 Cooling system shall be suitable for automatic, local manual and remote operation and necessary devices for these modes of operations shall be provided. Each fan shall be provided with contactor and control gear of suitable design both for starting and stopping the fan manually and automatically.
- 3.9.27.2.2 Automatic control operation of fans shall be provided (with temperature change) from the contacts of the Winding Temperature Indicator (WTI). Selector switches and push buttons shall also be provided in the cooler control cabinet to disconnect the automatic control and start/stop the fans manually.
- 3.9.27.2.3 Each cooling fan 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. All control and indicating devices for the cooling system shall be supplied and mounted in transformer marshalling box
- 3.9.27.2.4 All cooling fans shall be suitable for operation on 415 V, 3 phase, 50 Hz A.C. supply system and shall conform to latest edition of IS: 325 as amended up to date except when specified otherwise.

- 3.9.27.2.5 Suitable manual control facility for cooler fans shall be provided. Adequate warning/safety labels are required to indicate that the fans may start at any time. If any one group (s) is out of service and isolated, this shall not affect the automatic starting of the other radiator banks.
- 3.9.27.3 Alarm and Indications
- 3.9.27.3.1 The following alarm initiating devices shall be included in the transformer cooling system:
- a) 415 V cooler supply auto changeover
 - b) Cooling fan failure for each radiator bank
- 3.9.27.3.2 The following indication shall be provided in cooler control cabinet:
- a) Cooling fans start
 - b) Cooling system on automatic control
 - c) Cooling system on manual control
 - d) Selector switch in auto or manual for each group of fan
 - e) Control supply failure for main and stand by
 - f) Cooling fan failure
 - g) Common thermal overload trip
- 3.9.27.3.3 One potential free initiating contact for all the above conditions shall be wired independently to the terminal blocks of the cooler control cabinet.
- 3.9.28 Control Cabinet/Panels
- 3.9.28.1 Each Power Transformer unit shall be provided with local OLTC control cabinet, cooler control cabinet and RTCC panel.
- 3.9.28.2 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. 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
- 3.9.28.3 A space heater and cubicle lighting with ON-OFF switch shall be provided in each panel.
- 3.9.28.4 Necessary shorting of terminals shall be done at cooler control cabinet, local OLTC cabinet and remote OLTC panel.

- 3.9.28.5 Remote Tap Changer Control (RTCC)
- 3.9.28.5.1 The Bidder shall supply a Remote Tap Changer Control (RTCC) panel for remote operation of On Load Tap Changing gear.
- 3.9.28.5.2 The RTCC panel shall be located in control room. The size and colour of the RTCC panel to be supplied by the tenderer shall match with Control Panel
- 3.9.28.5.3 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
- 3.9.28.5.4 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.
- 3.9.28.6 Local OLTC Control Cabinet
- 3.9.28.6.1 The local OLTC control cabinet shall house all necessary devices meant for OLTC control and indication
- 3.9.28.6.2 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/contactors 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.

3.9.28.7 Cooler Control Cabinet

3.9.28.7.1 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 shall be wired up to the terminal board in the cooler control cabinet. All the necessary terminals for remote connection to C&R panel shall be wired up to the cooler control cabinet.

3.9.28.7.2 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 and the terminal boards meant for termination of various alarm and trip contacts.

3.9.28.7.3 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

3.9.28.7.4 One cooler control cabinet of each type shall be tested for IP: 55 protection in accordance with IS: 13947.

3.9.28.8 Control Cabinet/Marshalling Box

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

3.9.28.8.2 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.

3.9.28.8.3 Control Cabinets shall, in general conform to IS: 5039. The enclosure of the control cabinet shall provide a degree of protection equivalent to IP-55.

3.9.28.8.4 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.

3.9.28.8.5 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 finished synthetic enamel paint, both inside and outside. The colour of the finishing paints shall be light grey

- 3.9.28.8.6 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.
- 3.9.28.8.7 To prevent internal condensation, space heater shall be provided. Heater shall be suitable for operation at 240 V AC supply. An ON-OFF switch and fuse shall be provided with the heater
- 3.9.28.8.8 For illumination of cabinet, switch controlled incandescent lamp shall be provided. The cabinet shall also be provided with MCB on incoming power supply and one 15 amp switch and socket.
- 3.9.28.8.9 The incoming cable shall enter from bottom and the gland plate 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 future use.
- 3.9.28.9 Terminal Block
- 3.9.28.9.1 All internal wiring to be connected to the external equipment shall terminate on blocks, preferably vertically mounted on the side of cabinet, junction box.
- 3.9.28.9.2 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.
- 3.9.28.9.3 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. Washers, nuts and locknuts shall be provided.
- 3.9.28.9.4 The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails. 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.
- 3.9.28.9.5 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. Cabinet wiring should be suitable for 60 deg. C temperature as the space heaters will keep the temperature 10 deg. C higher than the ambient.

- 3.9.28.9.6 The terminal blocks shall be fully enclosed with removable covers of transparent, non-inflammable, non-deteriorating type plastic materials. The terminals shall be provided with the marking tags for wiring identification. The terminal blocks shall have white marking tags for circuit-identification. The boxes shall be provided with 20% spare terminals unless otherwise specified. Unless otherwise specified, terminal blocks shall be suitable for connecting 2.5 mm² copper cables.
- 3.9.28.9.7 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
- 3.9.28.9.8 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
- 3.9.28.9.9 Arrangement 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.

3.9.29 Control Wiring and Cabling

- 3.9.29.1 Supply of all cables and accessories required for proper termination from the control cabinet/marshalling box to make transformer shall be supplied by the Bidder.
- 3.9.29.2 Bidder shall also supply rigid GI conduits/pipes and all accessories required for routing cable in ground and the concrete. 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.
- 3.9.29.3 Solder less crimping type of tinned copper lugs, which firmly grip the conductor and insulation. Insulated sleeves shall be provided at all the wire terminations.
- 3.9.29.4 Power cable (415 V) used from transformer accessories to control cabinet/marshalling box shall be 1100 volts grade, PVC insulated armoured copper conductor cables. Compression type cable connector shall be provided for the termination of power and control cables.

