

Amendments in Technical Specification No.

- **GETCO/E/TS - XMER/R14 Jun'22 for 66/11.55 or 23.1kV – 05, 10, 15 & 20 MVA and 33/11kV – 05 MVA POWER TRANSFORMER**

Sr	Clause No.	Instead of	Read as
01	<b>SECTION: C</b> <b>Cl. 3.0 (General Technical requirement)</b> <b>Cl. 3.2</b>	The transformer and all its accessories including CTs etc shall be designed to withstand without any 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 secs. The short circuit apparent power of the HV System to which the HV of transformer will be connected is 3000 MVA. The thermal ability to withstand short circuit for duration of 3 seconds shall be demonstrated by calculation. The calculation of dynamic ability to withstand short circuit shall also be submitted with the offer.	<p><b><u>OPTION 1:</u></b></p> <p>The transformer and all its accessories including CTs etc shall be designed to withstand without any 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 secs. The short circuit apparent power of the HV System to which the HV of transformer will be connected is 3000 MVA. The thermal ability to withstand short circuit for duration of 3 seconds shall be demonstrated by calculation. The calculation of dynamic ability to withstand short circuit shall also be submitted with the offer.</p> <p><b><u>OPTION 2:</u></b></p> <p>The transformer and all its accessories including bushing /built in CTs etc. shall be designed to withstand the thermal and mechanical effects of any external short circuit to earth and of short circuits at the terminals of any winding without damage. <b>The transformer shall be designed to withstand the thermal stress due to short circuit for a duration of 2 seconds</b> and the same shall be verified during design review. However, <b>generator transformer and associated auxiliary transformer shall be designed to withstand the thermal stress due to short circuit for a duration of 3 seconds.</b></p> <p>The following short circuit level shall be considered for the HV &amp; IV System to which the transformers will be connected:</p> <p>765kV system - 63 kA for 1 sec (sym, rms, 3 phase fault)  400kV system - 63 kA for 1 sec (sym, rms, 3 phase fault)  220kV system - 50 kA for 1 sec (sym, rms, 3 phase fault)  132kV system - 40 kA for 1 sec (sym, rms, 3 phase fault)  66kV system - 31.5 kA for 1 sec (sym, rms, 3 phase fault)</p> <p>However, for transformer design purpose, the through fault current shall be considered limited by the transformer self-impedance only (<b>i.e. <math>Z_s = 0</math></b>).</p>
02	<b>SECTION: C</b> <b>Cl. 3.0 (General Technical requirement)</b> <b>Cl. 3.6</b>	Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any winding.	<p>If <b><u>OPTION 1</u></b> is chosen in amended Section-C, Clause No-3.2 of detail Specification:</p> <p>Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any winding.</p>

			<p>If <b>OPTION 2</b> is chosen in amended Section-C, Clause No-3.2 of detail Specification:</p> <p>Transformer shall be capable of withstanding thermal and mechanical stresses due to symmetrical and asymmetrical faults on any terminals. Mechanical strength of the transformer shall be such that it can withstand 3-phase and 1-phase through fault with rated voltage applied to HV and/or IV terminals of transformer. The short circuit shall alternatively be considered to be applied to each of the HV, IV and tertiary (LV) transformer terminals as applicable. The tertiary terminals shall be considered not connected to system source. For short circuit on the tertiary terminals, the in-feed from both HV &amp; IV system shall be limited by the transformer self-impedance only and the rated voltage of HV and IV terminals shall be considered.</p>																																										
03	<p><b>SECTION: C</b> <b>Cl. 3.0 (General Technical requirement)</b> <b>Cl. 3.14</b></p>	<p>The transformers are to be designed with maximum permissible losses as indicated in below.</p> <table><tr><th><b>Transformer Rating</b></th><th><b>No Load Loss at Rated Volt. in kW</b></th><th><b>Full load losses (Copper + stray loss) at 75 oC, in kW</b></th></tr><tr><td>10 MVA 66/11.55 KV</td><td>6.5</td><td>37</td></tr><tr><td>10 MVA 66/23.1 KV</td><td>6.5</td><td>47</td></tr><tr><td>15 MVA 66/11.55 KV</td><td>9.5</td><td>51</td></tr><tr><td>15 MVA 66/23.1 KV</td><td>9.5</td><td>51</td></tr><tr><td>20 MVA 66/11.55 KV</td><td>10</td><td>62</td></tr><tr><td>20 MVA 66/23.1 KV</td><td>10</td><td>62</td></tr></table> <p>With specified fixed loss figures of maximum losses, manufacturers have to adhere to these figures by designing transformer suitably. Bidder will not be asked to give any loss figure in GTP. Therefore, there will be no capitalization at tender stage.</p> <p>The order will be placed to lowest price bidder as per GETCO policy and actual losses measured during acceptance. It will be at discretion of GETCO to accept/reject the unit whenever there is positive variation in the losses measured at actual.</p> <p>However, the unit shall not be accepted in the event measured losses are beyond the following limits against the fixed loss figures specified in the tender.</p>	<b>Transformer Rating</b>	<b>No Load Loss at Rated Volt. in kW</b>	<b>Full load losses (Copper + stray loss) at 75 oC, in kW</b>	10 MVA 66/11.55 KV	6.5	37	10 MVA 66/23.1 KV	6.5	47	15 MVA 66/11.55 KV	9.5	51	15 MVA 66/23.1 KV	9.5	51	20 MVA 66/11.55 KV	10	62	20 MVA 66/23.1 KV	10	62	<p>The maximum permissible losses (No load loss, I<sup>2</sup>R loss, auxiliary loss and load loss) at rated voltage/current (at 75 deg C) have been specified as under.</p> <table><tr><th><b>Transformer Rating</b></th><th><b>No Load Loss at Rated Volt. in kW</b></th><th><b>Full load losses (Copper + stray loss) at 75 oC, in kW</b></th></tr><tr><td>10 MVA 66/11.55 KV</td><td>6.5</td><td>37</td></tr><tr><td>10 MVA 66/23.1 KV</td><td>6.5</td><td>47</td></tr><tr><td>15 MVA 66/11.55 KV</td><td>9.5</td><td>51</td></tr><tr><td>15 MVA 66/23.1 KV</td><td>9.5</td><td>51</td></tr><tr><td><b>20 MVA 66/11.55 KV</b></td><td><b>14</b></td><td><b>80</b></td></tr><tr><td>20 MVA 66/23.1 KV</td><td>14</td><td>80</td></tr></table> <p>With specified fixed loss figures of maximum losses, manufacturers have to adhere to these figures by designing transformer suitably. Bidder will not be asked to give any loss figure in GTP. Therefore, there will be no capitalization at tender stage.</p> <p>The order will be placed to lowest price bidder as per GETCO policy and actual losses measured during acceptance. It will be at discretion of GETCO to accept/reject the unit whenever there is positive variation in the losses measured at actual.</p> <p>However, the unit shall not be accepted in the event measured losses are beyond the following limits against the fixed loss figures specified in the tender.</p>	<b>Transformer Rating</b>	<b>No Load Loss at Rated Volt. in kW</b>	<b>Full load losses (Copper + stray loss) at 75 oC, in kW</b>	10 MVA 66/11.55 KV	6.5	37	10 MVA 66/23.1 KV	6.5	47	15 MVA 66/11.55 KV	9.5	51	15 MVA 66/23.1 KV	9.5	51	<b>20 MVA 66/11.55 KV</b>	<b>14</b>	<b>80</b>	20 MVA 66/23.1 KV	14	80
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		<div>1) No Load losses : 5%</div> <div>2) Full Load losses : 2%</div> <div>3) Aux losses : 2%</div> <div>Penalty towards the higher losses within above limits shall be recovered as follow:<div>1) No Load losses: 3 times capitalization cost of 3,33,000/- per kW</div><div>2) Full Load losses: 3 times capitalization cost of 1,36,000/- per kW</div><div>3) Aux losses: 3 times capitalization cost of 1,36,000/- per kW</div><div>The testing of unit will be carried out in presence and witness of third party selected by GETCO at the discretion of GETCO.</div><div>The measurement of losses shall be carried out with 3 (Three) Watt meter method only and CTs, PTs and meters used for these measurements shall be of class of accuracy of 0.2.</div><div>However, no weightage shall be given for supply of transformer, with losses (measured during routine tests) less than the above specified losses.</div></div> <div><div>1) No Load losses : 2%</div><div>2) Full Load losses : 2%</div><div>3) Aux losses : 2%</div><div>Penalty towards the higher losses within above limits shall be recovered as follow:<table><tr><th>S.N.</th><th>Differential of specified losses vs Measured losses</th><th>RATE (in INR per KW)</th></tr><tr><td>1</td><td>No load Loss</td><td>Rs. 10,00,000/KW</td></tr><tr><td>2</td><td>I²R Losses/Load Losses (Differential of whichever loss is higher shall be considered for penalty)</td><td>Rs. 8,00,000/KW</td></tr><tr><td>3</td><td>Auxiliary Losses</td><td>Rs. 8,00,000/KW</td></tr></table><div>Note: For a fraction of a kW, the penalty shall be applied on pro rata basis.</div><div>The testing of unit will be carried out in presence and witness of third party selected by GETCO at the discretion of GETCO.</div><div>The measurement of losses shall be carried out with 3 (Three) Watt meter method only and CTs, PTs and meters used for these measurements shall be of class of accuracy of 0.2.</div><div>However, no weightage shall be given for supply of transformer, with losses (measured during routine tests) less than the above specified losses.</div></div></div>	S.N.	Differential of specified losses vs Measured losses	RATE (in INR per KW)	1	No load Loss	Rs. 10,00,000/KW	2	I²R Losses/Load Losses (Differential of whichever loss is higher shall be considered for penalty)	Rs. 8,00,000/KW	3	Auxiliary Losses	Rs. 8,00,000/KW	
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04	<div>SECTION: C</div> <div>Cl. 4.0</div> <div>(Constructional Detail)</div> <div>Cl. 4.3 Core</div>	<div>To be added:</div> <div><div>➤ Manufacturers of Stampings / Laminations / Cores of transformers (with or without winding) from CRGO/Amorphous material have to get Certificate of Conformity (CoC) from Bureau of Indian Standard (BIS).</div><div>➤ Essential Requirements (As per Ministry of Steel, GOI Steel and Steel Products (Quality Control) Order, 2020 dated 27.05.2020: Table 2)</div><table><tr><th>Goods &amp; Articles</th><th>Essential Requirements</th><th>ITC (HS) Code</th><th>Date of Impleme ntation</th></tr><tr><td>Stampings / Laminations / Cores of transformers (with or without winding)</td><td>Made from BIS standard marked Grain Oriented Electrical Steel Sheet and Strip confirming to IS 3024:2015 or Cold rolled non-oriented electrical steel sheet and strip confirming to IS 648:2006 or Magnetic materials – specification for individual material – Fe based amorphous strip delivered in the semi-processed state confirming to IS 16585:2016.</td><td>85049010 85049090</td><td>With immediate effects</td></tr></table></div>	Goods & Articles	Essential Requirements	ITC (HS) Code	Date of Impleme ntation	Stampings / Laminations / Cores of transformers (with or without winding)	Made from BIS standard marked Grain Oriented Electrical Steel Sheet and Strip confirming to IS 3024:2015 or Cold rolled non-oriented electrical steel sheet and strip confirming to IS 648:2006 or Magnetic materials – specification for individual material – Fe based amorphous strip delivered in the semi-processed state confirming to IS 16585:2016.	85049010 85049090	With immediate effects					
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05

SECTION: D (i)  
Cl. 1.0 (POWER TRANSFORMER PRINCIPLE PARAMETERS)  
Sr No:19

S N	Item	Specification
19)	System Short Circuit level	25 KA for 3 Sec

**OPTION 1:**

S N	Item	Specification
19)	System Short Circuit level	25 KA for 3 Sec

**OPTION 2:**

The transformer and all its accessories including bushing /built in CTs etc. shall be designed to withstand the thermal and mechanical effects of any external short circuit to earth and of short circuits at the terminals of any winding without damage. **The transformer shall be designed to withstand the thermal stress due to short circuit for a duration of 2 seconds** and the same shall be verified during design review. However, **generator transformer and associated auxiliary transformer shall be designed to withstand the thermal stress due to short circuit for a duration of 3 seconds.**

The following short circuit level shall be considered for the HV & IV System to which the transformers will be connected:

765kV system - 63 kA for 1 sec (sym, rms, 3 phase fault)  
400kV system - 63 kA for 1 sec (sym, rms, 3 phase fault)  
220kV system - 50 kA for 1 sec (sym, rms, 3 phase fault)  
132kV system - 40 kA for 1 sec (sym, rms, 3 phase fault)  
66kV system - 31.5 kA for 1 sec (sym, rms, 3 phase fault)

However, for transformer design purpose, the through fault current shall be considered limited by the transformer self-impedance only (**i.e.  $Z_s = 0$** ).

Further, following clause are revised & incorporated in Technical Specification as per CEA (April-2021).

Sr	Description	To be added/revised														
01	Insulation Resistance	<div>➤ The minimum satisfactory values for insulation Resistance at 30°C (one minute measurements) at the time of commissioning is as under,</div> <table><tr><th>Rated Voltage class of winding</th><th>Minimum desired IR value at 1 minute (Mega ohm)</th></tr><tr><td>11kV</td><td>500 MΩ</td></tr><tr><td>33kV</td><td>1000 MΩ</td></tr><tr><td>66kV &amp; above</td><td>1500 MΩ</td></tr></table>	Rated Voltage class of winding	Minimum desired IR value at 1 minute (Mega ohm)	11kV	500 MΩ	33kV	1000 MΩ	66kV & above	1500 MΩ						
Rated Voltage class of winding	Minimum desired IR value at 1 minute (Mega ohm)															
11kV	500 MΩ															
33kV	1000 MΩ															
66kV & above	1500 MΩ															
02	Polarization Index Test	<div>➤ The Polarization Index (PI) is the ratio of the 10 min to the 1 min mega-ohm readings.</div> <table><tr><th>Polarization Index</th><th>Insulation Condition</th></tr><tr><td>Less than 1</td><td>Dangerous</td></tr><tr><td>1.0 - 1.1</td><td>Poor</td></tr><tr><td>1.1 - 1.25</td><td>Questionable</td></tr><tr><td>1.25 - 2.0</td><td>Fair</td></tr><tr><td>2.0 – 4.0</td><td>Good</td></tr><tr><td>Above 4.0</td><td>Excellent</td></tr></table>	Polarization Index	Insulation Condition	Less than 1	Dangerous	1.0 - 1.1	Poor	1.1 - 1.25	Questionable	1.25 - 2.0	Fair	2.0 – 4.0	Good	Above 4.0	Excellent
Polarization Index	Insulation Condition															
Less than 1	Dangerous															
1.0 - 1.1	Poor															
1.1 - 1.25	Questionable															
1.25 - 2.0	Fair															
2.0 – 4.0	Good															
Above 4.0	Excellent															
03	Tan Delta of Windings and bushings	<div>➤ For Winding and bushings, the tan delta value shall not exceed <b>0.005</b> i.e. 0.5 % (during first charging).</div>														



Dated: 08.09.2020

### **TTR validity amendment-1**

**(Addendum to Technical Specification for validity of type test reports  
for *major electrical equipments*)**

Sr. No.	Name of test/ Equipment	Type test reports validity (In Years)
i.	On Line Tap Changer (OLTC)	10
ii.	Power Transf. Bushing/ Reactor Bushing	7
iii.	Transformer/reactor fittings and accessories.	10
iv.	Circuit Breaker	10
v.	Isolators	10
vi.	Lightning Arrestors	10
vii.	Wave Trap	10
viii.	Instrument Transformer	7
ix.	Low Voltage (LV) & Medium Voltage (MV) Switchgear	10
x.	Cable & associated joints	10
xi.	Capacitors	10
xii.	Energy Meters [including smart meters & Availability Based Tariff (ABT) meters]	5
xiii.	Conductors & earth wire	10
xiv.	Insulators(Porcelain/ Glass)	10
xv.	Composite Insulators	5
xvi.	Power Line Carrier Communication (PLCC)/Fibre Optic (FO) cable/Optical Ground Wire (OPGW)	5
xvii.	Terminal connectors of all major equipments including transformers	10

**Note:** Type test reports shall be valid as on the last date of submission of bid.

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# **GUJARAT ENERGY TRANSMISSION CORPORATION LTD.**

**SARADAR PATEL VIDYUT BHAVAN,  
RACE COURSE, BARODA – 390 007.**

## **TECHNICAL SPECIFICATIONS FOR**

**66/ 11.55 or 23.1 kV- 05, 10, 15 & 20 MVA,  
33/11KV- 5MVA  
POWER TRANSFORMER**

GETCO/E/TS - XMER/ R14 Jun'22

(Without Capitalisation, with innovative solutions, NIFPS, *Ester oil option*)



## **SPECIAL INSTRUCTIONS TO BIDDER**

Please read following instructions carefully before submitting your bid.