- 3.9.29.5 All control wiring from transformer accessories to control cabinet/marshalling box shall be 1100 volts grade PVC insulated 2.5 sq. mm stranded copper cable.
- 3.9.29.6 All devices and terminal blocks with the control cabinet/marshalling box shall be clearly identified by symbols corresponding to those used on applicable schematic or wiring diagram.
- 3.9.29.7 All internal wiring shall be securely supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks.
- 3.9.29.8 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.

3.9.30 Auxiliary Power Supply

- 3.9.30.1 Duplicate (Main & Reserve) 415 volt, three phase, four (4) wire auxiliary power supply shall be provided for OLTC, cooler control and power circuit. 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 changer control and cooler circuits.
- 3.9.30.2 Design features of the transfer switch shall include the following:
 - 3.9.30.2.1 Provision for the selection of one of the feeders as normal source and other as standby.
 - 3.9.30.2.2 Upon failure of the normal source, the loads shall be automatically transferred after an adjustable time delay to the standby source.
 - 3.9.30.2.3 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.
 - 3.9.30.2.4 Automatic re-transfer to normal source without any time delay following re-energizing of the normal source.
 - 3.9.30.2.5 Both the transfer & re-transfer shall be dead transfers and AC feeders shall not be paralleled at any time.

3.9.30.3 Power Supply for OLTC Circuits

A. C. feeder shall be brought to the local OLTC control cabinet by the bidder, for control power circuit of OLTC. The Bidder shall derive power for OLTC control circuit 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.

3.9.30.4 Power Supply for Cooler Circuits

Control and power supplies are to be given for cooler circuit as mentioned above. 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 converters shall be provided by the Bidder. Necessary isolating switches/ MCB shall be provided at suitable points.

3.9.31 Fittings and Accessories

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

- 3.9.31.1 Conservator for main tank with accessories
- 3.9.31.2 Conservator for OLTC with accessories
- 3.9.31.3 Pressure relief devices with alarm/trip contact
- 3.9.31.4 Buchholz relays
- 3.9.31.5 Inspection openings and covers
- 3.9.31.6 Bushings
- 3.9.31.7 Temperature indicators
- 3.9.31.8 Oil preservation equipment
- 3.9.31.9 Oil flow indicator
- 3.9.31.10 Cooling accessories
- 3.9.31.11 Protected type mercury thermometer
- 3.9.31.12 The rating and diagram plates on transformers and auxiliary apparatus.
- 3.9.31.13 Earthing terminals
- 3.9.31.14 Flanged bi-directional wheels/ trolley for movement
- 3.9.31.15 Cooler control cabinet
- 3.9.31.16 On load tap changing equipment, OLTC control cabinet and RTCC panel
- 3.9.31.17 Drain valves/plugs
- 3.9.31.18 Insulating oil.
- 3.9.31.19 Terminal marking plate

- 3.9.31.20 Weather proof marshalling box
- 3.9.31.21 Drain, Filter and Sampling Valve
- 3.9.31.22 Cover lifting eyes, transformer lifting lugs, jacking pads, Haulage lugs and core and winding lifting lugs.
- 3.9.31.23 The fittings listed above are only indicative. Any other fittings, which generally are required for satisfactory operation of the transformer, are deemed to be included at offered price.

3.9.32 Motors

Motors for fans, OLTC shall conform to IS: 325 shall be of self ventilated type having totally enclosed fan cooled enclosures. Motors shall be 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.

3.9.33 Labels

- 3.9.33.1 Labels shall be provided for all apparatus such as relays, switches, fuses contained in control cabinets/marshalling box
- 3.9.33.2 Description labels for mounting indoor or inside control cabinets/marshalling box shall be of such a material that will ensure permanence of lettering. A matt finish shall be provided to avoid dazzle from reflected light. Labels mounted on dark surfaces shall have white lettering on a black background. All plates shall be of a material, which will not get corroded. Labeling shall be clear, concise and adequate.
- 3.9.33.3 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 ensure permanence of the lettering/markings. Labels shall be attached to panels with brass screws or with steel screws, which have received rust preventive treatment
- 3.9.33.4 Labels shall be supplied as far as possible in the following standard sizes.
 - 3.9.33.4.1 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.

- 3.9.33.4.2 Labels for relays, contactors, thermal devices and similar apparatus shall measure 65 mm by 20 mm and shall have lettering as specified above
- 3.9.33.4.3 Labels for controllers and change over switches shall measure 70 mm by 30 mm and where practicable have 20 mm lettering with 1.5 mm strokes
- 3.9.33.4.4 Labels for the doors of marshalling boxes and similar equipment shall measure 125 mm x 50 mm and have 13 mm lettering with 1.5 mm wide strokes.

3.9.34 Cleaning and Painting

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.

The interior of transformer 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 insoluble insulating varnish or paint.

Except for nuts, bolts and washers, which may have to be removed for maintenance purpose, all external surfaces exposed to weather shall receive a minimum of three coats of paint.

The primary coats shall be of 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 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 extremes of weather.

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 of light grey colour with anti corrosion mixture.

Any damage to paint work incurred during transport and erection shall be made good by thoroughly cleaning the damaged portion and applying the full number of coats of paint that had been applied before damage was caused. Paint shall not scale off or be removed by abrasion while handling. The Bidder shall supply the requisite quantity of paint so that one coat of additional paint shall be applied at site.

3.10 Inspection and Testing

The bidder shall submit details of test facilities available at the bidder's/ manufacturer's works for carrying out all the routine tests as specified. 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 tenderer shall bear all additional costs related to tests which cannot be carried out at his works.

3.10.1 Inspection

3.10.1.1 Tank and Conservators

3.10.1.1.1 Certification of chemical analysis and material tests of plates

3.10.1.1.2 Check for flatness

3.10.1.1.3 Electrical interconnection of top and bottom by braided tinned copper flexible

3.10.1.1.4 Welder's qualification and weld procedure

3.10.1.1.5 Testing of electrodes for quality weld base materials and coatings

3.10.1.1.6 Inspection major weld preparation

3.10.1.1.7 Crack detection of major strength of weld seams by dye penetration test

3.10.1.1.8 Measurement of film thickness of:

- a) Oil insoluble varnish
- b) Zinc chromate paint
- c) Finished coat

3.10.1.1.9 Check correct dimensions between wheels, demonstrate turning of wheels.

3.10.1.1.10 Check for physical properties of materials for lifting lugs, jacking pads, etc.

3.10.1.1.11 All load bearing welds including lifting lug welds shall be subjected to Non Destructive Testing

3.10.1.1.12 Leakage tests of the conservator

3.10.1.1.13 Certification of all test results.

3.10.1.2 Core

3.10.1.2.1 Sample testing of core materials for checking specific loss, bend properties, magnetization characteristics and thickness.

3.10.1.2.1 Check on the amount of burrs.

- 3.10.1.2.3 Check on the quality of varnish if used on the stampings.
 - a) Measurement of thickness and hardness of varnish on stampings.
 - b) Solvent resistance test to check that varnish does not react in hot oil.
 - c) Check overall quality of varnish by sampling to ensure uniform shining colour, no bare spot, no over burnt varnish layer and no bubbles on varnished surface.
- 3.10.1.2.4 Check for overlapping of stampings. Corners of the sheet are to be flat.
- 3.10.1.2.5 Visual and dimensional check during assembly stage.
- 3.10.1.2.6 Check for inter laminar insulation between core sections, before and after pressing.
- 3.10.1.2.7 Check on completed 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.
- 3.10.1.2.8 Visual and dimensional check for straightness and roundness of core, thickness of limbs and suitability of clamps.
- 3.10.1.2.9 High voltage test (2 kV for one minute) between core and clamps.
- 3.10.1.2.10 Certification of all test results.
- 3.10.1.3 Insulating Material
 - 3.10.1.3.1 Sample check for physical properties of materials
 - 3.10.1.3.2 Check for dielectric strength
 - 3.10.1.3.3 Visual and dimensional checks
 - 3.10.1.3.4 Check for reaction of hot oil on insulating materials
 - 3.10.1.3.5 Dimension stability test at high temperature for insulating material
 - 3.10.1.3.6 Tracking resistance test on insulating materials
 - 3.10.1.3.7 Check for tensile strength
 - 3.10.1.3.8 Certification of all test results.
- 3.10.1.4 Winding
 - 3.10.1.4.1 Sample check on winding conductor for mechanical properties and electrical conductivity
 - 3.10.1.4.2 Visual and dimensional checks on conductor for scratches, dent marks etc.
 - 3.10.1.4.3 Sample check on insulating paper for pH value, bursting strength, electric strength.

- 3.10.1.4.4 Check for the reaction of hot oil on insulating paper
- 3.10.1.4.5 Check for bonding of the insulating paper with conductor
- 3.10.1.4.6 Check and ensure that physical condition of all material taken for winding is satisfactory and free of dust.
- 3.10.1.4.7 Check for absence of short circuit between parallel strands
- 3.10.1.4.8 Check for brazed joints wherever applicable
- 3.10.1.4.9 Measurement of voltage ratio to be carried out when core/yoke is completely restacked and all connections are ready.
- 3.10.1.4.10 Conductor enamel tests for checking of cracks, leakage and pin holes.
- 3.10.1.4.11 Conductor flexibility test.
- 3.10.1.4.12 Heat shrink test for enameled wire.
- 3.10.1.4.13 Certification of all test results.
- 3.10.1.5 Checks before Drying Process
- 3.10.1.5.1 Check condition of insulation on the conductor and between the winding.
- 3.10.1.5.2 Check insulation distance between high voltage connection, cables and earth and other live parts.
- 3.10.1.5.3 Check insulation distances between low voltage connection and earth and other parts.
- 3.10.1.5.4 Insulation test of core earthing. Insulation of the core shall be tested at 2 kV / Min. between core to bolts and core to clamp plates.
- 3.10.1.5.5 Check for proper cleanliness and absence of dust etc.
- 3.10.1.5.6 Certification of all test results
- 3.10.1.6 Checks during Drying Process
- 3.10.1.6.1 Measurement and recording of temperature, vacuum and drying time during vacuum treatment.
- 3.10.1.6.2 Check for completeness of drying by periodic measuring IR and Tan delta.
- 3.10.1.6.3 Certification of all test results.

- 3.10.1.7 Assembled Transformer
 - 3.10.1.7.1 Check completed transformer against approved outline drawings, provision for all fittings, finish level etc.
 - 3.10.1.7.2 Die Penetration test shall be carried out after jacking test.
 - 3.10.1.7.3 Jacking test with oil on all the assembled transformers.
 - 3.10.1.7.4 Certification of all test results.
- 3.10.1.8 Bought out items

The bidder shall also prepare a comprehensive inspection and testing program for all bought out/ sub contracted items (as per relevant IS). The purchaser reserves the right to insist for witnessing the acceptance, routine testing or waiving off of tests of the bought out items. Such program shall include the following components:

 - 3.10.1.8.1 Buchholz Relay
 - 3.10.1.8.2 Axles and wheels
 - 3.10.1.8.3 Winding temperature indicators.
 - 3.10.1.8.4 Oil temperature indicators
 - 3.10.1.8.5 Bushings.
 - 3.10.1.8.6 Cooler control cabinet /OLTC control cabinet.
 - 3.10.1.8.7 Cooling equipments
 - 3.10.1.8.8 Fans
 - 3.10.1.8.9 Auxiliary motors and motor starting contacts
 - 3.10.1.8.10 On Load Tap change gear.
 - 3.10.1.8.11 Pressure relief device
 - 3.10.1.8.12 Terminal connectors
 - 3.10.1.8.13 Control devices
 - 3.10.1.8.14 Oil level indicator
 - 3.10.1.8.15 Radiator
 - 3.10.1.8.16 Pressure gauges
 - 3.10.1.8.17 The above list is not exhaustive and the bidder shall also include other bought out items in his program.

3.10.2 Testing

3.10.2.1 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 be subjected to routine and acceptance tests as per IEC: 60076/IS-2026.

3.10.2.2 All routine tests and special tests shall be carried out in presence of Purchaser’s representative. The price for these tests shall be included in the offered price.