1. All the drawings, i.e. elevation, side view, plan, cross sectional view etc., in AutoCAD format and manuals in PDF format, for offered item shall be submitted. Also the hard copies as per specification shall be submitted.
2. The bidder shall submit Quality Assurance Plan for manufacturing process and Field Quality Plan with the technical bid.
3. The bidder shall have to submit all the required type test reports for the offered item. However, in the event of partial submission or reports older than specified limit, bidder must submit his confirmation for those type test report/s to be submitted in the event of an order, without affecting delivery schedule, before commencement of supply, free of cost. In absence of this confirmation, the evaluation shall be carried out accordingly as non submission of type test reports.
4. The bidder must fill up all the point of GTP for offered item/s. Instead of indicating "refer drawing, or as per IS/IEC", the exact value/s must be filled in.
5. All the points other than GTP, which are asked to confirm in technical specifications must be submitted separately with the bid.
6. The bidder is required to impart training in view of manufacture, assembly, erection, operation and maintenance for offered item, at his works, to the person/s identified by GETCO, in the event of an order, free of cost. The cost of logistics will be bear by GETCO.
7. Please note that the evaluation will be carried out on the strength of content of bid only. No further correspondence will be made.
8. The bidder shall bring out all the technical deviation/s only at the specified annexure.
9. The bidder should indicate manufacturing capacity by submitting latest updated certificate of a Chartered Engineer (CE).

Note for RIP/ RIF/ RIS bushings :

If offered RIP/ RIF/ RIS bushings are to be supplied from Indian manufacturing unit under technical collaboration with foreign OEM, then type test reports & satisfactory performance certificate from their offered country works of foreign OEM shall be considered valid for BID evaluation. However, in event of order, following type test reports to be submitted by Indian manufacturing unit having technical collaboration of foreign OEM, before commencement of supply, without affective delivery schedule, free of cost to GETCO.

- a. Dielectric Test as per IEC 60137 (Latest Edition)
- b. Temperature Rise Test as per IEC 60137 (Latest Edition)

## POWER TRANSFORMERS

### SCOPE OF TENDER INQUIRY

#### Section A (a)

Sheet 1 of 1

#### 1.0 SCOPE

- 1.0.1 This specification covers the design, construction, manufacture, Assembly, testing of performance of transformers at Manufacturer's works, packing, supply and delivery to FOR site of 66 kV class power Transformers complete with all fittings, accessories and associated equipments which are required for efficient & trouble free operation.
- 1.0.2 It is not the intent to specify completely design & construction of the transformer; however, the transformer shall conform in all respects, to relevant standards of engineering, design and workmanship and shall be capable of performing its continuous commercial operation up to the Bidder's, guarantee as well as satisfactorily for entire service life stipulated in schedules of relevant electrical act in a manner acceptable to the purchaser. Purchaser shall interpret the meanings of drawings & specifications & shall have the right to reject any work or material which in his option is not full accordance therewith. The offered transformer shall be complete with all the components necessary for their, effective & trouble free operation. Such components shall be deemed to be within Bidder's scope, irrespective of whether these are specifically brought out in this specification and/or purchase order or not.
- 1.0.3 Whenever requirement of 66 kV class transformers with SCADA compatibility is indicated in Schedule – A of respective tender, the Annexure – A and Annexure B shall also be considered in scope of supply.
- 1.0.4 **New technology and innovative solutions like SF6 filled transformer / dry type transformer / wooden frame / stainless steel frame / insulating materials / Ester Oil /OIP polymer bushing / RIP bushing / in-tank OLTC / vacuum tap OLTC, as per applicable standards are acceptable for the bidding which could help in energy efficiency, reduction in safety & environmental impacts. It is compulsory that type tested design is available upfront for such solutions and type test report is required to be submitted along with bid. Notwithstanding above, GETCO shall accept maximum 10% of the ordered quantity on successful bidder and performance related criteria mentioned in QR shall not be applicable in this case.**
- 1.0.5 The scope of work shall also include supplying each transformer with (i) Nitrogen Injection System, for oil filled transformer, having suitable capacity for Protection against the Fire & Explosion including civil, erection, testing & commissioning works, as per specification, if indicated in Schedule-A of commercial Bid. *If NIFPS scheme is not in scope of supply of bidder as per Schedule - A of tender, provision for NIFPS scheme shall be made with transformer.*
- 1.0.46 'Purchaser / Owner' shall mean the Gujarat Energy Transmission Corporation Ltd, Race Course, Baroda – 390007 / its authorized officers who have issued the inquiry.

## DEFINITION OF TERMS & SPECIFICATION DOCUMENTS

Section A (b)

Sheet 1 of 5

- 1.2 'Bidder' shall mean the firm / party who quote against an inquiry.
- 1.3 'Vendor' shall mean the successful bidder whose bid has been accepted by the purchaser, and on whom the 'contract' or 'Purchase order' is placed by the purchaser and shall include his heirs, legal representatives, successors & permitted assigns.
- 1.4 'Sub-vendor' shall mean the person or firm named in the 'Contract' undertaking a part of the work or any person to whom a part of the 'contract' has been sublet with the consent in writing of the purchaser & shall include his heirs, legal representatives, successors & permitted assigns.
- 1.5 'Manufactures' refers to a person or firm who is the producer or furnisher of material or designer and fabricator of equipment to either the owner / purchaser or the vendor or both under the contract.
- 1.6 'Others' shall mean other successful bidders, whose bids have been accepted by the PURCHASER / OWNER and to him the orders have been placed by the PURCHASER / OWNER & shall include their heirs, legal representatives, successors and permitted assigns.
- 1.7 'Inspector' shall mean the authorised representatives appointed by the 'Owner / Purchaser' for the purpose of inspection of materials / equipment / works.
- 1.8 'Site' shall mean the actual place of 66 kV substations, or other place where the transformers with accessories are to be installed.
- 1.9 'Month' shall mean calendar month.

## DEFINITION OF TERMS & SPECIFICATION DOCUMENTS

Section A (b)

Sheet 2 of 5

- 1.10 'Specification' shall mean collectively all the terms and stipulations contained in these portions of the contract known as General Conditions, the specifications & such amendments, revisions, deletions or additions, as may be made in the agreement and all written agreement made or to be made pertaining to the method and manner of performing the work or to the quantities & quality of the material to be furnished under the contract.
- 1.11 'Bid shall mean the proposal/ document that the Bidder submits in the requested & specified form in the 'Specification.'
- 1.12 'Equipment' and 'work' or 'works' shall mean respectively the goods to be supplied and services to be provided by the vendor under the 'Purchase order' or 'contract.'
- 1.13 'Contract' or 'Purchase order' shall mean the order & associated specifications executed by the owner/purchaser & the vendor including other documents agreed between the parties or implied to form a part of the contract.
- 1.14 'Guarantee period' shall mean the period during which the 'part' or 'equipment' shall give the same performance as guaranteed by the vendor and as stated in the Specification.
- 1.15 'Approved' and 'Approval' where used in the Specification shall mean respectively approved by and approval of the Owner/ Purchaser.
- 1.16 'Writing' shall include any manuscript, typewritten or printed statement, under or over signature and/ or seal as the case may be.

## **DEFINITION OF TERMS & SPECIFICATION DOCUMENTS**

Section A (b)

Sheet 3 of 5

- 1.17 'Manufacturer's works' shall mean and include the land and other places which are used by the vendor / sub-vendor for the manufacture of equipment or performing the 'works'.
- 1.18 'Commissioning' shall mean the integral activity covered under 'Preliminary operation', 'Initial operation', 'trial operation' & carrying out 'Performance tests'.
- 1.19 'Drawing' shall mean all (i) drawings furnished by / the owner / purchaser as a basis for proposal. (ii) Supplementary drawings furnished by the owner / purchaser to clarify and to define, in greater detail the intent of the contract. (iii) Drawings submitted by the vendor with his proposal, provided such drawings are acceptable to the Owner/Purchaser.
- 1.20 'Performance tests' shall mean such tests as are prescribed in the Specification to be done by the vendor before the equipment is taken under guarantee by the Owner/ Purchaser.

### **2.0 SPECIFICATION DOCUMENTS**

- 2.1 This specification consists of sections as listed below and all of these are to be considered together for correct understanding & interpretation of specification.
- 2.1.1 SECTION A (a) & A (b)
- 2.1.2 This section A (a) covers the scope of inquiry and section A (b) covers description of definitions of terms, the specification documents and the list of contents.

## DEFINITION OF TERMS & SPECIFICATION DOCUMENTS

Section A (b)

Sheet 4 of 5

### 2.1.3 SECTION B

Section 'B' furnished relevant site information for the reference & use of bidder.

### 1.1 SECTION C

Section 'C' comprises detailed general technical specification for individual components / equipments. It covers general technical requirement.

### 1.2 SECTION D

Section 'D' covers, the Data sheets A1 & A2 indicating specific requirements, parameters and standards in respect of equipments to be supplied. Data sheet 'B' specifies the data to be furnished by the Bidder and Data sheet 'C' specifies the data to be furnished within commencement period on award of contract.

### 2.1.6 SECTION E

This covers general technical specification for painting, packing, erection, commissioning etc, and general & commercial requirements like test inspection, documents, drawing instruction manual, painting etc. in case of supply of supply contract.

### 2.1.7 SECTION F

This covers the schedule 'A1' of Bidder's experience, schedule 'A2' of deviation for technical specification, and schedule 'B' of places of Test & inspection. It also covers Annexure III, oil characteristics, and reference drawings for HV & LV Terminal connectors.

- 2.2 The bidder shall be deemed to have examined the specification in its complete form to have fully informed & satisfied himself as to the details, nature, character &

## DEFINITION OF TERMS & SPECIFICATION DOCUMENTS

Section A (b)

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quantities of work to be carried out, site conditions, other pestilent matter & details & the general commercial terms & conditions, described under part II.

- 2.3 The bidders are required to review these documents & clearly state in their offer their acceptance of the same. The final contract between OWNER/PURCHASER and VENDOR shall be subjected to such amendment if any mutually agreed upon the OWNER/ PURCHASER and the VENDOR and included in the purchase order.
- 2.4 The bidder shall specify all deviations with respect to this specification in the Annexure – 12 only. Please note that any technical deviation indicated other than Annexure – 12 shall not be considered.
- 2.5 The bidder shall furnish the data called for in Data sheet ‘B’, the schedules in the standard proforma, to facilitate correct evaluation of his bid in an expeditious manner. It is in the interest of Bidder to submit the Bid in the above manner, failing which it is likely that his bid may not be considered.
- 2.6 Data sheet ‘B’ forms are enclosed with this specification. Bidders shall fill up the details completely in the forms and submit the same duly signed, with the offer.
- 2.7 The bidder shall furnish the data called for in data sheet ‘C’, for purchaser’s / owner’s approval all data should be furnished in the specified form only.



## SITE INFORMATION

### Section B

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## 2.0 Service Condition

### 2.1 Climatic condition:

- |       |                                                   |       |
|-------|---------------------------------------------------|-------|
| (i)   | Maximum Altitude above sea level less than 1000M  |       |
| (ii)  | Service conditions                                |       |
| (a)   | Maximum ambient air temperature (C <sup>0</sup> ) | 50    |
| (b)   | Average daily air temperature. (C <sup>0</sup> )  | 35    |
| (c)   | Maximum yearly air temperature (C <sup>0</sup> )  | 50    |
| (d)   | Minimum ambient air temperature (C <sup>0</sup> ) | 3.5   |
| (iii) | Maximum relative humidity (%)                     | 95    |
| (iv)  | Average annual rainfall (mm)                      | 1000  |
| (v)   | Maximum wind pressure kg/m <sup>2</sup>           | 150   |
| (vi)  | Seismic level (Horizontal acceleration)           | 0.3 g |

## 1.2 Auxiliary Power supply

Auxiliary electrical equipments shall be suitable for operation on the following supply system.

- |     |                                       |                                 |                                                             |
|-----|---------------------------------------|---------------------------------|-------------------------------------------------------------|
| (a) | Power Devices                         | (i)                             | 415V, 3 Phase; four wire 50 Hz, neutral grounded AC supply. |
|     |                                       | (ii)                            | 240V, single phase, 2 wire 50 Hz, AC supply.                |
| (b) | Alarm, Control and Protective device. |                                 | 220 / 110 DC,                                               |
| I   | (i)                                   | Variation in AC supply          | Voltage $\pm 10 \%$<br>Frequency $\pm 5 \%$                 |
|     | (ii)                                  | Variation in DC supply voltage. | -15 % to + 10 %                                             |

## **POWER TRANSFORMERS**

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#### **Section – C**

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### **3.0 GENERAL TECHNICAL REQUIREMENTS**

- 3.1 The transformer and OLTC should be suitable for unidirectional flow of rated power HV to LV.
- 3.2 The transformers and all its accessories shall be designed to withstand without injury the thermal & mechanical effects of any external short circuit to earth & of short circuits at the terminals. The short circuit duration for conforming thermal limit shall be three seconds. The short circuit apparent power of the HV System to which the HV of transformer will be connected is 3000 MVA. The thermal ability to withstand short circuit for duration of 3 seconds shall be demonstrated by calculation. The calculation of dynamic ability to withstand short circuit shall also be submitted with the offer.
- 3.3 The transformer shall be capable of being loaded continuously in accordance with IS: 6600 up to loads of 110%. There shall be no limitation imposed by bushings, tap changer or any other accessory.
- 3.4 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 assigned voltage of tapping.
- 3.5 The transformer shall be of oil and natural cooling.
- 3.6 Transformer shall be capable of withstanding thermal & mechanical stress caused by symmetrical and asymmetrical faults due to external short circuits, on any winding.

## **POWER TRANSFORMERS**

### **GEN. REQUIREMENTS**

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- 3.7 All materials used shall be new and is of best quality & of the best class, most suitable for working under the conditions specified and shall withstand variation of temperature & atmospheric condition without distortion or deterioration, or setting up of undue stress in any part and also, without affecting the strength and stability of the various parts for the work which they have to perform.
- 3.8 Exposed parts shall not leave pockets where water can collect.
- 3.9 Internal design of the transformer shall ensure that air is not trapped in any location.
- 3.10 Materials in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in oil shall not be galvanized or cadmium plated.
- 3.11 Labels indelibly marked shall be provided for identifiable accessories / parts.
- 3.12 Center line of transformer shall be marked on top plate.
- 3.13 The GM valves shall conform to IS: 778.

## POWER TRANSFORMERS

### GEN. REQUIREMENTS

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#### 3.14 TRANSFORMER LOSSES

The transformers are to be designed with maximum permissible losses as indicated below:

Sr No	Transformer Rating	No load loss at 75 <sup>0</sup> C at rated voltage.	Full load losses (Copper loss + stray loss) at 75 <sup>0</sup> C
1.	10 MVA 66/11.55 KV	6.5 KW	37 KW
2.	10 MVA 66/23.1 KV	6.5 KW	47 KW
3.	15 MVA 66/11.55 KV	9.5 KW	51 KW
4.	15 MVA 66/23.1 KV	9.5 KW	51 KW
5.	20 MVA 66/11.55 KV	10 KW	62 KW
6.	20 MVA 66/23.1 KV	10 KW	62 KW
7.	05 MVA 66/11.55 KV	4.7 KW	26 KW
6	05MVA 33/11 KV	3.6 KW	21 KW

3.14.1 With specified fixed loss figures of maximum losses, manufacturers have to adhere to these figures by designing transformer suitably. Bidder will not be asked to give any loss figure in GTP. Therefore, there will be no capitalization at tender stage.

The order will be placed to lowest price bidder as per GETCO policy and actual losses measured during acceptance. It will be at discretion of GETCO to accept/reject the unit whenever there is positive variation in the losses measured at actual.

However, the unit shall not be accepted in the event measured losses are beyond the following limits against the fixed loss figures specified in the tender.

- 1) No Load losses : 5%
- 2) Full Load losses : 2%
- 3) Stray losses : 2%

Penalty towards the higher losses within above limits shall be recovered as follow:

- 1) No Load losses : 3 times capitalization cost of **Rs.** 3,33,000/- per kW
- 2) Full Load losses : 3 times capitalization cost of **Rs.** 1,36,000/- per kW
- 3) Stray losses : 3 times capitalization cost of **Rs.** 1,36,000/- per kW

The testing of unit will be carried out in presence and witness of third party selected by GETCO at the discretion of GETCO.

The measurement of losses shall be carried out with 3 (Three) Watt meter method only and CTs, PTs and meters used for these measurements shall be of class of accuracy of 0.2.

However, no weightage shall be given for supply of transformer, with losses (measured during routine tests) less than the *above specified* losses.

3.14.1A *The stray losses shall not be more than **18** % of total losses at 75 °C calculated from measured losses.*

#### 3.15 REJECTION:

The Purchaser shall reject transformer, if any of the following conditions during acceptance testing arises:

- i) No load losses or load losses or Stray losses exceed the value specified above.
- ii) Impedance value deviates the guaranteed value by + 10% or more.
- iii) Oil or winding temperature rise exceeds the specified value.
- iv) Transformer fails to withstand any of the dielectric tests.
- v) Transformer fails to pass any of acceptance tests.
- vii) Transformer is proved to have been manufactured not in accordance with agreed specification.

The Purchaser reserves the right to retain the rejected transformer and use it until the bidder replaces the defective transformer by a new transformer, as a stop gap arrangement, within a reasonable period, at no extra costs to the GETCO. Defective transformer may be replaced by new acceptable transformer. In such case the transportation, loading, unloading on plinth, inspection, erection, testing & commissioning charges shall be borne by the bidder.

## 4 CONSTRUCTIONAL DETAILS

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

### 4.1 TRANSFORMER TANK

The tanks shall be made from good commercial grade steel & shall be of welded construction. The structural steel material used for fabrication of tank shall be as per IS:

2062 (latest edition). All joints shall be hot oil tight & no bulging shall take place while in service. All the oil tight joints shall be made with suitable flanges, treated cork or other approved type of packing. The tanks shall be so designed that the core and winding can be lifted freely from the case with as little dismantling as possible. Suitable guide may, also, be provided for positioning of cores. External lugs or eyes for lifting the core with windings, as also, the complete transformer with oil shall be fitted with a substantial under carriage and mounted on four bi-directional flanged, wheels for rail track gauge of 1436 mm. The main tank body excluding tap changer compartment and radiators shall be capable of withstanding vacuum of 500mm of hg. The tank shall be designed to withstand mechanical shock during transportation, vacuum filling of oil. It shall also with stand the pressure for one hour corresponding to twice the normal head of oil or to the normal pressure plus 35KN/m<sup>2</sup> (5 Lbs/Inch<sup>2</sup>) whichever is lower, measured at the base of the tank.

***Dimensions of turret for provision of bushing shall be such that required clearances are maintained and there will not be any discharge or high field stress developed.***

*Necessary provision shall be made for installation of Nitrogen Injection Fire Prevention cum Extinguishing System. Location and size of the same shall be finalized during detailed engineering.*

#### 4.2 AXLE & WHEELS

- (a) The transformer shall be provided with flanged bi-directional wheels & axle. These shall be designed not to deflect excessively to interfere with the movement of the transformer.
- (b) The wheels are required to swivel and they shall be arranged so that they can be turned through 90<sup>0</sup>, when the tank is jacked upto clear of rail, Means shall, also, be provided for locking the swivel movements in positions parallel & right angle to the longitudinal axis of tank. The anti earth quake clamps should be provided for protection against earth quake.
- (c) The rail track gauge shall be 1436mm along longer axis as well as shorter axis.

#### 4.3 CORE

The transformer shall be of three legged core type with inter leafed /step lap, core joints. On no account, interleaved step down butt joints shall be offered. The core shall be bolt less & built of non-ageing **prime grade** CRGO laminations having high permeability and low hysteresis loss and with hot oil proof insulation. The core material shall be prime CRGO, shall be procured directly from manufacturer or through accredited marketing organization of reputation. It shall be properly clamped together to the frame & bonded by application of araldite tightly to prevent undue vibration or noise. The complete design of the core must ensure permanency of the core losses with continuous working of the transformer.

## **POWER TRANSFORMERS**

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Core-clamping bolts, if used, shall be effectively insulated. Maximum flux density at normal voltage and frequency shall not exceed 1.7 tesla. The core shall be provided with lugs suitable for lifting it & coil assembly shall be so fitted in the tank that shifting will not occur during transport or short circuits.

- 4.3(a) The thickness of lamination shall be 0.27 mm or less. Surface insulation of laminations shall be rust resistant and have high interred laminar resistance. Insulation shall withstand annealing temperature as high as 850 ° C. Insulation shall be resistant to hot cooling medium. Laminations are not to be punched.
- 4.3(b) Bidder should have in house core cutting facility for proper monitoring & control on quality & also to avoid any possibility of mixing of prime material with defective/second grade material. This should be indicated invariably in the QAP. The purchaser may witness the core-cutting process. In case the in-house core cutting facility is not available, then the same shall be carried out in the presence of the representative of GETCO.
- 4.3(c) Bidder will offer the core for stage inspection and get approval from purchaser during manufacturing stage. The bidder has to produce following documents at the time of stage inspection for confirmation of use of prime core materials.
- a) Invoice of supplier
  - b) Mills approved test certificates
  - c) Packing list
  - d) Bill of lading
  - e) Bill of entry certificate by custom.
- 4.3(d) To avoid any possibility of mixing of 'Prime material' with any other second grade/ defective material, the imported packed slit coils of CRGO materials shall be opened in the presence of the GETCO's representative. Only after the inspection and approval from purchaser, the core material will be cut in-house OR sent to

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External agency for cutting individual laminations. In case the core is sent to external agency for cutting, the GETCO's representative will have full access to visit such agency for the inspection of the cutting of core.

After having sheared, the laminations shall be treated to remove all burrs and shall be re annealed in a non- oxidizing atmosphere to remove all residual stresses and restore the original magnetic properties of CRGO sheets. The insulation of the lamination shall be inert to the action of hot transformer oil. Paper and varnish insulation will is not accepted. The nature of insulation should be specified in the bid in GTP.

The core shall be rigidly clamped to ensure adequate mechanical strength and to prevent vibration during operation. The clamping structure shall be so constructed that eddy currents will be minimum. The insulation of bolt less core to clamp plates shall be such as to with stand 2000 V A.C. for one minute.

The design of 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 components at right angles to the plane of the laminations which may cause local heating.

The core shall be provided with lugs suitable for lifting the complete core and coil assembly of the transformer.

The core and the coil assembly shall be so fixed in the tank that shifting will not occur and cause any damage when the transformer is moved shifted, or during a short circuit.

**4.3(e) the core shall not be earthed at multiple locations. Terminal shall be brought on top of tank and earthed through link. Core and Frame terminals should be brought out on transformer top so as to enable meger.**

#### 4.4 WINDING

The winding shall be of electrolytic grade copper conductors. The arrangement of windings must be such that there is good electrical and magnetic balance under all



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loading & short circuit conditions. Oil ducts shall be provided to ensure uniform temperature gradients and absence of hot spots. All similar coils shall be interchangeable.

It is essential that the windings shall be subjected to thorough shrinking & seasoning process, so that no further shrinkage of winding occurs, even during service. However adjustable devices shall be provided for taking up any possible shrinkage of coils, while in service. The general design and construction of the transformer and the bracing of the windings shall be such that no mechanical movement of the coils is possible with dead short circuit on either side.

The insulation paper shall be of high quality and the value of degree of polymerization shall not be less than 1200 Pv and the necessary test certificate shall be submitted along with the stage inspection report. Provision shall be made for taking sample of paper for testing purpose and location shall be easily accessible and indicated on the transformer tank by affixing special caution plate.

The material used in the insulation and assembly windings shall be insoluble, non-crystallite and chemically inactive in the hot transformer oil and shall not soften or otherwise, be affected under the operating conditions.

Transformers shall be capable of withstanding dynamic & thermal forces, due to three phase symmetrical faults at the terminals, without considering any system impedance. The short circuit duration for conformity of thermal limit shall be three seconds. Current density of windings shall be stated. The calculations of Thermal stability and dynamic ability to withstand short circuit shall also be submitted with the offer. ***Ampere turns shall be balanced at various heights of windings for HV, LV and tapping winding. Bidder shall justify for the same by submitting details.***

***Calculation of offered losses with respect to offered winding and core materials shall be submitted with technical bid.***

Special attention shall be given for the provision of adequate insulation and clearance between HV & LV windings. All clearance of widening & other live parts must be adequate, for the maximum voltage of operation, plus 10 %. The minimum required clearance of windings in oil shall be stated.

The HV winding shall be interleaved / disc type. Disc winding shall be with the static end rings at both ends. The winding shall be suitable for chopped wave & full wave impulse voltage. The wave shape of the impulse voltage shall be in

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accordance with IS 2026 (Part III) & relevant IEC standard for high voltage Tests. LV winding shall be continuous disc type / Layer type.

The impulse strength of HV and LV winding for 1.2 / 50 micro sec., wave is stated under sr. No. 1.1 (15) of Section 'D'. Full description of the windings for the transformer, offered, shall be furnished in the offer.

Bidder shall invariably indicate in the GTP, the cross sectional area of all windings with respect to the current density adopted.

All threaded connections shall be provided with locking facilities. All leads from the winding shall be duly brazed for proper contact to the terminal board and bushings shall be rigidly supported to prevent injury from vibration.

The guaranteed minimum IR value should be indicated in GTP. The measured IR value with 5 kV motorized megger during acceptance test shall not be less than guaranteed minimum value.

#### 4.5 FITTINGS & ACCESSORIES

Standard fittings as described in ARE: 2026 (latest issue) and stated below shall be provided for each transformer.

- (a) **Main conservator shall have air cell type constant oil preservation system to prevent oxidation and contamination of oil due to contact with moisture.** Conservator for main tank shall fitted with oil filling flange & cap, isolating valve, drain valve, 150mm magnetic oil level gauge with low level alarm potential free contacts. Conservator shall be at right angle to the axis of HV bushing. The conservator shall be provided with separate compartment for OLTC. No separate conservator tank shall be provided for OLTC.

**The air cell shall be provided as per specification given in Annexure - IV attached here with.**

- (b) Prismatic oil level gauge shall, also, be provided on conservator tank. The background shall be so painted that the oil level can be seen from ground level also. The three positions of oil level shall be indicated viz.

(i) Minimum                      (ii) Normal                      (iii) Maximum.

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- (c) Silica gel dehydrating breather of acrylic seamless body with clear view design. The capacity of breather for main conservator tank should be such that it can contain minimum 5 kgs. Silica gel and minimum 1 kg. For OLTC conservator compartment. The GI pipe connecting breather with conservator should be seam less and no joint is permitted. ***It will be located below conservator tank opposite to HV side of transformer.***
- (d) Pressure Relief valves should be provided one each for main tank and OLTC of minimum size of T6 and T3 respectively. Necessary pressure operation test will have to shown during acceptance testing of transformer. It shall operate before reaching the test pressure specified in transformer tank pressure test. The operating pressure shall be recorded. The device shall seal off after excess pressure has been released. The terminal box of PRV should conform to degree of protection as per IP – 55 of IS: 13947.
- (e) One drain valve (gate) of 75mm diameter, with flange. Two Nos. Oil sampling valves, of 25mm size-each at top & bottom of main tank with the provision for fixing PVC pipe. All the necessary flanges with adopter suitable to connect piping for oil tanking and filtration process. Necessary guiding cover must be provided to these valves.
- (f) Two Nos. Oil filter valves (gate) of 50mm size, on diagonally opposite corners of the transformer tank with flange and adopter for connection of (30mm) hose pipe for filtration of oil.
- (g) Rating and diagram plate of Brass / stainless steel with details engraved.
- (h) Jacking lugs.
- (i) Minimum Two Nos. of inspection covers on tank cover. No inspection cover shall be provided on any of the sides, of transformer.
- (j) Four nos. of earthing pads each with four nos. of tapped holes (M 12 Bolts,) with M12 bolts, plain & spring washers suitable for connection of 50 x 6 mm GS earthing flats. These earthing pads should be provided one each on each side of transformer at centre.

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- (k) All the gaskets to be provided shall be of RC70C or RC80C grade. ***It shall not be older than one year.*** Necessary tests certificates from manufacturer shall be submitted along with acceptance test report. Flat gasket material will be SRBC (Synthetic rubber bonded cork) with minimum joints. When chords are used it shall be provided in fabricated groove. It shall be of Nitrile rubber. In fabricated groove the inner strip shall be welded for its full length.
- (l) Four nos. of anti earth quake clamps should be provided along with the required sized foundation bolts.
- (m) HV and LV terminal connectors shall be supplied along with the transformer as per section Section – D (iii) of this specification.
- (n) 150 mm dial temperature indicator of switch contacts with pointer reading 'Maximum', suitable resetting device, set of electrical contacts for 'alarm' and 'trip' along with necessary length of capillary tubing to be provided one each for Oil & Winding temperature monitoring. The contact rating shall be at least 2 Amp continuous at 250 V AC or DC. The range shall be from 0°C to 150°C
- (o) Double float buchholz relay with 'alarm' & 'trip' contacts. The oil connection from transformer tank to conservator vessel shall be arranged at rising angle of 6 to 9 degrees to horizontal up to the Buchholz relay and shall consist of suitable pipe of inside diameter (heavy gauge) as per IS: 3639.
- (p) Marshalling Box, housing the temperature indicators and auxiliary contacts.
- (q) Air release plugs
- (r) Detachable pressed steel radiators shall be provided with two butterfly valves, one for inlet & the other for outlet connection. The nos. of radiator to be provided shall be arrived from the cooling calculation submitted with the bid. The details of nos. of sections, its thickness and material should be indicated in GTP.
- (s) Two isolating GM valves of 50mm dia shall be provided for Buchholz relay on either side.
- (t) Skids.

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- (u) Additional thermometer pockets to be provided other than for Oil and winding temperature measurement. The capillary so provided for both pockets shall be only of Brass and having same diameter and threads suitable to interchange.
- (v) Flanged bi-directional rollers suitable for 1436mm rail track gauge with anti earth quake clamps.
- (w) Terminal marking plates of Brass/ Stainless steel should be provided and it should be legible from ground level also.
- (x) Lifting lugs.
- (y) Oil surge relay with trip contacts for OLTC, with 25mm GM gate valve on either side should be provided.
- (z) Bushing with metal parts & gaskets as specified under CI. 1.1(20) of section 'D'.
- (aa) Neutral earthing **HDG MS** bar of size 50 x 6 mm thick along with 22 kV class Epoxy support insulators should be provided. The details of the same must be filled in GTP.
- (bb) Any other accessories not covered here in and are useful or necessary for efficient operation of transformer shall be indicated in the bid.
- (cc) *Bushing CT on LV side as well as neutral as noted below shall be provided for REF protection.*

Sr No	CT Parameters	Up to 10 MVA		15 & 20 MVA	
		11 kV	22 kV	11 kV	22 kV
1	Ratio	600/1	300/1	1200/1	600/1
2	Class	PS	PS	PS	PS
3	Knee Point Voltage	≥300 V at 600 A	≥150 V at 600 A	≥600 V at 1200 A	≥300 V at 600 A

$R_{ct}$  and  $I_m$  shall be as per IS: 2705 and may be optimized to suite the design as well as system requirement. Any change in parameters of CT required at the time of detailed engineering will have to be incorporated without any extra cost.

- (dd) *Buchholz relay & PRV, alarm & tripping contacts shall be provided in terminal box having ingress protection of IP55 with connecting cable up to marshaling cubicle. Termination shall be push & plug type. The switch shall be mercury free. Also, Buchholz & PRV shall be provided shall have 2 switch 4 terminal arrangement for tripping contact*
- (ee) *Conservator with air cell shall be provided with Air Cell Rupture Relay. Suitable arrangement to be made to extend alarm signal to control room.*
- (ff) *Submit type test report of accessories/ brought out items for offered make & type during detailed engineering.*

#### 4.6 COOLING ARRANGEMENT

All the transformers covered by this specification shall have 'ONAN' cooling. The cooling shall be effected by pressed steel radiators conforming to IEEMA. The radiators fins provided shall have sufficient surface to limit temperature rise to values specified under clause No. 1.1 (20) of section D (i). The tubes shall be so arranged as to admit scrubbing without trouble when necessary. It will be so designed that any scale forming inside will flake off and pass to the bottom of the tank by gravity. Oil leak proof butterfly valves (positive operated) shall be provided to facilitate taking out any of the radiators without disturbing the transformer. Necessary gaskets in required nos. for fixing radiators and butterfly valve operating keys shall be provided. The space between the bottom of tank and mounting rail shall be maintained to minimum of 350 mm, for free air circulation.

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### 4.7 OIL

The insulating oil for transformer shall, generally conform to IS: 335 (latest edition) and as per Purchaser's / owners specification furnished under Annexure III in Section F (f). Sufficient quantity of oil for the first filling of complete transformer (with accessories) plus 10% extra oil shall be supplied by the vendor in non-returnable 210 litre capacity drums. The quantity of oil for transformer (including accessories) and OLTC should be indicated separately in the rating plate.