3.10.2.3 Cabinet/ panel of each type should have been tested for IP-55 degree of protection.

3.10.2.4 The Bidder shall furnish a comprehensive testing and inspection program for inspection and testing of transformer during the manufacture of transformer. The inspection and test plan is given herewith, however this is not a comprehensive program as it is responsibility of bidder to draw up and carry out such program in the form of detailed Quality Assurance Plan.

3.10.2.5 No equipment / material shall be dispatched until the test reports are duly approved by the Purchaser and Material Dispatch Clearance Certificate is issued.

3.10.2.6 Routine Transformer Tests

All standard routine tests in accordance with IS: 2026 / IEC: 60076 shall be carried out on each transformer and complete test report shall be submitted to the Purchaser after proper scrutiny and signing on each page by the test engineer. Tests listed below are only indicative. Any other test required in conformity to the aforesaid specification is deemed to be included in the offered price.

3.10.2.6.1 Measurement of winding resistance

3.10.2.6.2 Voltage ratio measurements

3.10.2.6.3 Polarity and voltage vector relationship

3.10.2.6.4 No-load loss

3.10.2.6.5 Impedance voltage and load loss measurement

3.10.2.6.6 Short duration heat run test

3.10.2.6.7 Measurement of insulation resistance

3.10.2.6.8 Switching impulse voltage withstand test

- 3.10.2.6.9 Separate source voltage withstand test
- 3.10.2.6.10 Induced AC over voltage withstand test
- 3.10.2.6.11 Short circuit withstand test
- 3.10.2.6.12 Power Frequency Voltage Withstand Test
- 3.10.2.6.13 Test of cooling device
- 3.10.2.6.14 On load tap changer test
- 3.10.2.6.15 Core assembly dielectric and earthing continuity test
- 3.10.2.6.16 Appearance, construction and dimension check
- 3.10.2.6.17 High voltage with stand test on auxiliary equipment and wiring
- 3.10.2.6.18 Over excitation test
- 3.10.2.6.19 Oil leakage test on transformer tank
- 3.10.2.6.20 Tank vacuum test
- 3.10.2.6.21 Tank pressure test
- 3.10.2.6.22 Magnetic balance test
- 3.10.2.6.23 Measurement of no load current
- 3.10.2.6.24 Frequency Response analysis
- 3.10.2.6.25 Measurement of exciting current harmonics
- 3.10.2.6.26 Measurement of power taken by fans
- 3.10.2.6.27 Measurement of zero-sequence impedance
- 3.10.2.6.28 Measurement of acoustic noise level.
- 3.10.2.6.29 Measurement of the harmonics in the no load current.
- 3.10.2.6.30 Gas Analysis
- 3.10.2.6.31 Measurement of capacitance and tan delta of windings
- 3.10.2.6.32 Cooler control cabinet, oil surge relay, magnetic oil level gauge and all junction terminal boxes, PRD enclosure shall be tested for IP: 55

3.10.2.7 Type Tests of Transformer

Transformer may be type tested in accordance with the latest addition of IS: 2026 / IEC: 60076. Type tests shall be carried out in presence of Purchaser's representatives and complete test report shall be submitted for approval of the Purchaser. Tests listed below are only indicative. Any other test required in conformity to the aforesaid specification is deemed to be included in prices offered for testing.

3.10.2.7.1 Lightning impulse voltage withstand test

3.10.2.7.2 Temperature rise test

3.10.2.8 Transformer Tank

(a) Vacuum Test

(b) Pressure Test on completely assembled transformer

3.10.2.9 Testing of Transformer Bushings

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

3.10.2.10 Testing of Insulating Oil

Samples of oil from each bulk consignment shall be tested in accordance with latest addition of IS: 335 (as amended up to date) before oil is dispatched

3.10.2.11 Testing of On-Load Tap Changer

On-Load Tap Changers shall comply in all respects with type and routine tests specified in IS: 8468 (As amended up to date).

3.10.2.12 Testing of Accessories

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

3.10.2.13 Testing of Buchholz Relay

The Buchholz relay shall be subjected to the type and routine tests specified in IS: 3637 (as amended up to date). The bidder 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. Relevant routine and type test reports shall be furnished.

3.10.2.14 Testing of other Auxiliary Equipments

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

3.10.2.14.1 Fans - IS: 2312

3.10.2.14.2 Motors - IS: 325

3.10.2.14.3 Switchgear - IS: 2607 for Isolators.

a) IS: 1882 for Motor Starters.

b) IS: 2516 for Circuit Breaker.

c) IEC: 337 for Control Switches

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

3.10.3 Additional Tests:

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

3.10.4 Pre-shipment Check at Manufacturer's Works

3.10.4.1 Check for interchangeability of components of similar transformers for mounting dimensions.

3.10.4.2 Check for proper packing and preservation of accessories like radiators, bushings, explosion vent, dehydrating breather, rollers, buchholz relay, fans, control cubicle, connecting pipes, conservator etc.

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

3.10.4.4 Gas tightness test to conform tightness.

3.10.4.5 Determination of leakage rate and ensure the adequate reserve gas capacity.

3.10.5 Test Reports

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

- 3.10.5.2 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 dispatched.
- 3.10.5.3 All records of routine tests reports shall be maintained by the bidder at his works for periodic inspection by the Purchaser. All test reports for tests conducted during manufacturing shall also be maintained by the bidder. These shall be produced for verification as and when requested for by the Purchaser having following details
- 3.10.5.3.1 Complete identification data including serial number of the transformer / equipment tests.
- 3.10.5.3.2 Method of application and interpretation of results of each test.
- 3.10.5.3.3 Temperature dependent data corrected to 75 deg. C.
- 3.10.5.4 Five (5) copies of routine test reports shall be furnished to the Purchaser. The routine test reports shall also contain the following information:
- 3.10.5.4.1 Calculated values of regulation at unity, 0.9, 0.8 lagging and 0.8 leading power factors.
- 3.10.5.4.2 Calculated values of positive, negative and zero phase sequence impedance
- 3.10.5.4.3 Calculated values of efficiency of transformer at 50, 75 and 100% of rated capacity at 1.0 and 0.9 power factors.
- 3.11 **Other Auxiliaries**
- 3.11.1 Oil Storage Tank
- 3.11.1.1 This specification covers supply of oil storage tank of 15 cubic meter capacity along with complete accessories. The oil storage tank shall be designed and fabricated as per relevant Indian standards IS: 803 or other internationally acceptable standards.
- 3.11.1.2 Transformer oil storage tanks shall be towable and rested on pneumatic tyres of adequate quantity & size. The tank shall be of cylindrical shape & mounted horizontally and made of mild steel plate of adequate thickness. The tank shall be designed for storage of oil at a temperature of 100° C
- 3.11.1.3 The tank shall have 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.
- 3.11.1.4 The internal and external surfaces to be painted shall 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 and oil resistant anti corrosive paint.