### 4.8 TERMINAL ARRANGEMENT

#### 4.8.1 BUSHING

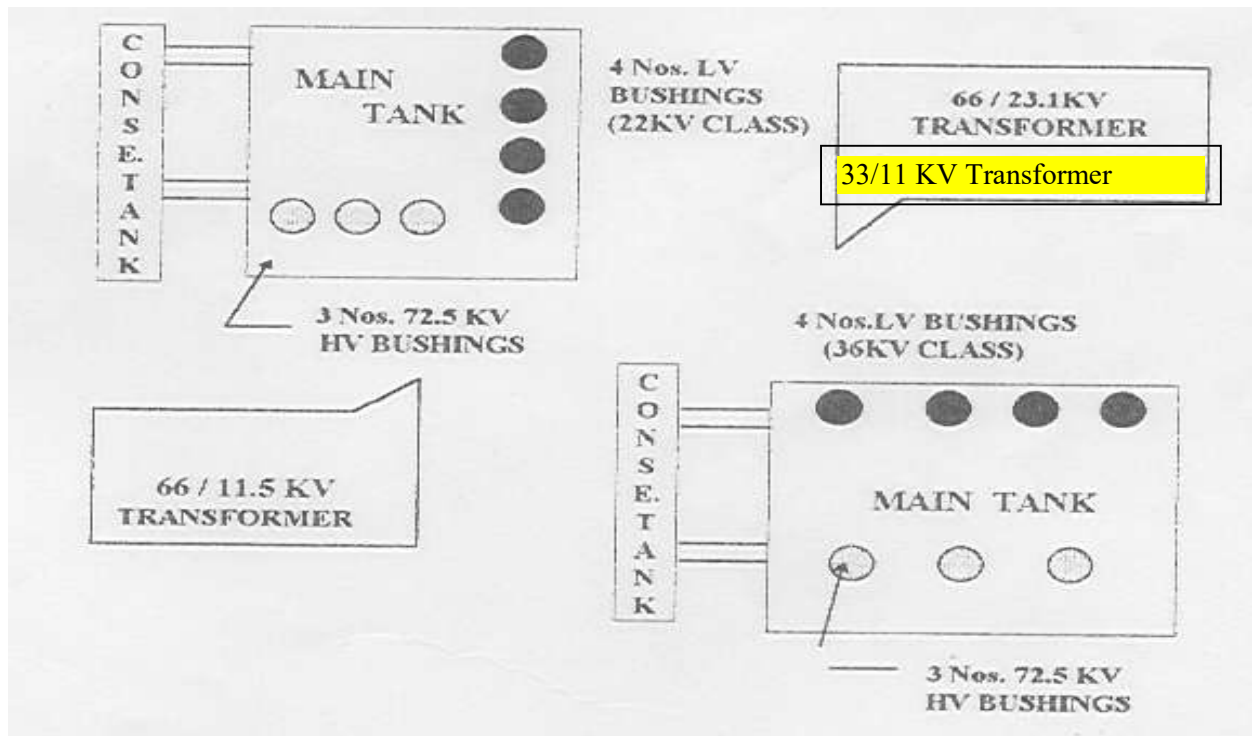
- (a) The electrical & mechanical characteristic of bushing shall be in accordance with IS: 2099 & (IS 3347 (Part – III / Section I) respectively, and bushings shall be suitable for heavily polluted atmosphere.
- (b) 72.5 kV bushing shall be oil filled condenser type & hermetically sealed. 24 kV & 36 kV bushing to be used for LV side shall be solid porcelain.
- (c) Condenser type bushing shall be provided with
  - (i) Oil level glass
  - (ii) Tap for capacitance / tan delta test.
- (d) Bushing of identical ratings shall be interchangeable.
- (e) Porcelain used in the manufacture shall be homogeneous, free from lamination, cavities & other flaws or imperfection that might effect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.
- (f) Glaze of porcelain and busing shall be of uniform brown colour, free from blisters burrs & other defects.
- (g) Clamps & fittings shall be hot dip galvanised steel.
- (h) For neutral, the bushing of the same rating shall be used as those to be used for LV terminals.
- (i) **In case of polymer bushing, all the parameters shall be as per applicable standard and as per requirement of technical specification Annexure –V**

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### 4.8.2 TERMINAL ARRANGEMENT

The Terminal Arrangement should be as under:



Special Adjustable co-ordinating gaps shall be provided as per relevant IS, on all bushing terminals and the gap setting shall be fixed with reference to the impulse strength of the windings. The bidder shall state the impulse flash over values of the bushings & the calibration with settings for coordinating gap shall be given for the arrangement of the terminals. All the required type test reports as per relevant IS stated above for the bushings to be used shall be submitted along with the offer or have to confirm to submit during detailed engineering. The height of live part shall be so arranged that minimum clearance up to plinth shall be maintained as follow:

**66 kV - 4500 mm, 33KV/ 22 kV – 3800 mm, 11 kV - 3600 mm.**



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#### **5 FOUNDATIONS**

The transformers shall be erected on concrete foundations, which shall be laid by purchaser in time to have the foundations ready before the Transformers arrive at site. The foundation shall be of concrete masonry with reinforced steel as per requirement. The supplier shall furnish complete information regarding loading and maximum stress in the foundations etc. and the purchaser will design the foundations as per site conditions.

#### **6 COMPLETENESS OF CONTRACT**

All fittings, accessories, or apparatus, which may not have been specifically mentioned but which are useful or necessary for the efficient working of the transformer shall be deemed to be included in the contract and shall be provided by the supplier without any extra charge. The transformer with accessories shall be complete with all details whether such details are stated in the specification or not.

#### **7 TOOLS**

The bidder shall also, quote the prices for one set of special tools, if any. The Purchaser / Owner reserves the right to order for any quantity of tools, as may be deemed fit.

#### **8 INTERCHANGEABILITY**

All similar parts of the various transformers shall be inter-changeable as far as possible.

**Section – D (i)**

Data sheet 'A1'

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**1.0 POWER TRANSFORMER PRINCIPLE PARAMETERS**

1.1 The transformer and requirements shall conform to the following specific parameters.

Sr. No.	Item	Specification											
1	Type of power Transformer	3 Ph, Double copper wound, Core type, Transformer, Suitable for outdoor installation.											
2	Rated capacity	05 MVA, 10 MVA, 15 MVA or 20 MVA											
3	Type of mounting	On wheels, mounted on rails.											
4	System Frequency	50 HZ.											
5	Rated Voltage Ratio	66 / 11.55 kV or 66 / 23.1 kV or 33/11 KV											
6	Type of cooling	ONAN											
7	Method of connection	HV – Delta LV – Star											
8	Connection Symbol	Dyn 11											
9	System earthing	Neutral solidly grounded											
10	Transformer Neutral earthing	Directly earthed.											
11	Percentage impedance At rated MVA and normal tap.(± 10 % tolerance)	<table><tr><td>33/11 KV</td><td colspan="5">66 / 11.55 kV Or 66 / 23.1 kV</td></tr><tr><td>05 MVA 7.5%</td><td>05 MVA 8.0%</td><td>10 MVA 9.5 %</td><td>15 MVA 9.5 %</td><td>20 MVA 9.5 %</td></tr></table>	33/11 KV	66 / 11.55 kV Or 66 / 23.1 kV					05 MVA 7.5%	05 MVA 8.0%	10 MVA 9.5 %	15 MVA 9.5 %	20 MVA 9.5 %
33/11 KV	66 / 11.55 kV Or 66 / 23.1 kV												
05 MVA 7.5%	05 MVA 8.0%	10 MVA 9.5 %	15 MVA 9.5 %	20 MVA 9.5 %									

Section – D(i)

Data sheet 'A1'

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Sr. No.	Item	Specification			
12	Tap changing gear.				
	(i) Type	On LOAD			
	(ii) Class (kV)	66KV or 33KV as per HV Voltage			
	(iii) Provide on	HV winding for LV variation			
	(iv) Tap range	-5% to + 15% (looking from LV side)			
	(v) Tap Steps	1.25 %			
	(vi) Category of voltage variation	V F V V			
	(vii) Control	Manual with Local & Remote Selection			
	(viii) Tolerance in voltage ratio @ all taps.	± 0.5 %			
	(ix) Current rating of OLTC (Amp) Control cubicle to be supplied.	<b>For 66/11.55KV:</b> 200A for 05, 10 & 15 MVA and 300A for 20 MVA <b>For 33/11KV:</b> 150 A for 05 MVA By vendor			
13	Over voltage operating capability	10% over voltage of maximum Voltage			
14	Over Fluxing Required	Yes			
15	Max. Flux density at normal voltage, rated MVA & frequency	1.7 (Tesla)			
16	Insulation level for windings - tests	HV	HV	LV	LV
		72.5KV	33 KV	24KV	12KV
	(a) 1.2/50 Microsecond wave impulse withstand voltage (KVP)	350	170	150	90
	(b) Power Frequency withstand voltage (kV rms)	140	70	55	30
	(c) Separate source voltage test	140	70	55	30
	(d) Induced over voltage test	Twice the rated voltage (kV) of the winding at double the rated frequency.			

		Section – D (i) Data sheet 'A1' Sheet 3 of 5				
Sr. No.	Item	Specification				
17	Type of winding	HV Interleaved Type / Disc type With static end Rings at both ends.		LV Continuous disc type/ Layer Type		
18	(a) HV winding (b) LV winding	Uniformly insulated Uniformly insulated				
19	System short circuit level	25 kA for 3 sec				
20	Noise level at rated voltage & frequency	As per NEMA TR.I				
21	Permissible temp. rise over ambient temperature specified in Cl.1.1 (ii) (a) under section 'B' (i) of top oil measured by thermometer. (C <sup>0</sup> ) (ii) of winding measured by resistance (C <sup>0</sup> )	35  45				
21(A)	Maximum value of tan delta for transformer windings	1.0% at 20 °C				
21(B)	Minimum value of I R value of windings to earth and between windings –	10000 Mega Ohm at 27 °C.				
21(C)	P.I. Value (10 Min / 1 Min) of windings to earth and between windings –	1.2 to 2.2 (both inclusive)				
22 (A)	Bushing (Suitable for Heavily Polluted atmosphere)	For HV 66KV Wdg	For HV 66 KV Wdg	For LV 23.1KV Wdg	For LV 11.55KV & 11 KV	FOR LV Neutral
(i)	Rated Voltage class (KV)	72.5	72.5 KV	36KV	24KV	Details same as those for LV bushing of respective transformer
(ii)	Current Rating					
	05 MVA	400	400	NA	400	
	10 MVA	400	NA	630	630	
	15 MVA	400	NA	630	1000	
	20 MVA	400	NA	800	1600	
(iii)	Insulation Level					
	(a) Lighting Impulse withstand voltage (KVp)	350	350	175	90	
	(b) 1 Minute Power Frequency Voltage	140	140	70	55	

	withstand test					
	(c) Creepage Distance (mm)	1810	1810	900	600	
	(d) Maximum value of tan delta	0.7 % at 20 °C	0.7% at 20°C	N/A	N/A	
	(e) Type	OIP Condenser	OIP Condenser	Solid Porcelain	Solid Porcelain	
22 (B)	Minimum clearance (mm) <b>from live part including jumper to nearest earth potential shall be maintained as below. The same shall be shown in the clearance circle diagram during detailed engineering.</b> <div><div>(i) PH to PH</div><div>HV(66KV) HV(33KV) LV(23.1) LV(11.55)</div><div>790 350 330 270</div><div>(ii) PH to E</div><div>HV(66KV) HV(33KV) LV (23.1) LV(11.55)</div><div>690 320 280 270</div></div> Note :- Bare terminals on transformer bushing stem for connection to rigid bus bars or over head conductor.					
23	Terminal connectors HV (66 kV/33KV): Compression type bimetallic <b>aluminum alloy</b> / Copper Terminal Connectors suitable for ACSR panther / Zebra conductor having short time current rating of 25 kA for 3 sec. LV (11/22 kV): Copper threaded Terminal Connectors suitable for connecting 2/3/4 nos. 11 kV 240 mm <sup>2</sup> XLPE cable <b>or ACSR conductor having short time current rating of 25 kA for 3 sec.</b> Neutral bushing to earthing strip connection shall be through copper flexible strip of size 50 x 10 mm. (Connectors must withstand all short circuit currents, when bus fault occurs. They shall be duly tested at 25 kA currents for 3 sec. Type test certificate of connector should be enclosed with relevant detailed drawings, as stated in data sheet 'A1' of section 'D(i) A' Clamps & connectors.)					

	Section – D (i) Data sheet 'A1' Sheet 5 of 5	
Sr. No.	Item	Specification
24	Earthing Conductor-Material/size	Hot dip Galvanized steel 50 x 6mm as per IS:2629
25	(A) Type Test (i) Impulse Test (ii) Heat run test (B) Short Circuit Test (C) Additional Test I. Vacuum test on transformer tank of each rating as per CBIP- manual. II. Pressure test on tank of each rating of transformer III. Oil leakage test on complete assembled transformer IV. Degree of Protection V. PRD test VI. Capacitance & Tan Delta test VII. Tests on Air cell VIII. <b>Tests for any other item required under new technology / innovative solution</b>	Full wave and chopped wave on all three phases of HV & LV winding - <b>On 1 No. from each of lot of 5 for each of 66 kV &amp; 33KV class 05, 10, 15 &amp; 20 MVA transformers.</b> On 1 No. <b>from each of lot of 5 for</b> each of 66 kV & 33kV class 05, 10, 15 & 20 MVA transformers. (Special test) Of <b>offered or</b> higher rating, <b>same class</b> of transformer. On 1 No., each of 66 kV & 33KV class 05, 10, 15 & 20 MVA transformers. On 1 No., each of 66 kV & 33KV class 05, 10, 15 & 20 MVA transformers. On 1 No., each of 66 kV & 33KV class 05, 10, 15 & 20 MVA transformers. For MK box and RTCC panel For each size For each size On each of 05, 10, 15 & 20 MVA transformers For each of 05, 10, 15 & 20 MVA transformers <b>As per applicable standards</b>
<p><b><u>Important note for type tests:</u></b> Following type test reports as specified in IS: 2026 (amended up to date) shall be submitted for the offered class and rating of transformer, invariably with the bid. If bidder is unable to comply this requirement, following is acceptable:</p> <p>(1) Bidder shall submit at least one out of (a) Impulse Voltage Withstand Test (b) Heat run test for offered voltage class/ MVA rating transformer along with confirmation for balance test/s to be carried out before commencement of supply, without affecting delivery schedule, free of cost, duly witnessed by representative of NABL accredited laboratory, in the event of order;</p> <p>OR</p> <p>(2) Submit full type test report for the higher voltage class/ rating transformer along with confirmation for tests to be carried out on offered transformer, before commencement of supply, without affecting delivery schedule, free of cost, duly witness by NABL accredited laboratory representative, in the event of order.</p>		

*The type test reports shall not be older than FIVE years and shall be valid as on the last date of submission of bid.*

GETCO reserves right to pick up from field any transformer supplied against respective tender and get it tested at any of NABL accredited laboratory, for any of tests to ascertain any such guaranteed parameters. In the event of not meeting any or all such guaranteed parameters, bidder shall be liable to replace/attend such transformer (at discretion of GETCO), and shall have to borne all those expenses made for all the activities included there in, right from switching off the transformer to re-commission the same at any given substation. In such case no cost shall be borne by GETCO.

26	Transformer to be transported	Filled with oil or that filled with inert gas, along with reducer connection, pressure gauge is preferred.
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**POWER TRANSFORMER**

Section – D (i)

Data Sheet A2

Sheet 1 of 1

1	POWER TRANSFORMER	* IS 2026	BS 171	IEC 76
2	FITTINGS & ACCESSORIES	* IS 3639		
3	CLIMATE PROOFING	* IS 3202	BS-CP-1014	
4	LOADING OF OIL IMMERSSED TRANSFORMER	* IS 6600	BS-CP-1010	IEC 354
5	OIL	* IS 335	BS-148	IEC 296
6	BUSHINGS	* IS 2099	BS 223	IEC 137
7	DEGREE OF PROTECTION	* IS 13947		
8	TESTS	* IS 2026	BS 171	IEC 76
9	TOLERANCE ON GUARANTEED PARTICULARS	* IS 2026	BS 171	IEC 76
10	BUCHHOLZ RELAY	* IS 3637		
11	ELECTRICAL INSULATION BY THERMAL STABILITY	* 1271	BS 2727	IEC 85
12	ON LOAD TAP CHANGER	IS 2026		IEC 214

**NOTES**

1. EQUIPMENT, ACCESSORIES, COMPONENTS / PARTS, RAW MATERIALS AND TEST SHALL IN GENERAL CONFORM TO IS / BS / IEC
- 2.\* Applicable standards.



**POWER TRANSFORMERS**

Section – D (i)

Data sheet – B

Sheet 1 of 8

**GUARANTEED TECHNICAL PARTICULARS****(to be filled by the Bidder)**

<b>SR. NO.</b>	<b>ITEM</b>
1.0	Transformer application / designation
2.0	Applicable standards
3.0	Quantity offered
4.0	Full load rating (MVA)
5.0	3 phase unit
6.0	Auto wound /two winding transformers/ Three winding transformers.
7.0	Rated no-load voltages :
	(a) HV kV
	(b) LV kV
7.1	Rated current.
	(a) HV Amp.
	(b) LV Amp.
8.0	Cooling for the transformer.
9.0	Guaranteed percentage Impedance at rated Current at the principle tap at 75 <sup>0</sup> C.
10.0	Efficiency at 75 <sup>0</sup> C, at unity p.f.
	(a) At full load %
	(b) At ¾ full load %
	(c) At ½ full load %
11.0	(a) Regulation at full load, 0.8 PF at 75 <sup>0</sup> C winding temperature.
	(b) Regulation at full load, at unity P.F.
12.0	Rated frequency (Hz)
13.0	External short circuit withstand capacity in view of specified system short circuit level (MVA)

**POWER TRANSFORMERS**

Section – D (i)

Data sheet – B

Sheet 2 of 8

**GUARANTEED TECHNICAL PARTICULARS****(to be filled by the Bidder)**

<b>SR. NO.</b>	<b>ITEM</b>				
14.0	Core :				
	(a) Material of core lamination				
	(b) Thickness of core plates (mm)				
	(c) Insulation of core lamination				
	(d) Insulation of core clamping plates				
	(e) Press board material & thickness				
	(f) Prime quality grade				
15.0	Winding connections :				
	(a) HV				
	(b) LV				
	(c) Vector group				
15.1	Type of winding	HV	HV	LV	LV
		(66 kV)	(33KV)	(23.1 kV)	(11.55 kV)
15.2	(i) Winding material				
	<b>(ii) Type of conductor</b>				
15.3	Cross sectional area				
16.0	Tapings on winding				
16.1	On-load/Off Load				
16.2	On-HV/LV winding				
16.3	Full power tapping range $\pm$				
16.4	For vfvv rating :				
	(a) Maximum voltage tapping and Corresponding voltage				
	(b) Maximum current tapping and Corresponding current				

**POWER TRANSFORMERS**

Section – D (i)

Data sheet – B

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**GUARANTEED TECHNICAL PARTICULARS****(to be filled by the Bidder)**

<b>SR. NO.</b>	<b>ITEM</b>
17.0	If ON load taps, specify details of OLTC gear.
17.1	Manual / automatic control
17.2	Remote / local control
17.3	For remote control, Remote control cubicle is in BIDDER'S scope of supply
17.4	Voltage class of the OLTC
17.5	Current rating of the OLTC
18.0	Winding insulation category : (a) HV uniform / non-uniform (b) LV uniform / non-uniform
19.0	Type & Material of axial coil supports HV LV
20.0	Type & Material of radial coil supports HV LV
21.0	Impulse voltage withstand 1.2/50 MICRO Second wave (a) HV (kV peak) (b) LV (kV peak)
22.0	Power frequency withstand voltage (dry and wet) (a) HV kV (rms) (b) LV kV (rms)

**POWER TRANSFORMERS**

Section – D (i)

Data sheet – B

Sheet 4 of 8

**GUARANTEED TECHNICAL PARTICULARS****(to be filled by the Bidder)**

<b>SR. NO.</b>	<b>ITEM</b>			
23.0	Guaranteed maximum temperature Rise :			
	(a) Oil (by thermometers) °C			
	(b) Winding (by resistance) °C			
24.0	Tank cover is conventional			
25.0	Minimum clearance height for lifting core and winding from tank (mm)			
26.0	Bushings :			
		HV	LV(11 kV)	LV(22kV)
	(a) Rated voltage class (kV)			
	(b) Rated current (Amp)			
	(c) 1.2/50 ms impulse voltage withstand (kVp)			
	(d) One minute power Frequency withstand voltage by Dry and wet (kV rms)			
	(e) Minimum clearance in air (mm)			
	(f) Minimum total creepage distance (mm)			
	(g) Quantity of oil in oil filled Bushings (Litre & Kgs.)			
	(h) Free space required at top for removal (mm)			
	(i) Capacitance (in pF)	:		
	(j) Tan Delta value in %	:		
	<b>(k) Type of bushing</b>	:		

## POWER TRANSFORMERS

Section – D (i)

Data sheet – B

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SR. NO.	ITEM		
27.0	Maximum guaranteed Load loss at rated current at 75 <sup>0</sup> C winding temperature without any positive tolerance (KW) <b>(Bidder is not allowed to enter any of loss figures.)</b>	As per clause 2.14 of this specification	
28.0	(a) Maximum guaranteed No load losses (core loss and dielectric loss) at 100% rated voltage and frequency, without any positive tolerance (KW) <b>Bidder is not allowed to enter any of loss figures.)</b>  (b) Stray eddy losses as % of total losses :  (c) <b>Measures taken to achieve minimum stray losses</b> :	As per clause 2.14 of this specification	
29.0	Guaranteed no-load current : (a) When excited from LV side at 100% rated voltage (Amp) (b) When excited from LV side at 110% rated voltage (Amp)		
30.0	Maximum flux density : (a) At rated voltage (Tesla) (b) At 110% rated voltage (Tesla)		
31.0	Over fluxing capability		
32.0	Current density	HV – A/cm <sup>2</sup>	LV – A/cm <sup>2</sup>
	(a) Guaranteed		
	(b) Current density as per short circuit calculation submitted		
	(c) Current density as per short circuit test		
32.1	Rollers for transformer.		
	(a) Plain / flanged		
	(b) Unidirectional / bi-directional		
	(c) Quantity		
	(d) Gauge (s) mm		
	(e) Anti earth quake clamps provided		

## POWER TRANSFORMERS

Section – D (i)

Data sheet – B

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SR. NO.	ITEM
33.0	Vacuum withstand capability : main tank (mm of Hg)
34.0	All accessories supplied as specified Yes / No.
35.0	OLTC control scheme conforms to specification Yes / No
36.0	Weights
36.1	<i>(a) Net weight of the core lamination (Kgs.) (only CRGO) (tol. -2%) :</i>
	<i>(b) Net core area (sqcm) :</i>
	<i>(c) Total weight of core with clamps :</i>
36.2	Net weight a) HV Kg
	Of copper b) LV Kg
	Windings c) Total Kg.
36.3	<i>Net (bare) weight of copper (Kgs.) (tol. -2%) :</i>
	<i>a) H.V. (Kgs.):</i>
	<i>b) L.V. (Kgs.):</i>
	<i>c) Total (Kgs.):</i>
36.4	<i>Weight of complete core and windings:</i>
36.5	Oil Kg.
	Litre.
36.6	Tank, coolers and fittings Kg.
36.7	Total weight of transformer Kg
36.8	Untanking weight, Kg.
37.0	Material & sheet metal thickness of transformer tank (mm)
	a) TOP
	b) BOTTOM
	c) SIDE
37.1	Thickness of Indoor OLTC control cabinet (mm)
37.2	Thickness of Outdoor OLTC control cabinet (mm)
38.0	On-load tap changer
38.1	Make
38.2	Type designation
38.3	Suitable for auto/electrical / manual operation

**POWER TRANSFORMERS**

Section – D (i)

Data sheet – B

Sheet 7 of 8

**GUARANTEED TECHNICAL PARTICULARS****(to be filled by the Bidder)**

<b>SR. NO.</b>	<b>ITEM</b>
38.4	Rated voltage (KV)
38.5	Rated current (Amp)
38.6	Number of steps
38.7	Step voltage (Volts)
38.8	Rated voltage of drive motor (Volts)
38.9	Rated voltage of control circuit (Volts)
38.10	Time to complete tap changing Operation from any one step to next higher or lower step on manual operation through push button (Sec)
39.0	List of routine tests to be carried out
39.1	List of acceptance tests to be carried out
40.0	List of other tests which will be carried out against extra price
41.0	Drawing number of the general outline drawing enclosed with the Bid showing the transformer with accessories.
42.0	Material of gasket Grade of gaskets
43.0	Cooling calculation shall be submitted
44.0	Radiator (a) Total Nos. of sections (b) Size of radiator
45.0	Neutral bar support insulator Type & BIL

**POWER TRANSFORMERS**

Section – D (i)

Data sheet – B

Sheet 8 of 8

**GUARANTEED TECHNICAL PARTICULARS****(to be filled by the Bidder)**

<b>SR. NO.</b>	<b>ITEM</b>		
46.0	Minimum I R Value in Mega Ohms HV to Earth  LV to Earth  HV to LV		
<b>47.0</b>	<b>Breather details</b>	<b>Main tank</b>	<b>OLTC</b>
	Type :		
	Capacity :		
48.0	Details of Turret :		
	Height :		
	Diameter :		
	Clearance maintained between and lead nearest earth part :		
<b>49.0</b>	<b>Additional details in respect of new technology or innovative solutions, if Offered, against clause no. 1.0.4 shall be Mentioned here.</b> :		

**Signature of Bidder****Date :-**



**POWER TRANSFORMERS**

Section – D (i)

Data sheet – C

Sheet 1 of 4

Information to be furnished by the vendor, after the award of contract before commencement of supply.

<b>Sr. No.</b>	<b>Item</b>
1.0	Percentage Impedance at principle tap.
2.0	Efficiently at 75 <sup>0</sup> C winding temperature.
2.1	at 100% Full load
2.2	At 75% Full load
2.3	At 50% Full load.
3.0	Minimum efficiency & load at which it occurs.
4.0	Percentage regulation at full load @ 75 <sup>0</sup> C winding temperature
4.1	At unity power factor
4.2	At 0.8 power factor
5.0	Resistance per phase of
	HV winding : Ohms
	LV winding : Ohms
6.0	Conductor Area (sq.-cm)
	HV winding
	LV winding
7.0	Type of winding
	HV
	LV
10.0	Insulating material for interterm insulation
	HV winding
	LV winding
11.0	Insulating Material for interwinding insulation
	HV winding
	LV winding
12.0	Insulating material between

**POWER TRANSFORMERS**

Section – D (i)

Data sheet – C

Sheet 2 of 4

<b>Sr. No.</b>	<b>Item</b>
12.1	LV winding & core
12.2	Laminations of the core
13.0	Shipping details
13.1	Size of longest packages (Length x width x Height)
13.2	Weight of the largest package (tones)
13.3	Total gross weight to be handled (tones)
13.4	Total volume to be handled (cubic meters)
14.0	Make, size & type of valves
15.0	Make, Type, Dial size, Number of contacts & contact rating for the following
15.1	Magnetic oil level gauge.
15.2	Dial type thermometer
15.3	Winding temperature Indicator
15.4	Bachholz relay
	Make
	Type
	No of contacts
	Current rating
15.5	Oil surge relay
	Make
	Type
	No of contact
	Current rating
	Voltage rating
16.0	Control switches
	Make
	Type
	No of contact

**POWER TRANSFORMERS**

Section – D (i)

Data sheet – C

Sheet 3 of 4

<b>Sr. No.</b>	<b>Item</b>
17.0	Cubicle heater rating
17.1	Rating (KW)
17.2	No. of heaters provided in OLTC control cabinet
17.3	Cubicle Illumination lamps
17.4	Rating of each in watts
17.5	Nos of lamps
18.0	Motor starters
18.1	Make
18.2	Type
18.3	Range of setting for thermal overload protection
19.0	CONSERVATOR
19.1	Total oil volume of conservator (litres)
19.2	Volume of conservator between the height & the lowest levels of oil (litres)
20.0	Calculated time constants
20.1	For natural cooling
21.0	Thermal withstand capacity under full short circuit conditions in terms of number of times of occurrences of short circuit & corresponding anticipated age reduction in transformer life
22.0	Drawings
	The following drawing, shall be submitted for purchaser's approval
22.1	General outline drawing as submitted at the bidding stage but with binding dimensions & weight.

**POWER TRANSFORMERS**

Section – D (i)

Data sheet – C

Sheet 4 of 4

Sr. No.	Item
22.2	General outline drawing, showing plan, front, elevation & side elevation with all fittings & accessories locating dimensions of cable entries, earthing terminals, foundations / floor mounting details, jacking pads along with Bill of materials.
22.3	GA drawing of OLTC cabinet & RTCC panel
22.4	Marshaling Box : GA drawing & schematic wiring diagram.
22.5	Bushings, plan, elevation, terminal details make, type number, current & voltage rating, creepage distance and principle characteristics.
22.6	Rating & diagram plate
22.7	OLTC control circuits schematic circuit diagram & detailed wiring diagram with terminal numbers.
22.8	RTCC schematic wiring diagram.
22.9	Valve Schedule.
22.10	Radiator: GA drawing and cooling calculation thereof.
22.11	Short-circuit current calculation.

## **POWER TRANSFORMER ON LOAD TAP CHANGING GEAR**

Section – D (ii)

Data sheet – A1

Sheet 1 of 7

### **1.0 General Requirement**

1.1 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 shall be submitted with the bid. Information regarding the service, experience on the gear and a list of important users shall be furnished. The tap changer shall change the effective transformation ratio without producing phase displacement.

- (a) The current diverting contacts shall be housed in a separate oil chamber not communicating with the oil in main tank of the transformer.
- (b) The contacts shall be accessible for inspection without lowering oil level in the main tank and the contact tips shall be replaceable.
- (c) The Bidder shall indicate the safeguards in order to avoid harmful arcing at the current diverting contacts in the event of operation of the OLTC gear under over-load conditions of the transformer. Necessary tools and tackles shall be furnished for maintenance of OLTC gear.
- (d) 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 oil surge relay; with the trip contacts. The outlet of which shall be connected to a separate conservator tank.
- (e) 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.

## **POWER TRANSFORMER ON LOAD TAP CHANGING GEAR**

Section – D (ii)

Data sheet – A1

Sheet 2 of 7

- (f) Tap changer shall be so mounted that TOP cover or transformer can be lifted without removing connections between windings and tap changer.
- (g) Drive mechanism chamber shall be mounted on the tank in accessible position. It should be adequately ventilated and provide with anti-condensation metal clad heaters. All contactors, relay coils and other parts shall be protected against corrosion, deterioration due to condensation, fungi etc.
- (h) The control feature shall provide the following:
  - i) Local / remote selector switch mounted in the local control shall switch control of OLTC in the following manner:
    - (1) When the selector switch is in LOCAL position, it shall be possible to operate the RAISE / LOWER control switches specified under sr. NO. (ii) below. Remote control of RAISE / LOWER functions shall be prevented.
    - (2) When the selector switch in REMOTE position the local control cubicle mounted RAISE / LOWER switches specified under Sr. No (ii) shall be inoperative. Remote control of the raise lower function shall be possible from the control panel.

The LOCAL / REMOTE selector switch shall have atleast two spare contacts per position which are closed in that position but open in the other position.
  - ii) A RAISE / LOWER CONTROL SWITCH shall be provided in the Local Control Cubicle. The switch shall be spring loaded to return to the centre 'OFF' position and shall require movement to the RIGHT to raise the voltage of the transformer. Movement to the left shall lower the voltage. This switch shall be operative only when 'local / remote, selector switch is in "local" position. As an alternative to the

## **POWER TRANSFORMER ON LOAD TAP CHANGING GEAR**

Section – D (ii)

Data sheet – A1

Sheet 3 of 7

raise / lower Control switch, push button Shall be provided for the said purpose.

- iii) An OFF-ON tap changer control switch shall be provided in the OLTC local control cabinet for transformer. The tap changer shall be inoperative in the OFF positioning. 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.
- iv) Operating mechanism for on load tap changer shall be designed to go through one step or tap change per command. Subsequent tap changes shall be initiated only by a new 'ON' repeat command.
- v) On load tap changer shall be equipped with a time delay 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.
- (i) 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 over running of the mechanism under any condition.
- (j) Limit switches may be connected in the control circuit of the operating motor provided that a mechanical declutching mechanism is incorporated.
- (k) 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 drive mechanism chamber and shall be clearly marked for the purpose of identification.
- (l) A permanently legible lubrication chart shall be fitted within the driving mechanism chamber.

## **POWER TRANSFORMER ON LOAD TAP CHANGING GEAR**

Section – D (ii)

Data sheet – A1

Sheet 4 of 7

- (m) A five-digit counter shall be fitted to the tap changing equipment to indicate the number of operations completed.
- (n) All relays and operating devices shall operate correctly at any voltage between the limits specified.
- (o) It shall not be possible to operate the electric drive when the manual operating gear is in use.
- (p) It shall not be possible for any two controls to be in operation at the same time.
- (q) 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 / switch which may be required for remote tap position.
- (r) Operation from the local or remote control switch shall cause one tap movement only until position between successive operations.
- (s) All electrical control switches and the local operating gear shall be clearly labeled in a suitable manner to indicate the direction of tap changing.
- (t) Transfer of source failure of one AC supply shall not affect tap changing operation.
- (u) One number each of Oil Surge Relay and Pressure Relief Valve should be provided.

### **1.2 Manual control**

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



## POWER TRANSFORMER ON LOAD TAP CHANGING GEAR

Section – D (ii)

Data sheet – A1

Sheet 5 of 7

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

### 1.3 (a) Electrical control

This includes the followings:

- (j) Local Electrical control
- (ii) Electrical remote control from remote control panel. ***RTCC panel shall be either front or rear door opening. The requirement shall be informed during detailed engineering.***
- (c) The control circuits shall have the followings features:
  - (i) An interlock to cut off electrical control automatically upon recourse being taken to the manual control in emergency.
  - (ii) Reinforcement of the initiating impulse for a tap change, ensuring a positive completion once initiated to the next (higher or lower) tap.
  - (iii) Step-by-step operation 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.
  - (iv) An interlock to cut-out electrical control when it tends to operate the gear beyond either of the extreme tap positions.

## **POWER TRANSFORMER ON LOAD TAP CHANGING GEAR**

Section – D (ii)

Data sheet – A1

Sheet 6 of 7

- (v) An electrical interlock to cut-off a 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.
- (vi) Tap change in progress by means of an indicating lamp at the Purchaser's / owner's control panel & necessary contacts for this and for remote tap position indicator at purchaser's / owner's control panel shall be provided by the Bidder.
- (vii) Protection apparatus, considered essential by the Bidder according to specialties.
- (d) Remote Electrical Group Control

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

- (i) 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 either Master, Follower or Independent mode.
- (ii) Out of step relays with timer contacts shall also be provided to give alarm and indication in case of tap positions in all the transformers under group control being not in same position.
- (iii) 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 controls of the MASTER unit. Independent operation of the units

## **POWER TRANSFORMER ON LOAD TAP CHANGING GEAR**

Section – D (ii)

Data sheet – A1

Sheet 7 of 7

under FOLLOWER mode shall have to be prevented. However, the units under independent mode will be controlled independently.

(iv) FOLLOWER POSITION

If the selector switch is in FOLLOWER mode, control of OLTC shall be possible only from MASTER panel.

(v) INDEPENDENT POSITION

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

1.4 Type tests: Following test reports, as per IEC – 60214, should be submitted with the technical bid.

- a) Short Circuit current test
- b) Dielectric test
- c) Temperature Rise test
- d) Mechanical test
- e) Degree of Protection IP55 test on driving mechanism box.

**Signature of Bidder**

**Date:-**

**GUARANTEED TECHNICAL PARTICULARS  
ON LOAD TAPCHANGING GEAR  
(to be filled by the bidder)**

Section – D (ii)  
Data Sheet – B  
Sheet 1 of 2

<b>Sr. No.</b>	<b>Item</b>
1.0	Make
2.0	Type designation
3.0	Suitable for auto/electrical/manual operation YES / NO
4.0	Rated voltage (KV)
5.0	Rated current (Amps)
6.0	Step voltage (Volts)
7.0	Number of steps
8.0	Rated voltage of drive motor (V)
9.0	List of type tests carried out
10.0	Location of the taps with respect to the terminals of the tapped winding
11.0	Drawing or pamphlet-number of the technical and Descriptive particulars of the OLTC, enclosed with the Bid.