- 3.11.1.5 The tank shall also 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 capacity in horsepower to pull one tank completely fitted with oil. Oil level indicator shall be provided with calibration in terms of liters 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 meter long shall also be provide.
- 3.11.1.6 All steel surfaces exposed to weather shall be given a primary coat of zinc chromate, second coat of oil and weather resistant paint of a colour distinct from primary and final two coats of glossy oil and weather resistant light grey paint in accordance with shade no. 631 of IS: 5. All paints shall be carefully selected to withstand heat and 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.
- 3.11.1.7 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 pump shall be electric motor driven, and shall have a discharge of not less than 6.0 kl/hr. with a discharge head of 8.0 m. the pump motor and the control cabinet shall be enclosed in a cubical with IP-55 enclosure.
- 3.11.1.8 Prices for oil storage tank shall be quoted separately..
- 3.11.2 Oil Sampling Bottle
- 3.11.2.1 Oil sampling bottles shall be suitable for collecting oil samples from transformers for Dissolved Gas Analysis. Bottles shall be robust enough, so that no damage occurs during frequent transportation of samples from site to laboratory.
- 3.11.2.2 Oil sampling bottles shall be made of stainless steel having capacity of 1 liter.

- 3.11.2.3 Oil sampling bottles shall be capable of being sealed gas tight and shall be fitted with cocks on both ends
- 3.11.2.4 The design of bottles and seal shall be such that loss of hydrogen shall not exceed 5% per week.
- 3.11.2.5 An impermeable oil proof, transparent plastic or rubber tube of about 5 mm diameter, and of sufficient length shall also be provided with each bottle along with suitable connectors to fit the tube on to the oil sampling valve of the equipment and the oil collecting bottles respectively.
- 3.11.2.6 The scope of oil sampling bottles shall be included in the bid price

3.11.3 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. Prices for on line dissolved gas monitoring shall be quoted separately.

3.11.4 Tools and Spare Parts

The transformer shall be supplied with one complete set of all special tools as may be required to assemble the equipment. One set of spare parts, as recommended by the tendered for five year's successful operation shall also be supplied. Item wise unit prices for mandatory tools spare parts shall be given in the enclosed annexure.

3.12 **Guarantee**

- 3.12.1 Transformers, On load tap changer and accessories thereof shall carry a performance guarantee for a period of 5 years from the date of their commissioning. If any defect develops during this period in any part of the equipment, the Tenderer shall replace or repair the same to the satisfaction of the purchaser expeditiously free of cost.
- 3.12.2 The tenderer shall indicate whether he shall make facilities available at the site for repairs to transformers on load tap changers and accessories offered by him after the guarantee period, if required by the purchaser.

3.12.3 In case of any delay for replacing or repairing of damaged equipment/material during guarantee period, the Department reserves the right to get the equipment replaced/repaired and the charges against such repairs shall be debited to the Supplier.

3.13 **Tolerance**

Tolerances in losses, voltage ratio, Impedance voltage, short circuit current, no-load current etc shall be as per latest revision of IS: 2026 (amended up to date).

3.14 **Supervision Charges**

The tenderer shall state rates for the service of suitable nos. of erection engineer for installation, testing at site and commissioning of the equipment including transformer OLTC and accessories.

3.15 **Guaranteed Technical Parameters**

The tenderer shall furnish all guaranteed technical particulars in accordance to the enclosed schedule.

**Superintending Engineer,
Electric Planning & Design, Bemina
Srinagar, Kashmir.**

ANNEXURE-I

**SCHEDULE OF TECHNICAL PARTICULARS
(TO BE FILLED IN BY THE TENDERER)**

<u>S. #</u>	<u>Description</u>
1	Name of Supplier
2	Name of Manufacturer
3	Type of Transformer
4	Service
5	Duty
6	Rated Output
7	Rated Voltage (HV)
8	Rated Voltage (LV)
9	Rated Primary Current
10	Rated Secondary Current
11	Rated Frequency
12	Transformation Ratio
13	Cooling of Transformer
14	Rating at Different Cooling
15	Maximum Ambient Temperature
16	Temperature Rise Over Maximum Ambient Temperature
16.1	- of Top Oil measured by Thermometer
16.2	- of Winding measured by Resistance Method
17	Temperature gradient between Winding and Oil

- 18 Limit of hotspot Temperature for which the Transformer is Designed
- 19 Winding Connections
 - 19.1 HV Winding.
 - 19.2 LV Winding
 - 19.3 Vector Group References No. & Symbol
- 20 Fault level
- 21 1.2/50 μ sec. Lightning Impulse Withstand Voltage HV/ LV
- 22 One Minute Power Frequency Withstand Voltage HV/ LV
- 23 Construction of Transformer
- 24 Magnetizing Current HV/LV at Normal Ratio and Rated Frequency
 - 24.1 85 percent of rated voltage
 - 24.2 100 percent of rated voltages
 - 24.3 105 percent of rated voltages
 - 24.4 Power factor of magnetizing current at rated voltage and frequency
- 25 Maximum Current Density
 - 25.1 HV winding
 - 25.2 LV winding
- 26 Maximum Flux Density
 - 26.1 Core
 - 26.2 Yoke
- 27 Resistance per Phase
 - 27.1 HV Winding
 - 27.2 LV Winding
- 28 Reactance per Phase
 - 28.1 HV Winding
 - 28.2 LV Winding