**GUARENTEED TECHNICAL PARTICULARS  
ON LOAD TAPCHANGING GEAR**

Section – D (ii)  
Data Sheet – B  
Sheet 2 of 2

<b>Sr. No.</b>	<b>Item</b>
12.0	Drawing number of the complete control schematic drawing enclosed with the Bid, along with a write-up of the scheme provided. YES / NO
13.0	Separate conservator and oil surge relay provided (YES / NO)
14.0	Local outdoor cabinet general arrangement drawing number (enclosed with the Bid).
15.0	Remote indoor control cabinet general arrangement drawing number (enclosed with the Bid.)
16.0	Quantity of oil in the OLTC chamber (Ltrs)
17.0	Capacity of OLTC conservator tank in Cu.mtr.

**Signature of Bidder**

**Date :-**

## CONTROL CABINET

Section – 'D' (iii)  
Data Sheet A1  
Sheet 1 of 5

### 1.0 GENERAL REQUIREMENT

#### 1.1 LOCAL OLTC CONTROL CABINET & REMOTE OLTC PANEL

- (a) (i) Each three phase transformer unit shall be provided with Local OLTC control cabinet, and remote OLTC panel.
- (ii) The cabinet and remote OLTC Panel shall be provided with non disconnecting stud type terminal blocks. Each of the terminal blocks in the above panels should have 20 % spare terminals exclusively for owner's / Purchaser's use. Necessary shorting of terminals shall be done at the local OLTC cabinet and remote OLTC panel.
- (iii) The Local OLTC control cabinet shall house all necessary devices meant for OLTC control and indication.
- (iv) Following cabling are specifically excluded from the scope of the Bidder. However, interconnection drawings for the same are to be submitted by the Bidder.
  - (i) Cabling between Remote OLTC panel to Local OLTC cabinet.
  - (ii) Cabling between Remote OLTC to purchaser's / owner's Panel.
  - (iii) Cabling between Local OLTC Cabinet to purchaser's / owners panel.
- (b) The sheet steel used shall be at least 2.6mm thick for indoor and 3mm thick for outdoor use. The degree of protection shall be IP 55 (FOR OLTC cabinet & Marshaling Box) & IP 54 (OLTC REMOTE CONTROL PANEL) in accordance with IS 13947. All the separately mounted cabinets and panels shall be free standing floor mounted type and have domed or sloping roof. Test reports of degree of protection for the panels & MK Box shall be submitted with the bid, in which the size and material of enclosures and gasket should be indicated.

(c) The temperature indicators shall be so mounted that the dials are not at height more than 1600 mm from ground level. Glass door of suitable size shall be provided for convenience of reading.

(d) A space heater and cubicle lighting with ON-OFF switch shall be provided.

(e) TERMINAL BLOCKS

(i) The terminal blocks to be provided shall be fully enclosed with removable covers and made of molded, non inflammable plastic material with block and barriers molded integrally. Such block shall have washer and biding nut bolts for external circuit wire connections, a white marking strip for circuit identification and molded plastic cover.

All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring.

(ii) All internal wiring to be connected to the external equipment shall terminate on terminal blocks, preferably vertically mounted on the side of each panel. The terminal blocks shall be 1100 V grade and have 10 amps continuous rating, molded piece, complete with insulated barriers, non-disconnecting stud type terminals, washers, nuts and lock nuts. Terminal block design shall include a white fiber marking strip with clear plastic, slip on / clip on terminal cover. Markings on the terminal strips shall correspond to wire number and terminal numbers on the wiring diagrams.

(iii) At least 20% spare terminals shall be provided on each panel and these spare terminals shall be uniformly distributed on all terminal blocks.

(iv) Unless otherwise specified, terminal blocks shall be suitable for connecting the minimum of one no. 2.5mm<sup>2</sup> copper conductors on each side.

- (v) There shall be a minimum edge to edge clearance of 250mm between the first row of terminal blocks and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150mm.
- (vi) Arrangement of the terminal block assemblies and the wiring channel within the enclosure shall be such that a row of terminal blocks 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 the wiring duct shall be reserved for the purchaser's / owner'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 450mm intervals for support of incoming cables.
- (vii) The number and sizes of the owner's / purchaser's multicore incoming cable will be furnished to the Bidder after placement of the order.
- (f) The gaskets shall be of neoprene rubber.

## 1.2 BOLTS & NUTS

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

## 1.3 WIRING AND CABLING

- (a) All external cabling will be carried out by purchaser / owner based on wiring diagram & interconnection schedule to be supplied by the bidder. Cable box / sealing end shall be suitable for following types of cables: -
  - (i) 415 Volt power : 1100 Volt grade PVC insulated stranded copper conductor cable with Armour.
  - (ii) Control : 1100 Volt grade PVC insulated 7/0.737mm stranded copper conductor cable with armour.



- (b) Compression type cable connector shall be provided for termination of power and control cables.
- (c) Not more than 2 wires shall be connected to one terminal. Each terminal shall be suitable for connecting two 7/0.737mm stranded copper conductors from each side.
- (d) All internal wiring shall be securely supported neatly arranged, readily accessible and connected to equipment terminals and terminal blocks.
- (e) Engraved code identification plastic ferrules marked to correspond with schematic diagrams 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.

#### 1.4 Local OLTC Control Cabinet

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

- (i) A contractor with thermal overload devices for controlling the AC auxiliary supply to the OLTC motor.
- (ii) Cubicle light with door switch.
- (iii) Space heaters to prevent condensation of moisture.
- (iv) Padlocking arrangement for hinged door of cabinet.
- (v) Cable terminal glands for power and control cables to the OLTC gear.

#### 1.5 Remote OLTC Control Equipment

- (a) Equipment to be mounted in RTCC: Control and signal devices required to be mounted as follow:

- (i) Actuating switch for electrical raise / lower control
- (ii) Remote tap position indicator.
- (iii) Signal lamps for
  - (a) Tap changer in progress
  - (b) Tap changer out of step
  - (c) Tap changer motor trip
  - (d) Tap changer Supply ON
  - (e) Tap changer Supply OFF
- (iv) Annunciator: A 6 window microprocessor based Annunciator shall be provided for following fascia:
  - 1. AC SUPPLY FAIL
  - 2. OUT OF STEP RELAY OPERATED
  - 3. TAP CHANGER MOTOR TRIP
  - 4. TAP CHANGE INCOMPLETE
  - 5. SPARE
  - 6. SPARE
- (b) Remote OLTC Control panel (to be supplied by the Bidder): The auxiliary devices for remote electrical control of the OLTC except those mentioned in a 1.3 (a) above shall be housed in a separate panel to be placed in the control room. The size shall be 2312 x 600 x600 mm and colour will be of shade 631 of IS:5.

## CONTROL CABINET SPECIFIC REQUIREMENT

Section – 'D' (iii)  
Data Sheet A2  
Sheet 1 of 2

Sr. No.	Particulars	
(A)	GENERAL	
(i)	DESIGNATION	MARSHALING BOX, OLTC LOCAL CABINET, OLTC REMOTE PANEL FOR POWER TRANSFORMERS
(ii)	LOCATION & DEGREE OF PROTECTION (As per IS 13947)	(a) IP 54 FOR INDOOR REMOTE CONTROL PANEL  (b) IP 55 FOR OLTC CABINET & MARSHALING BOX
(iii)	FINISHING COLOUR	OUTSIDE LIGHT BATTLESHIP GRAY SHADE 631 AS PER IS 5 INSIDE GLOSSY WHITE
(iv)	CABLE ENTRY	BOTTOM
(v)	SHORT CIRCUIT LEVEL KA	25
(vi)	THICKNESS mm	2.6 FOR INDOOR & 3.0 FOR OUTDOOR
(vii)	Dimensions of RTCC panel (mm)	600 x 600 x 2312
(B)	MAIN BUS BARS & ASSOCIATED EQUIPMENT	
(i)	DESIGN AMBIENT TEMPERATURE	50°C
(ii)	CONTINUOUS CURRENT RATING (AMP)	BY BIDDER

## CONTROL CABINET SPECIFIC REQUIREMENT

Section – 'D' (iii)  
Data Sheet A2  
Sheet 2 of 2

Sr. No.	Particulars	
(iii)	(i) SHORT TIME CURRENT DURATION (SEC)	THREE
	(ii) SHORT TIME CURRENT (KA rms)	25
(C)	AUXILIARY POWER SUPPLY	415V, 3 PH, 50HZ
(i)	FOR POWER DEVICES, DRIVE MOTORS, ETC.	DUPLICATE FEED PROVIDED
(ii)	SPACE HEATER / LIGHTING SUPPLY	240V, 1PH 50HZ
(iii)	CONTROL SUPPLY VOLTAGE	110V, SINGLE PHASE AC AND 110V, DC FOR ANNUNCIATION
(D)	CONTROL SCHEMATIC FOR CONTROL CABINET	NOT ENCLOSED NOT ENCLOSED
(E)	PURCHASER'S EARTHING CONTROL MATERIAL SIZE (mm)	GALVANISED STEEL STRIP 25 X 4
(F)	CONTROL SWITCHES WITH NAC / NAT CONTACTS	REQUIRED
(G)	NO OF CONTROL SWITCHES & NO OF CONTACTS	TO SUIT CONTROL SCHEME
(H)	ANNUCIATOR	REQUIRED FOR OLTC REMOTE PANEL

## CONTROL CABINET APPLICABLE STANDARD

Section – 'D' (iii)  
Data Sheet A3  
Sheet 1 of 1

Sr. No.	Particulars	
1	SWITCHGEAR GENERAL REQUIREMENTS	* IS-4237
1	AIR BREAK SWITCHES	* IS-4047 IEC-408
2	FUSES	* IS-2208 IEC-259-1
3	CONTACTORS	* IS-2959 IEC-158-1
4	STARTERS	* IS-1822 IEC-292
5	INDICATING INSTRUMENTS	* IS-1248 IEC-51
6	PANEL WIRING	* IS-375 IEC
7	DEGREE OF PROTECTION	* IS-13947

### NOTES

- 1 EQUIPMENT, ACCESSORIES, COMPONENTS / PARTS, RAW MATERIALS AND TESTS SHALL, IN GENERAL, CONFORM TO IS / IEC
- 2\* APPLICABLE STANDARD

**CONTROL CABINET**  
**GUARANTEED TECHNICAL PARTICULARS**  
(to be filled by the Bidder)

Section – D (iii)  
Data Sheet - B  
Sheet 1 of 2

<b>SR. NO.</b>	<b>ITEM</b>
1.0	Manufacturer's name and Country
2.0	Indoor/ outdoor application
3.0	Design ambient air temperature (C <sup>0</sup> )
4.0	Thickness of sheet steel for outdoor & indoor panels (mm)
5.0	Degree of protection provided (as per IS : 13947 or equivalent)
6.0	Bill of material for various equipment giving make, type, ratings etc. enclosed (YES /NO)
7.0	Colour of finish paint a) Outside b) Inside
8.0	Temperature rise at rated current over specified ambient temp of 50 <sup>0</sup> C (C <sup>0</sup> )
8.1	Continuous current rating (Amp)
8.2	Three second current rating (KA) (short time)
9.0	Control wiring
9.1	Material of conductor for various circuits

---

<b>SR. NO.</b>	<b>ITEM</b>
9.2	Size of conductor for various circuits mm <sup>2</sup>
9.3	Conductor – Solid / Stranded
10.0	Terminal Blocks
10.1	Make
10.2	Current rating (a) Power terminals (Amp) (b) Other terminals (Amp)
11.0	All tests as specified in Section-D (ii) DATA SHEET A1 Specification for the control panel will be carried out Yes / No.
12.0	Space heater rating (Watts)
13.0	Material and size of Gasket
14.0	Size of RTCC panel
15.0	Make & type of Annunciator

---

**Signature of Bidder**  
**Date :-**

## **CONTROL CABINET**

Section – D (iii)  
Data Sheet - C  
Sheet 1 of 1

### **DATA TO BE FURNISHED BY THE VENDOR AFTER THE AWARD OF CONTRACT**

1. Bill of material for all the equipment
2. Control cabinet drawing showing outline dimensions, floor openings, floor / wall / pedestal fixing arrangements, weights, Front view, inside view showing the mounting arrangement of various equipment.
3. Schematic diagram of control cabinet.
4. Interconnecting drawing showing the PURCHASER'S external cable connections to the control cabinet.
5. MANUFACTURER'S descriptive literature on various equipment mounted on control cabinet.
6. Cabinet internal wiring diagram (This drawing shall be submitted only for information and records and shall be based on a approved schematic drawing. The correctness of the drawing shall be the responsibility of vendor).
7. Test certificates for the control cabinet and the various equipment mounted therein.

#### **NOTE :-**

The VENDOR should allow at least three weeks time in his manufacturing schedule for approval of the drawing by the PURCHASE.



## CLAMPS & CONNECTORS GEN REQUIREMENT

Section – D (iii)

Data Sheet – A1

Sheet 1 of 1

### 1.0 TERMINAL CONNECTOR

- 1.1 Bushing terminal shall be provided with bimetallic terminal connectors for HV & LV, of approved type and size, for connection of external parts. The terminal connectors offered must have been type tested as per IS: 5561. ***HV terminal connector shall be bimetallic with STC rating of 25 kA for 3 sec.*** Copper threaded Terminal Connectors suitable for connecting 2/3/4 nos. 11 kV 240MMSQ XLPE cable / ***ACSR conductor*** as required. **Neutral bushing to earthing strip connection shall be through copper flexible strip of size 50 x 10 mm.**
- 1.2 All castings of the terminal connectors shall be free from holes, surface blisters, cracks & cavities. All sharp edges and corners shall conform to designation A6 to IS : 617.
- 1.3 No part of a clamp shall be with less than 10mm thickness.
- 1.3.1 All the bolts and nuts shall not be provided of size less than 12 mm. Check nuts shall be provided for all the bolts.
- 1.4 All ferrous parts shall be hot dip galvanised, as per IS: 2629.
- 1.5 For, bimetallic terminal connector, copper alloy liner of minimum thickness of 2 mm, shall be cast integral with aluminum body.
- 1.6 All current carrying parts shall be designed & manufactured to have minimum resistance.
- 1.7 The short time rating of terminal connectors shall be 25 kA for 3 sec.
- 1.8 The general arrangement drawings for HV terminal connectors and LV connectors to be given as per item sr. no. 23 of principle parameters.
- 1.9 The type test report of accredited laboratory shall be submitted.

## CLAMPS & CONNECTORS SPECIFIC REQUIREMENTS

Section – D (iv)  
Data Sheet – A2  
Sheet 1 of 1

### (A) EQUIPMENT TERMINAL / CONDUCTOR DETAILS

- |     |             |                                                 |
|-----|-------------|-------------------------------------------------|
| (a) | APPLICATION | FOR POWER TRF BUSHING<br>TERMINAL               |
| (b) | TYPE        | BIMETALLIC ALUMINIUM<br>DESIGNATION A6 – IS 617 |
| (c) | QUANTITY    | AS PER NUMBER OF<br>TERMINALS BROUGHT OUT       |

### (B) EQUIPMENT TERMINAL / CONDUCTOR DETAILS

- |       |                                                         |                                                                                                                               |
|-------|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| (i)   | MATERIAL                                                | ALUMINIUM ALLOY                                                                                                               |
| (ii)  | EQUIPT TERM SIZE / SKETCH,<br>IF ANY                    | BY BIDDER                                                                                                                     |
| (iii) | CONDUCTOR NAME                                          | Panther / Zebra FOR HV & 22 kV and 3/4X240<br>MM <sup>2</sup> XLPE CABLE or <b>ACSR conductor</b> for 11 / 22 kV as required. |
| (iv)  | OVERALL DIAMETER IN (mm)                                | AS ABOVE                                                                                                                      |
| (v)   | CONTINUOUS CURRENT<br>RATING (Amp)                      | TO MATCH WITH TRF<br>CURRENT RATING                                                                                           |
| (vi)  | MAX TEMPERATURE RISE<br>OVER REF AMBIENT C <sup>0</sup> | 45 <sup>0</sup>                                                                                                               |

**CLAMPS & CONNECTORS**

Section – D (iv)  
Data Sheet – A3  
Sheet 1 of 1

<b>SR. NO.</b>	<b>PARTICULAR</b>	<b>REF OF STANDARD</b>
1	FITTINGS FOR ALUMINIUM AND STEEL CORED ALUMINIUM CONDUCTORS FOR OVERHEAD LINES	* IS 2121 BS 3288 IEC
2	ELECTRIC POWER CONNECTORS	* IS 5561 BS 159 IEC
3	HOT DIP GALVANISED PROCESS	* IS 2629 BS 729 IEC
4	ACSR CONDUCTORS	* IS 398 BS IEC

**NOTES :-**

- 1 EQUIPMENT, ACCESSORIES, COMPONENT, PARTS, RAW MATERIAL, TEST ETC SHALL IN GENERAL CONFORM TO IS / BS / IEC
- 2 TYPE BIMETALIC
- 3\* APPLICABLE STANDARDS

**CLAMPS & CONNECTORS (for HV & LV)**  
**GUARANTEED TECH PARTICULARS**  
 (To be filled by the Bidder)

Section – D (iv)  
 Data Sheet - B  
 Sheet 1 of 2

SR. NO.	ITEM	HV	LV
1.0	Bidder's name and address		
1.1	Manufacturer's name and address		
2.0	Applicable standards		
3.0	Application		
4.0	Type (Bimetallic compression type – HV) (Bimetallic compression type – 22 kV) (Copper Threaded type – 11 kV)		
5.0	For connection to		
5.1	Conductor size and arrangement		
5.2	Equipment terminal size and arrangement		
6.0	Material (state percentage composition of constituents and impurities present)		
6.1	Clamp body		
6.2	Bolts and nuts(including check nuts)		
6.3	Spring washers		
6.4	Liners		
7.0	Rated current		
8.0	Maximum temperature rise over Reference ambient temperature (C <sup>0</sup> ) (specified in project information when carrying rated current)		
9.0	Rated terminal load (Kg)		
9.1	Factor of Safety		
10.0	Minimum thickness of any part (mm)		