- 28.3 Reactance voltage drop at 75° C average winding temperature expressed as percentage of rated voltage
- 29 Capacitance
 - 29.1 Capacitance of LV Winding to Earth/ Power Factor
 - 29.2 Capacitance of HV Winding to Earth/ Power Factor
 - 29.3 Inter Winding Capacitance/ Power Factor
- 30 Impedance voltage at normal ratio and 75° C average winding temperature expressed as percentage of rated voltage
- 31 Dimension of Transformer
 - 31.1 Length
 - 31.2 Breadth
 - 31.3 Height
- 32 Quantity of Oil in Transformer
 - 32.1 Transformer Tank
 - 32.2 Radiators
 - 32.3 Conservators
- 33 Transformer Tank Details
 - 33.1 Thickness of Side Plate
 - 33.2 Thickness of Bottom Plate
 - 33.3 Thickness of Cover Plate
 - 33.4 Thickness of Radiators
 - 33.5 Vacuum which the tank can withstand
 - 33.6 Pressure which the tank can withstand
- 34 Conservator
 - 34.1 Total volume
 - 34.2 Volume of Conservator between Highest and Lowest Levels
- 35 Weight of Transformers and Fittings
 - 35.1 Tank
 - 35.2 Core and winding
 - 35.3 Radiator and other Fitting
 - 35.4 Oil

- 35.5 Total Weight
- 36 Mounting Details
 - 36.1 Width of Rail-track gauges
 - 36.2 Details of Rollers
 - 36.3 Size
 - 36.4 No
 - 36.5 Material
- 37 Core
 - 37.1 Material of Core Lamination
 - 37.2 Thickness of Core Plates
 - 37.3 Insulation of Core Lamination
 - 37.4 Insulation of Core and Plates
 - 37.5 Insulation of Core Bolts
 - 37.6 Insulation of Core Belt Washer
 - 37.7 Details of Oil Ducts in Core
- 38 Insulation Level
 - 38.1 Full Wave Lightning Impulse Withstand Voltage and Wave Form
 - 38.1.1 HV Winding
 - 38.1.2 LV Winding
 - 38.2 Switching Impulse Withstand Voltage
 - 38.2.1 HV Winding
 - 38.2.2 LV Winding
 - 38.3 Separate Source Power Frequency Withstand Voltage.
 - 38.3.1 HV Winding
 - 38.3.2 LV Winding
 - 38.3.3 HV Neutral
 - 38.4 Induced Over Withstand Voltage and Wave Form
 - 38.4.1 HV Winding
 - 38.4.2 LV Winding
 - 38.5 Inter-turn Insulation Test
 - 38.5.1 Test Voltage for 10 seconds 50 c/s on HV

- 38.5.2 Test Voltage for 10 seconds 50 c/s on LV
- 38.5.3 Voltage to earth for which the star point will be insulated
- 39 Type of axial coil supports
 - 39.1 HV Winding
 - 39.2 LV Winding
- 40 Radial coil supports
 - 40.1 HV Winding
 - 40.2 LV Winding
- 41 Winding
 - 41.1 Type of Winding
 - 41.2 HV Winding
 - 41.3 LV Winding
 - 41.4 Voltage per Turn
- 42 Class of Insulation
 - 42.1 HV Winding
 - 42.2 LV Winding
 - 42.3 Type of Insulation
 - 42.4 HV Winding
 - 42.5 LV Winding
 - 42.6 Graded or Un-graded
 - 42.7 Whether HV Winding are Inter-leaved
- 43 Insulating Material
 - 43.1 HV Winding
 - 43.2 LV Winding
 - 43.3 Between HV and LV Winding
 - 43.4 Between core and LV winding
- 44 Minimum Clearance
 - 44.1 Between HV and Earth
 - 44.2 Between LV and Earth
 - 44.3 Between HV and Tank
 - 44.4 Size of Cooling Ducts
 - 44.5 Drawing to Scale Indicating Flow of Oil in Radial and Axial Ducts of Each Limb and Winding

- 45 Complete details of Bucholz Relay
- 46 Complete details of Oil Temperature Indicators
- 47 Complete details of Winding Temperature Indicators
- 48 Complete details of Remote Winding Temperature Indicators
- 49 Transformer Bushing (HV/LV/Neutral)
 - 49.1 1.2/50 micro second Impulse Withstand Voltage
 - a) Positive
 - b) Negative
 - 49.2 One Minute Dry Withstand Power Frequency Voltage
 - 49.3 One Minute Wet Withstand Power Frequency Voltage
 - 49.4 Visible Corona Discharge Voltage
 - 49.5 Under Oil Flashover or Puncture Withstand Impulse Voltage
 - 49.6 Under Oil Flashover or Puncture Withstand Power Frequency Voltage
 - 49.7 Creepage Distance in Air
 - 49.8 Recommended Gap Setting
 - 49.9 Weight of Assembled Bushing
 - 49.10 Terminal Arrangement
 - 49.11 HV Bushing
 - 49.12 LV Bushing
 - 49.13 HV/LV Neutral Bushing
- 50 Details of On Load Tap Changer
 - 50.1 Make
 - 50.2 Type
 - 50.3 Rated Voltage
 - 50.4 Rated Current
 - 50.5 Step Voltage
 - 50.6 No. of Steps
 - 50.7 Tap Range

- 50.8 Tap Control
- 50.9 Protective Devices
- 50.10 Approx Overall Weight
- 50.11 Approx Overall Dimension
- 50.12 Approx Overall Quantity of Oil
- 50.13 Whether Pad Lock Provided
- 51 Transportation Details
 - 51.1 Weight of heaviest package
 - 51.2 Size of largest package
 - 51.3 Method of Protecting Transformer Windings During Transportation
- 52 Minimum clearance height for lifting core and winding from tank
- 53 Whether Crane Lift Required
- 54 Noise Level at Rated Voltage and at Principal Tap

Signature of Tenderer

ANNEXURE-II

**SCHEDULE OF GUARANTEE PARTICULARS
(TO BE FILLED IN BY THE TENDERER)**

<u>S. #</u>	<u>Description</u>		
1	Guaranteed No Load Loss at normal ratio and rated frequency		
1.1	at 100% rated voltage		
1.2	at 110% rated voltage		
2	Guaranteed Load Losses at normal ratio, rated output, rated voltage, rated frequency and 75° C average winding temperature at site including auxiliary losses if any		
3	Total losses at normal ratio, rated output, rated voltage, rated frequency excluding auxiliary losses		
4	Auxillary losses, if any at full load		
5	Efficiencies at normal ratio, rated voltage frequency and at 75° C average winding temperature	Unity PF	0.85 Lagging
5.1	Full load		
5.2	¾ full load		
5.3	½ full load		
5.4	¼ full load		
6	Positive sequence impedance on rated MVA base, at rated current and frequency and 75° C winding temperature		
6.1	Principal Tap		
6.2	Highest Tap		
6.3	Lowest Tap		
7	Regulation at full load at 75° C		
7.1	Unity power factor		
7.2	0.85 power factor lagging		
8	Load at which maximum efficiency occurs		
9	Guaranteed output HV/ LV winding		

Signature of Tenderer

ANNEXURE-III

**SCHEDULE OF WORKS REQUIREMENT AND PRICES
(TO BE FILLED IN BY THE TENDERER)**

Name of work: Design, manufacture, testing, supply and delivery of Power Transformer in accordance with specification including supervision during erection, testing and commissioning of power transformer.

S · N o	Description of material	Ex-works price	Packing & Forwarding	Taxes			Freight & Transit Insurance	Total Unit Price FOR Site	Delivery Period (Months)	Total Amount
				Excise Duty	CST/VAT If Applicable	Entry & Toll Tax				
1	40/50MVA, 132/33 KV Three phase two Winding Power transformers having vector group YNyno with OLTC having voltage variation from +5% to -15% in 16 equal steps complete with all accessories including first filling of oil & terminal connectors.									
2	16/20MVA, 132/33 KV Three phase two Winding Power transformers having vector group YNyno with OLTC having voltage variation from +5% to -15% in 16 equal steps complete with all accessories including first filling of oil & terminal connectors.									
3	15% extra oil including all mandatory spares									
4	Type Test Charges									
5	Supervision Charges									
6	Capitalization losses									
7	Any other charges									

Tenderers are requested to quote the rates strictly in accordance with format.

Signature of tenderer

ANNEXURE-IV

**SCHEDULE OF DEVIATION
(TO BE FILLED IN AND SIGNED BY THE TENDERER)**

<u>S. #</u>	<u>Description</u>	<u>Specification</u>	<u>Deviation</u>	<u>Remarks</u>
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We/I have carefully gone through the technical specifications and the general conditions of this tender document and we/I have satisfied ourselves/myself and confirm hereby that our/my offer strictly conforms to the requirements of the technical specification and general conditions of this tender except for the deviations which are given below:

Signature of Tenderer

ANNEXURE-V

**SCHEDULE FOR PAST PERFORMANCE
(TO BE FILLED IN BY THE TENDERER)**

<u>S. #</u>	<u>Description of Installation</u>	<u>Customer</u>	<u>Date of supply</u>	<u>Remarks</u>
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Signature of Tenderer

- Satisfactory Past Performance shall be authenticated by the Purchaser mentioning the date of commissioning of the equipment and date of issuance of certificate.

ANNEXURE-VI

**SCHEDULE FOR PRICE VARIATION
(TO BE FILLED IN BY THE TENDERER)**

<u>S. #</u>	<u>Description</u>	<u>Basic Price</u>	<u>Price Variation Formula</u>	<u>Base Date</u>	<u>Remarks</u>
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1	Material				
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2	Labour				
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Any other information

Signature of Tenderer

➤ If prices are variable

ANNEXURE-VII

**SCHEDULE FOR EQUIPMENT DELIVERY
(TO BE FILLED IN BY THE TENDERER)**

<u>S. #</u>	<u>Description of Item</u>	<u>Quantity</u>	<u>Delivery</u>	<u>Remarks</u>
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Signature of Tenderer

- Delivery period shall be reckoned from the date of issuance of the order
- Earliest delivery period for each transformers complete with all accessories and insulating oil etc shall be specified

ANNEXURE-VIII

**SCHEDULE FOR SPARE PARTS
(TO BE FILLED IN AND SIGNED BY THE TENDERER)**

S. #	Description of Item	Quantity	Prices		Delivery	Remarks
			Ex Works	FOR Site		
1	HV Bushing					
2	LV Bushing					
3	Neutral Bushing					
4	Bucholz Relay					
5	Pressure Relief Device					
6	Silicagel Breather					
7	Oil Temperature Indicator					
8	Winding Temperature Indicator					
9	Set of Thermometers					
10	Magnetic Oil Gauge					
11	Set of Gaskets					
12	Inlet and Outlet Valves					
13	Complete Set of Tools for Installation and Maintenance of Transformer					
14	Any other spares for transformers as recommended by the tenderer					

Signature of Tenderer

- A list of spare parts generally required during operations is mentioned above. The tenderer shall recommend the quantity of spare parts necessary for five years of successful operation of the equipment. The spare parts shall be in conformity with the standards and relevant specifications. The prices of additional spare parts shall be firm and the Purchaser reserves the right to procure them at any time and in any quantity before the expiry of the Contract

ANNEXURE-IX

**SCHEDULE FOR SPECIAL TOOLS
(TO BE FILLED IN AND SIGNED BY THE TENDERER)**

<u>S. #</u>	<u>Description</u>	<u>Quantity</u>	<u>Prices</u>		<u>Remarks</u>
			<u>Ex Works</u>	<u>FOR Site</u>	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Signature of Tenderer

- The tenderer shall recommend the list all special tools as may be required for erection and maintenance of the transformer and its accessories. Special tools shall be in conformity with the standards and relevant specifications. The prices of all special tools shall be firm and the Purchaser reserves the right to procure them at any time till the commissioning of the equipment.