<b>SR. NO.</b>	<b>ITEM</b>
11.0	Weight of connector complete with Hardware (Kg)
12.0	Matching accuracy for matching surfaces maintained or not
13.0	Service – Indoor / Outdoor
14.0	Manufacturer's drawing no. (for each type) <b>(Drawings shall be submitted with technical bid)</b>
15.0	Type Tests
15.1	Whether type tests already carried out (YES / NO)
15.2	If yes, test certificates enclosed (YES / NO)
15.3	Details of type tests to be carried out
16.0	List of routine tests to be carried out by the BIDDER
17.0	Description of testing facilities for carrying out
17.1	Mechanical test
17.2	Heat run test
17.3	Material composition test
17.4	Test for checking blow holes, cracks etc.
18.0	For the above mentioned testing facilities, please indicate name and address

**Signature of Bidder**  
**Date :**

**Section – 'E' (i)**

Sheet 1 of 4

**1.0 Documentation**

- 1.1 (A) (i) The bidder shall furnish along with the bid the typical dimensional drawings of transformer & all other accessories.
- (ii) The drawings shall include the following information
- (a) Dimensions
  - (b) Tolerances on dimensions
  - (c) Material designation used for different components with reference to standards.
  - (d) Fabrication details, such as welds, finishes and coatings.
  - (e) Catalogue or part numbers for each component & total assembly with bill of materials.
  - (f) Identification marking
  - (g) Weight of individual components and total assembled weight.
- 1.1 (B) The successful bidder shall submit the drawings as listed under Sr. No. 22 of the data sheet C of section D (i), for approval of purchaser / owner.
- The time of submission of drawings shall be indicated in the purchase order
- 1.1 (C) General
- (i) All dimensions in drawings shall be in metric units unless, otherwise specified
  - (ii) All drawings shall indicate the following
    - (a) Name of the purchaser
    - (b) Purchase order No / Contract No.
    - (c) Title of the drawing
    - (d) Date of drawing
    - (e) Scale
    - (f)

- (g) Vendor's / Contractor's drawing No.
- (h) Signature of the responsible representative of vendor/  
Contractor

- (iii) Instruction manual shall be written in English language unless otherwise specified. It will contain the instructions for erection, commissioning & operation.

## 2.0 QUALITY ASSURANCE PLAN

The bidder shall invariably furnish following information's along with his offer, failing which his offer shall be liable for rejection. Information shall be separately given for individual type of equipments offered.

- i) QAP for incoming material, in process and final checks and testing.
- ii) Statement giving list of important raw materials, names of sub suppliers for the raw materials, list of standard according to which the raw materials are tested. List of tests normally carried out on raw materials in presence of bidder's representatives, copies of test certificates.
- iii) Information and copies of test certificates as in (i) above in respect of bought out accessories.
- iv) List of manufacturing facilities available.
- v) Level of automation achieved and list of areas where manual processing exists.
- vi) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- vii) Special features provided in the equipment to make it maintenance free.
- viii) List of testing equipments available with the supplier for final testing of transformer specified and test plant limitation, if any, for the special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in 'The schedule of divinations' for specified test requirements.
- ix) **Field Quality Plan shall be submitted with the technical bid.**

Section – 'E' (i)

Sheet 3 of 4

2.1 Information's and Type Test Certificates of Raw Materials and Bought out accessories:

The successful bidder shall within 30 days of placement of order, submit following information to the purchaser:

- i) List of raw materials as well as bought out accessories and the names of sub-suppliers selected from the list furnished along with offer.
- ii) Type test certificates of the raw material and bought out accessories.

2.2 Routine Test certificate of bought out accessories etc.

The successful bidder shall present on demand the routine test certificate of bought out accessories and central excise passes for raw material viz. Oil, copper, aluminum, conductors, insulating material & core material at the time of routine testing of the fully assembled equipment.

2.3 Quality Assurance of Accessories:

The performance test should be carried out by the manufacturer on all the accessories (100% inspection). This verification should be carried out on receipt of accessories at store.

2.4 Quality Assurance of Raw Materials:

The physical verification of bought out items viz. CRGO sheet, press pan, tank, all bought out items, windings, etc. should be carried out by the manufacturer of the power transformer and test them either internally or at other laboratory to correlate the results with those of test certificate received from the original manufactures. This will be useful for design as well as analysis in the event of the failure of transformer.

3.0 GUARANTEE:

The bidder shall furnish confirmations / guarantee for the following:



Section – 'E' (i)

Sheet 4 of 4

- (1) Quality and strength of material to be used
- (2) The bidder shall guarantee for satisfactory operation of the complete transformer for 36 months from the date of commissioning of the same or 42 months from the date of receipt of transformer at site whichever is earlier.
- (3) The bidder shall fill in the required details against each parameter described under Guaranteed Technical particulars. (Data sheet 'B' of Section 'D') It may be noted that the service guarantee would be applicable even when, the transformers are operated through any other agency, fixed by the purchaser/owner.

## TEST & INSPECTION

### 1.0 TESTS :

#### 1.1 TYPE TESTS & SPECIAL TEST:

The equipment offered shall be fully type tested and tested for special tests as per relevant standards **as per cl. 25 Section – D(i) sheet 5 of 5.**

Equipment offered shall have all Type Test Certificates from accredited laboratory (accredited based on ISO/IEC Guide 25 / 17025 or EN 45001 by the National accrediting body of the country where laboratory is located), as per IEC / IS / technical specification, **the type test reports shall not be older than FIVE years and shall be valid as on the last date of submission of bid.**

For any change in the design / type already type tested / tested for special test and the design / type offered against this bid, the purchaser reserves the right to demand repetition of same of all type tests and special test without any extra cost on the first or any one unit of any rating.

#### 1.2 Acceptance & routing tests:

All acceptance tests, as stipulated in the relevant standards, shall be carried out by the supplier in the presence of purchasers. ***All the routine / acceptance tests shall be carried out on transformer filled with oil to be supplied and fitted with all accessories to be supplied with transformer.***

## 1.3 Additional Tests :

All required Additional tests shall be carried out in the presence of purchaser's representative at no extra cost to the purchaser. **Also HV bushings shall be tested for measurement of Tan Delta value and capacitance at 10 kV and recorded.**

1.4 The bidder shall submit the type test reports for the type tests carried out as per IS 5561 (latest edition) on terminal connectors of HV side and LV side.

## 1.5 Tests for oil:

**Sample shall be taken from each lot of oil to be used, in presence of GETCO representative and shall be tested from NABL accredited laboratory for following tests:**

- 1) Specific Resistivity
- 2) Kinematic Viscosity
- 3) Total acidity
- 4) Tan delta
- 5) Water content in ppm.
- 6) Dissolved Gas Analysis

Before commissioning the transformer at site in presence of representative / commissioning engineer of successful bidder of transformer, 2 Nos. joint sample as per relevant IS may be collected and sealed. One sample will be sent for testing as per relevant IS **including all above 6 tests at NABL accredited laboratory** to confirm the quality of transformer oil and second sample will be preserved. In case of disputes about results of first sample, 2<sup>nd</sup> sealed sample should be got tested at any other approved test house by GETCO & results shall be binding to vendors.

2.0 Successful vendor shall have to offer transformer tank of each rating of transformer for vacuum and pressure test as per CBIP Manual (latest edition).

## 3.0 TEST REPORTS

3.1 After conducting type test referred above, three sets of certified type tests reports shall be submitted for approval prior to dispatch of the equipment. The equipment shall be dispatched only when all the required type & routine tests have been carried out & the test reports have been approved by the purchaser / owner.

3.2 Three copies of the test reports for the tests carried out on ancillary apparatus / shall be furnished to the owner / purchaser for approval prior to dispatch.

- 3.3 Three copies of test certificate shall be submitted for tests on auxiliary equipment as per relevant standard.

#### 4.0 INSPECTION

- 4.1 The owner / purchaser shall have access at all times to the works and all other places of manufacturer / vendor where the transformers are being manufactured and vendor shall provide all facilities for unrestricted inspection at his works, raw materials, manufacture of all accessories and for conducting necessary tests.
- 4.2 The successful bidder shall intimate the owner / purchaser, In advance, of the time of starting and progress of manufacture of the equipment in its various stages, so that arrangements can be made for inspection.
- 4.3 The acceptance of any quantity of equipment shall in no way relieve the vendor of his responsibility for meeting all the requirements at this specification & shall not prevent subsequent rejection, if such equipments are later, found to be defective.
- 4.4 The successful bidder shall submit the following during commencement period.
- i) Name of raw material as well as bought out accessories and the names of sub suppliers selected from those furnished along with the offer.
  - ii) Type test certificate of the raw material bought out accessories.
  - iii) Quality assurance plan with hold points for purchaser's inspection.
- 4.5 The successful bidder shall submit the routine test certificate of bought out items & raw materials at the time of routine testing of the fully assembled equipment.

## 5.0 TESTING DURING MANUFACTURING STAGE :

5.1 The manufacturer of the power transformer should keep records of the tests carried out during manufacturing stage, in detail for the checks / test carried out during assembling / manufacturing of the transformers. The manufacturer should keep the systematic record for complete drying out process, covering various parameters for the power transformer.

### 5.2 INSTRUMENTS / EQUIPMENTS

The manufacturer should keep the precise and accurate measuring instruments / equipments. The periodical calibration should be carried out of all the instruments / equipments used for the measurement during tests and for assessing the various properties of the material and accessories. The proper record of the same should be maintained during manufacturing stage and shall be shown to the inspecting officer on demand.

## 6.0 PAINTING

The transformer will be applied with one coat of epoxy red oxide paint as per IS : 104 and one each finishing coats of epoxy & enamel paint conforming to shade 631 of IS 5, after due sand blasting treatment on tank. An additional coat of synthetic paint will also, be given to minimize the chance of decomposition of epoxy in the outside atmosphere. The minimum total thickness of paint shall not be less than **80** microns. The same paint shall also be applied to main equipment & accessories. Transformer tank inner surface shall also be painted with one coat of epoxy red oxide paint as per IS: 104 and one each finishing coats of oil resistive paint conforming to glossy white shade of IS 5.

## **PACKING & TRANSPORT INSTRUCTION**

Section – E (iii)

Sheet 1 of 1

### **1.0 PACKING**

1.1 The equipment shall be packed in crates, suitable for vertical / horizontal transport as the case may be, and suitable to withstand handling during transport & storage during transit. The bidder shall be responsible for any damage 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 / item found short inside the packing cases shall be supplied by the bidder without any extra cost.

1.2 Each consignment shall be accompanied by a detailed packing list, containing the following information.

- (a) Name of consignee.
- (b) Details of consignment
- (c) Destination
- (d) Total weight of consignment
- (e) Sign showing upper / lower side of the crate
- (f) Handling & unpacking Instructions
- (g) Bill of material indicating Contents of each package

## ERECTION & COMMISSIONING

Section – E (ii)

Sheet 1 of 2

### 1.0 ERECTION

- 1.1 Transformer shall either be erected by the purchaser's engineer or the work may be entrusted to the vendor or any other approved agency. For such work, the responsibility for the proper working of the transformer shall be that of the vendor. The supplier shall be at liberty to depute his engineer to site when the erection work is under taken by the purchaser. The supplier shall be informed accordingly.

When the erection work is entrusted to the vendor, he shall arrange for taking delivery at site (if required), Transport to & from the storage space arranged by the GETCO, and complete erection & commissioning of transformers after testing.

Two final coats of special paint shade 631 of IS: 5 at site should be applied, if required. For this purpose the bidder shall quote his charges in the following manner.

- i) On lump sum basis including labour, spares tools etc but excluding the oil filter which will be provided free of cost by GETCO for drying out operations.
- ii) On monthly or daily basis for the service of supervision erection staff.

In all cases, free furnished quarters with free water, electricity and medical help near the site of work shall be provided upon the availability of the same to the supervisory erection staff only.

"The period for erection for each transformer should be stated in the offer".

Electricity for erection work shall also be provided free of charge from nearest distribution point.

Meggar of 1000V will be made available free of charge by purchaser. If vendor / agency has higher range of Meggar, he must make his own arrangement without any extra cost to the purchaser.

The erection engineer shall work under general direction of purchaser's engineer and shall submit progress report, erection programmer etc. as may be required from time to time.

## 1.2 COMMISSIONING OF TRANSFORMERS

When transformers are erected departmentally the GETCO will call engineer from supplier at the time of commissioning of the transformers without any charge to the purchaser. His stay at site will not be more than 72 hours, from the day he arrives at site.



## ANNEXURE – II

### Section F (f)

Sheet 1 of 3

### CHARACTERISTICS AND PARAMETERS OF INSULATING OIL (*Mineral*)

The insulating oil shall conform to all parameters specified below, while tested at suppliers' works. No inhibitors shall be used in oil. The successful bidder shall furnish test certificates from the supplier against their acceptance norms as mention below, prior to dispatch.

SR. NO.	CHARACTERISTICS	UNIT	REQUIREMENT	ACCEPTANCE NORMS
1.	Appearance		The oil shall be clear and transparent and free from suspended matter or sediments	A sample of oil shall be examined by GETCO representative during routine testing.
2.	Density at 29.5 <sup>0</sup> C	Gm/cm <sup>3</sup>	0.89	IS : 1448
3.	Kinematics viscosity at 27 Deg. C (Max)	cSt	27	IS : 1448
4.	Interfacial tension at 27 Deg. C (Min)	N/m	0.04	IS : 6104
5.	Flash point (Min) Pensky-martin (closed)	Deg. C	140	IS : 1448
6.	Pour point (Max)	Deg. C	(- 6)	IS : 1448
7.	Neutralisation value a) Total acidity (Max) Inorganic acidity / alkalinity	Mg / KOH /gm	0.03 Nil	IS:335 Appendix -A
8.	Corrosive sulphur (in terms of classification of copper strip)	Non corrosive	Non corrosive	IS:335 Appendix -A

## Section F (f)

## Sheet 2 of 3

SR. NO.	CHARACTERISTICS	UNIT	REQUIREMENT	ACCEPTANCE NORMS
9.	Electric strength (breakdown voltage)(Min) a) New unfiltered oil  (b) After filtration	KV (rms) Per minute KV (rms) Per Minute	30  60	IS:6792
10.	Dielectric dissipation factor (tan delta) at 90 Deg. C (Max)		0.002	IS:6262
11.	Water content (Max) by weight Untreated new oil After treatment	ppm	50 15	IS:2362 IS:1866
12.	Specific resistance at 90°C(min) Specific resistance at 27°C(min)	Ohm-cm Ohm-cm	$35 \times 10^{12}$ $1500 \times 10^{12}$	IS:6103
13.	Oxidation stability a) Neutralization value after oxidation (Max) b) Total sludge after oxidation (Max)	Mg/KOH/g. Percent by weight	0.40 0.10	
14.	Ageing Characteristics :-		Accelerated ageing (115 Deg.C for 96 Hours) shall be done by open beaker method with copper catalyst)	IS:12177

SR. NO.	CHARACTERISTICS	UNIT	REQUIREMENT	
a	Resistivity at 90°C (min)	Ohm-cm	0.20 x 10 <sup>12</sup>	
b	Resistivity at 27°C (min)	Ohm-cm	2.50 x 10 <sup>12</sup>	
c	Total acidity (Max)	Mg/KOH/g	0.05	
d	Sludge content by weight (Max)	Percent	0.05	
15.	Presence of oxidation-inhibitor		Oil shall not contain oxidation inhibitor.	IS:335 (Appendix – D)
16	Water content	in ppm	50 ppm Max.	

**Note:** Technical specification for Natural ester and synthetic ester oils are as per Annexure – III (A & B)

**APPENDIX – III (A) (Natural Ester)**

Section F (f)

**SPECIFICATION FOR NATURAL ESTERS insulating OIL for TRANSFORMER**

The NATURAL ESTERS (NE) insulating oil shall conform to all parameters of IEC 62770 as specified below, while tested at supplier's or manufacturer's works. The successful bidder shall furnish test certificate from the NE oil supplier as per below mentioned requirement and method of tests, prior to dispatch in presence of GETCO representative.