ANNEXURE-X

SCHEDULE OF TESTS (TESTS TO BE CONDUCTED BY THE TENDERER)

Routine Tests

1. Measurement of winding resistance
2. Voltage ratio measurements
3. Polarity test
4. No-load loss and current measurement
5. Impedance voltage and load loss measurement
6. Short duration heat run test
7. Measurement of insulation resistance
8. Test of cooling device
9. On load tap changer test
10. Core assembly dielectric and earthing continuity test
11. Appearance, construction and dimension check
12. High voltage with stand test on auxiliary equipment and wiring
13. Over excitation test
14. Oil leakage test on transformer tank
15. Tank vacuum test
16. Tank pressure test
17. Magnetic balance test
18. Separate Source Voltage Withstand test on all the line terminals
19. Induced Over Voltage Withstand test with partial discharge indication
20. Overload testing in short circuit method
21. Power Frequency Voltage Withstand test
22. Measurement of no load current
23. Frequency Response analysis
24. Measurement of exciting current harmonics
25. Measurement of power taken by fans
26. Measurement of zero-sequence impedance
27. Measurement of acoustic noise level.
28. Measurement of the harmonics in the no load current.
29. Gas Analysis

30. Measurement of capacitance and tan delta of windings
31. One cooler control cabinet, oil surge relay, magnetic oil level gauge and all junction terminal boxes, PRD enclosure shall be tested for IP: 55

Type Tests

1. Lightning Impulse Voltage Withstand test on all the line terminals
2. Temperature Rise Test

Signature of Tenderer

- Any other test required in conformity with the specification is deemed to be included in offered price

ANNEXURE-XI

SCHEDULE OF MANUALS AND DRAWINGS (TO BE SUPPLIED BY THE TENDERER)

Tender Drawings

1. General outline drawing showing front, 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.
2. General outline drawing showing dimensions, wheel loading, weights of transformers, radiators, tap change gear, marshalling box, their shipping weights.
3. Sectional views showing the general construction features.
4. General arrangements for foundations and structure mounting. Crane requirements for assembling and dismantling of transformers.
5. Type test certificate and oscillogram.
6. Dimension of the largest parts to be shipped and the position in which these are to be transported.
7. General outline drawing showing details and dimensions of Bushing.
8. Technical and descriptive literature giving details of the equipment and accessories offered including bought out items.

Contract Drawings

1. General outline drawing of transformer showing.
 - a) Plan
 - b) Elevation
 - c) End view
2. List of all accessories with detailed weights, quantity of insulating oil, dimensions clearances, spacing of wheels in direction, center of gravity, location of cooler etc.
3. Loading details for transformer foundation
4. Foundation Plan showing reaction at points of support, clamping arrangement and location of jacking pads
5. Over fluxing withstand duration curve
6. Schematic wiring diagram of OLTC
7. Mounting Arrangement and wiring diagram of remote WTI
8. Assembly drawings of HV and LV bushings
9. Outline and General Arrangement of Cooler Control Cabinet
10. Cooler Control cabinet schematic and wiring diagram
11. Magnetization Characteristics Neutral CTs

12. Hysteresis Characteristics of iron core
13. Rating and Diagram Plate giving details of terminal marking and connection diagram
14. Overall Transport dimension drawing of transformer
15. Oil Flow Diagram
16. Drawing showing typical sectional view of the windings with details of insulation, cooling circuit, method of cooling and core construction etc
17. Valve Schedule Plate drawing
18. Twin Bi-directional Roller
19. Connection Diagram of all protective devices of marshalling box
20. List of spares
21. Technical Literature of all fittings and accessories
22. Calculation to support short circuit withstand capacity of transformer
23. Calculation of hot spot temperature
24. Value of air core reactance
25. Oil sampling Bottle details
26. Typical heating and cooling curves
27. RTCC panel drawing
28. Transformer oil storage tank drawing
29. Complete bill of material
30. Customer inspection schedule
31. Test procedure of transformer
32. Type test reports of transformer
33. O & M manual for transformer

As built Drawings

1. Nine copies of as-built drawing of all above listed drawings corrected in accordance with the site requirements.
2. Nine copies of the instruction books/operation and maintenance manuals and spare parts.
3. Detailed literature and data on transformer construction, winding, bushing and tap changer

Signature of Tenderer

ANNEXURE-XII

**IMPORTANT CHECK LIST
(TO BE FILLED AND ENCLOSED WITH THE OFFER)**

COMMERCIAL

1. Quantity offered by the Tenderer
2. Amount of Earnest Money
3. CDR/FDR/Bank Guarantee No.
and Valid up to
4. Whether registered with DGS&D, NSIC or
Department of Industries.

Technical

1. Whether the material quoted by the
tenderer corresponds to relevant IS
standard. If yes, give reference of the
standard.
2. Whether all Types Test Certificates are
enclosed
3. Whether relevant drawings are enclosed
4. Whether the material fully corresponds to
NIT specifications

If not, have the deviations been pointed out

Whether the list giving status of past orders
received from various SEB's/PGCIL, etc

Signature of Tenderer

ANNEXURE-XIII

SCHEDULE OF QUANTITIES

S.No	Description	Qty.
1	40/50 MVA, 132/33 KV ONAN/ ONAF two winding, three -phase power-transformers with vector group YNyno with OLTC having variation of voltage from +5% to -15% in 16 equal steps with all accessories including first filling of oil .	5
2	16/20 MVA, 132/33 KV ONAN/ ONAF two winding, three -phase power-transformers with vector group YNyno with OLTC having variation of voltage from +5 % to -15% in 16 equal steps complete with all accessories including first filling of oil .	1

ANNEXURE -XIV

SCHEDULE OF GENERAL TERMS AND CONDITIONS

S. #	Particulars		
1	Terms of Payment		
2	EMD	Amount (Rs.)	
		Mode	
		No.	
		Validity	
3	Taxes and Duties	Excise / ED	
		CST / VAT	
		Service Tax	
		Entry Tax	
		Toll Tax	
		Any other Tax not specified herein	
4	Delivery		
5	Validity of Offer		
6	Guaranty/Warranty		
7	Prices		
8	Security Deposit cum Performance Guarantee		
9	Income Tax Clearance Certificate		
10	Deviation if any		
11	Penalty and Termination of Contract of Contract		
12	Spares		
13	Performance Certificate (2 Years and above)		
14	Remarks		

Signature of Tenderer