<b>Sr. No.</b>	<b>Characteristics of NATURAL ESTERS (NE) insulating Oil</b>	<b>Requirement</b>	<b>Method of test</b>
<b>1</b>	<b>Appearance</b>  <b>Colour</b>	<b>The oil shall be clear, free from sediments and suspended matter.</b>  <b>L1.0</b>	<b>Visual.</b>  <b>(A representative sample of the NE insulating oil shall be examined in a 100 mm thick layer, at 27 °C.)</b>  <b>ASTM D1500</b>
<b>2</b>	<b>Viscosity, mm<sup>2</sup>/sec</b> - at 100 °C - at 40 °C	<b>Max. 15</b>  <b>Max. 50</b>	<b>ISO 3104</b>  <b>ISO 3104</b>
<b>3</b>	<b>Pour point</b>	<b>Max. (-10 °C)</b>	<b>ISO 3016</b>
<b>4</b>	<b>Water content, mg/kg (ppm)</b> <b>a) Sample from drums/totes</b> <b>b) Sample from bulk</b> <b>c) After treatment before filling</b>	<b>Max. 100</b>  <b>Max. 200</b>  <b>Max. 50</b>	<b>IEC 60814</b>
<b>5</b>	<b>Density, gm/Cm<sup>3</sup></b> - at 20 °C	<b>Max. 1.0</b>	<b>ISO 3675 / ISO 12185</b>

<b>6</b>	<b>Dielectric break down voltage (2.5 mm gap)</b> <b>d) from drums/totes</b> <b>e) After treatment</b>	<b>Min. 35 kV</b> <b>Min. 70 kV</b>	<b>IEC 60156</b>
<b>7</b>	<b>Dielectric Dissipation Factor (Tan <math>\delta</math>) at 90 °C</b>	<b>Max. 0.05</b>	<b>IEC:60247</b>
<b>8</b>	<b>Soluble acidity, mg KOH/gm<sub>oil</sub></b>	<b>Max. 0.06</b>	<b>IEC:62021-3</b>
<b>9</b>	<b>Corrosive Sulfur DBDS</b>	<b>Non corrosive</b> <b>Below detection limit</b>	IEC 62535 or ASTM D1275B IEC 62697-1
<b>10</b>	<b>Total additives</b>	<b>Max. weight fraction 5%</b>	<b>IEC 60666 or other suitable method</b>
<b>11</b>	<b>Oxidation Stability after 48 Hrs. @ 120 °C,</b> <b>a) Total Acidity in mg KOH/gm<sub>oil</sub>.</b> <b>b) Viscosity at 40 °C</b>  <b>c) DDF (Tan <math>\delta</math>) at 90 °C</b>	$\leq 0.6$  <b>Max. 30% increase over the initial value</b> <b>Max. 0.5</b>	<b>IEC 61125 (method C)</b>  <b>1.9.4 of IEC 61125:1992</b>  <b>ISO 3104</b>  <b>IEC 60247</b>
<b>12</b>	<b>Fire point, °C</b>	<b>Min. 300</b>	<b>ISO 2592</b>
<b>13</b>	<b>Flash point, °C</b>	<b>Min. 250</b>	<b>ISO 2719</b>
<b>14</b>	<b>Biodegradation</b>	<b>Readily biodegradable</b>	<b>US EPA OECD 301 B, C or F</b>  <b>US EPA OPPTS 835.311</b>
<b>15</b>	<b>Impulse voltage at 25 °C with 25.4 mm gap</b>	<b>&gt;130 kVp</b>	<b>ASTM method D 3300</b>
<b>16</b>	<b>Polychlorinated biphenyls (PCBs), mg/kG</b>	<b>Max. 2</b>	<b>IEC 61619</b>

***Important Note:***

- 1) Natural Esters may be delivered in bulk, rail tank, cars, tank containers, or packed in drums or totes shall be clean and suitable for this purpose in order to avoid any contamination.
- 2) Each natural ester delivery shall be accompanied by a document from the supplier specifying at least; supplier's designation, liquid classification and quality certificate. Supplier shall declare generic types of all additives and their concentrations in a data sheet in accordance with the international and local regulations.
- 3) Sampling shall be carried out in accordance with the procedure described in IEC 60475.
- 4) Natural Esters being highly susceptible to oxidation and degrade with coming in contact with oxygen, adequate protection by means of sealing and avoiding leakage from any part of transformer.
- 5) DGA diagnosis criteria as per CIGRE TB 443 shall be applicable.
- 6) As per IEC: 60076-14, operating temperature shall not be more than 130 °C, relative permittivity shall be 3.2 at 25 °C, thermal conductivity at 25 °C shall be 0.17 (W/mK) and specific heat at 25 °C will be 2000 (J/kg °C).
- 7) In absence of experience change in values of IR, Tan delta, capacitance cannot be committed. Values achieved would be considered benchmark and shall be monitored on regular basis. However, IR value will be lesser than 10 G-ohm, power factor would be of order of 1.0% for transformer.
- 8) The temperature rise limits shall be same as specified in specification. Hence adequate radiators shall be provided.
- 9) In order to avoid direct contact of air with Natural Ester vegetable oil, during transport transformer shall be provided with nitrogen blanket of 100 mm above oil.
- 10) Deleted.
- 11) Due to higher viscosity of Natural Ester vegetable oil as compared to mineral oil, the recommendation is to fill under vacuum and to operate filter at higher temperature (80 °C).
- 12) Service information and handling guidelines for transformer with NE shall be provided.
- 13) As compared to mineral oil the settling time shall be double.
- 14) Oil leak and pressure test shall be carried out in line with CBIP, on each transformer as a special test.
- 15) During running condition, healthiness of the air cell and presence of no oil leakage shall be ensured. If by any means air come in contact with Natural

**Ester vegetable oil, the viscosity will be affected. Therefore, oil properties i.e. Appearance, Viscosity, Water content, Dielectric break down voltage (2.5 mm gap), Dielectric dissipation factor, Soluble acidity, Fire point, Flash Point including DGA shall be monitored for next 5 years from charging or expiry of guarantee period, whichever is later, as shown below for one transformer having each type of ester oil, identified by Chief Engineer (TR). In case of any adverse condition being found observed, the supplier shall take all corrective action in consultation with GETCO, free of cost (Note: At the end of fifth year, entire parameters (1 to 16) as mentioned in above table shall be measured except biodegradation).**

- a) Before energising**
- b) After 24 hrs of energising**
- c) After 7 days of energising**
- d) After 30 days of energising**
- e) Every month up to 6 months**
- f) Bi monthly after 6 months of energising for first year**
- g) Six monthly after 1 year of energising**

**However, all the transformers shall be tested before charging for all above parameters.**

- 16) Identification for these Transformers by way of aesthetic look and marking on tank on specified paint shade on 631 of IS:5, green strap of One foot at interval of one foot will be provided diagonally on complete tank on all surfaces.**
- 17) Special rating plate and instructions plate shall be provided on tank. Design and content will be finalized during detailed engineering.**

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**APPENDIX – III (B) (Synthetic Ester)**

Section F (f)

Sheet 1 of 3

**SPECIFICATION FOR SYNTHETIC ORGANIC ESTERS (SOE) insulating OIL for TRANSFORMER**

The SYNTHETIC ORGANIC ESTERS (SOE), *less flammable*, insulating oil shall conform to all parameters of IS 16081:2013 (IEC 61099:2010), as specified below, while tested at supplier's or manufacturer's works. The successful bidder shall furnish test certificate from the SE oil supplier as per below mentioned requirement and method of tests, prior to dispatch in presence of GETCO representative.

Sr. No.	Characteristics of SYNTHETIC ORGANIC ESTERS(SOE) insulating Oil	Requirement	Method of test
1	Appearance  Colour	The oil shall be clear, free from water, suspended matter & sediments.  Max. 200 Hazen	Visual.  (A representative sample of the SOE insulating oil shall be examined in a 100 mm thick layer, at 27 °C.)  ISO 2211
2	Viscosity, mm <sup>2</sup> /sec - at (-20 °C) - at 40 °C - at 60 °C - at 100 °C	Max. 3000 Max. 35 Max. 33 Max. 5.8	ISO 3104
3	Pour point	Max. (- 45 °C)	ISO 3016
4	Water content, mg/kg (ppm) f) Sample from drums g) Sample from bulk h) After treatment before filling	Max. 100 Max. 200 Max. 50	IEC 60814



5	Density, in kg/dm <sup>3</sup> - at 20 °C	Max. 1.0	ISO 3675 / ISO 12185
6	Dielectric break down voltage (2.5 mm gap) i) from drums/totes j) After treatment	Min. 45 kV Min. 70 kV	IEC 60156
7	Dielectric Dissipation Factor (Tan δ) at 90 °C, 50 Hz	Max. 0.03	IEC:60247
8	Soluble acidity, in mg KOH/gm <sub>oil</sub>	Max. 0.03	IEC:62021-1 or 2
9	Corrosive Sulfur DBDS	Non corrosive Below detection limit	IEC 62535 or ASTM D1275B ; IEC 62697-1
10	Total additives	Max. weight fraction 5%	IEC 60666 or other suitable method
11	Oxidation Stability after 164 Hrs. @ 120 °C, d) Total Acidity in mg KOH/gm <sub>oil</sub> . e) Total sludge (% mass)	0.3 Max. 0.01	IEC 61125 (method C)
12	Fire point, °C Fire class	Min. 300 K	ISO 2592
13	Flash point, °C	Min. 250	ISO 2719
14	Biodegradation	Readily biodegradable (Min. 89%)	US EPA OECD 301F
15	DC resistivity at 90 °C (GΩ x m)	Min. 2	IEC 60247
16	Polychlorinated biphenyls (PCBs), mg/kG	Max. 2	IEC 61619
17	Gassing tendency, µL/min	29.2	IEC 60628:1985 Method A
18	Relative permittivity, at 25 °C,	3.2	IEC 60247

**Important Note:**

- 1) **Synthetic Organic Esters (SOE) may be delivered in bulk, rail tank cars, tank containers, or packed in drums shall be clean and suitable for this purpose in order to avoid any contamination.**
- 2) **Each SOE delivery shall be accompanied by a document from the supplier specifying at least; supplier's designation, liquid classification, liquid net weight and quality certificate. Supplier shall declare generic types of all additives and their concentrations in a data sheet in accordance with the international and local regulations.**

**SOE shall be stored indoors and in suitable closed containers to prevent ingress of contamination.**

**Disposal and spillages guideline shall be submitted with bid and each delivery.**

- 3) **Sampling shall be carried out in accordance with the procedure described in IEC 60475.**
- 4) **SOE may be susceptible to oxidation and degrade with coming in contact with oxygen, adequate protection by means of sealing and avoiding leakage from any part of transformer shall be provided. *Manufacturers shall ensure that there shall be no contamination with polychlorinated biphenyls or teraphenyls (PCB or PCT); used, reclaimed or de-chlorinated oils; or other contaminations. Unused synthetic organic esters are considered non-toxic and supplier shall supply assays that define the product as non-toxic.***
- 5) **DGA diagnosis criteria as per CIGRE TB 443 shall be applicable.**
- 6) **As per IEC: 60076-14, operating temperature shall not be more than 130 °C, relative permittivity shall be 3.2 at 25 °C, thermal conductivity at 25 °C shall be 0.14 (W/mK) and specific heat at 25 °C will be >1800 (J/kg °C).**
- 7) **In absence of experience change in values of IR, Tan delta, capacitance cannot be committed. Values achieved would be considered benchmark and shall be monitored on regular basis. However, for transformer, IR value will be lesser than 10 G-ohm, power factor would be of order of 1.0%.**
- 8) **The temperature rise limits shall be same as specified in specification. Hence adequate radiators shall be provided.**
- 9) **In order to avoid direct contact of air with SOE oil, during transport transformer shall be provided with nitrogen blanket of 100 mm above oil.**
- 10) **Deleted.**

- 11) Due to higher viscosity of SOE oil as compared to mineral oil, the recommendation is to fill under vacuum and to operate filter at required higher temperature (80 °C).
- 12) Service information and handling guidelines for transformer with SOE shall be provided. For maintenance purpose IEC 61203 shall be applicable.
- 13) As compared to mineral oil the settling time shall be double.
- 14) Oil leak and pressure test shall be carried out in line with CBIP, on each transformer as a special test.
- 15) During running condition, healthiness of the air cell and presence of no oil leakage shall be ensured. If by any means air come in contact with Natural Ester vegetable oil, the viscosity will be affected. Therefore, oil properties i.e. Appearance, Viscosity, Water content, Dielectric break down voltage (2.5 mm gap), Dielectric dissipation factor, Soluble acidity, Fire point, Flash Point including DGA shall be monitored for next 5 years from charging or expiry of guarantee period, whichever is later, as shown below for one transformer having each type of ester oil, identified by Chief Engineer (TR). In case of any adverse condition being found observed, the supplier shall take all corrective action in consultation with GETCO, free of cost (Note: At the end of fifth year, entire parameters (1 to 16) as mentioned in above table shall be measured except biodegradation).
  - a) Before energising
  - b) After 24 hrs of energising
  - c) After 7 days of energising
  - d) After 30 days of energising
  - e) Every month up to 6 months
  - f) Bi monthly after 6 months of energising for first year
  - g) Six monthly after 1 year of energisingHowever, all the transformers shall be tested before charging for all above parameters.
- 16) Identification for these Transformers by way of aesthetic look and marking on tank on specified paint shade on 631 of IS:5, green strap of One foot at interval of one foot will be provided diagonally on complete tank on all surfaces.
- 17) Special rating plate and instructions plate shall be provided on tank. Design and content will be finalized during detailed engineering.

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### SPECIFIC REQUIREMENT OF ESTER FILLED TRANSFORMER

1. Ester filled transformer shall be operated at higher temperature up to 130 °C (Winding Temperature) and transformer shall deliver at least 30% extra MVA. The same shall be guaranteed by manufacturer and indicated in GTP.
2. Manufacturer shall use suitable Thermally Upgraded Paper (TUK/TUP) for conductor insulation and all other insulations accordingly in the transformer.
3. As per clause No. 25 of technical specification, one out of lot of 5 transformers will be subjected to guaranteed temperature rise test at rated MVA, which shall be further subjected to **extended temperature rise** test, up to 130 °C (Winding Temperature) and extra MVA delivered will be recorded.
4. All the parts of active part and gaskets shall be suitable to operate transformer continuously at 130 °C.
5. Each transformer shall be subjected to pressure test to ensure that there is no leakage from any part of transformer. In case of any leakage observed, it shall be attended by replacing complete gasket by new one and again pressure test shall be carried out.
6. OLTCs shall also be provided with same Ester oil used in main tank.
7. Manufacturer shall provide dedicated oil handling system for Natural, Synthetic and mineral oils at their works. This shall be confirmed by bidder in the technical bid and mentioned in tools and plants list, which will be verified during stage inspection. Utmost care shall be taken in handling esters during manufacturing.
8. OLTC conservator shall be provided with air cell.
9. Main tank gasket shall be suitable for higher temperature preferably of materials Nitrile or Neoprene or Viton chord fitted in groove.
10. Ester oil shall be tested at various stages right from oil suppliers works, acceptance at transformer manufacturer works, before filling, after type testing & before dispatch, etc. FAT at ester oil works shall be offered for inspection to GETCO.
11. Transformer tank shall be provided oil sight indicator to view and note the colour during service condition.
12. It shall be ensured that any material used in the transformer and coming in contact of esters shall be compatible and there shall be no adverse effect during service life of transformer.
13. Separate display plate for handling of Esters shall be provided.
14. All the radiators shall be thoroughly cleaned internally and duly flushed with ester oil only.

#### ADDENDUM IN GTP

1	Confirm that transformer shall be suitable to operate at higher temperature up to 130°C	
2	Extra MVA delivered by transformer if operated at 130°C	

### THIRD PARTY INSPECTION

Generally, Stage inspection during manufacturing process and Final inspection for routine tests on Power Transformer will be carried out by the GETCO's representative. However, the GETCO reserves right to carryout stage / Final inspection through THIRD PARTY duly authorized by the GETCO.

## STAGE INSPECTION CRITERIA FOR SUPPLY OF 05/10/15/20 MVA POWER TRANSFORMERS.

The bidder shall have to offer stage inspection, during manufacturing process of each offered power transformer. The proposed date of stage inspection shall be informed to GETCO **TEN** days in advance. GETCO reserves the right to inspect at any stage of manufacturing of offered transformer.

The first stage inspection will be carried out **by GETCO representative for offered lot of CRGO material (before slitting) and one sample will be collected from the same. Also inspection will be carried out** when the core formation and all the windings are ready for insertion in core. At this time bidder will have to demonstrate for guaranteed core losses. GETCO **will** collect the sample from the **built up** core laminations of offered transformer and **will** get it checked at any Government approved laboratory at risk and cost of the Transformer manufacturer, for the particulars guaranteed by the bidder.

Similarly, the winding shall also be inspected for its guaranteed particulars like cross sectional area, material etc., and if required, the GETCO **will** collect the sample of paper and conductor used and get it checked at any Government approved laboratory at risk and cost of the Transformer manufacturer, for the particulars guaranteed by the bidder. **Bidder shall make necessary provision during winding so as to take sample of conductor of required length.**

During stage inspection the bidder shall have to keep ready following documents and the same shall be verified by the inspector.

**[A] CRGO material:**

- 1) Invoice of supplier of raw materials
- 2) Approved certificates for Mills test of core material in their name.
- 3) Packing list
- 4) Bill of lading
- 5) Bill of entry certificate by custom.

**[B] Winding material:**

- 1) **Invoice of supplier of raw materials**
- 2) **Test certificate of supplier for chemical, physical & electrical properties of copper.**
- 3) **Test certificate for insulating paper and paper boards.**

**Following tests shall be carried out on selected sample of CRGO and winding material.**

**[A] CRGO material:**

- i) **Specific Core loss measurement**
- ii) **B-H curve**
- iii) **Lamination thickness**

**[B] Winding material:**

- a) **Dimensions:**
  - i) **Size of bare and covered conductor**

- ii) Size of insulation on conductor*
- iii) Nos of layers of insulating paper*
- iv) Overlap*
- v) Conductor finish*
- b) Mechanical Properties:**
  - i) Corner radius*
  - ii) Tensile strength*
  - iii) Hardness*
- c) Electrical properties:**
  - i) Conductivity*
  - ii) Resistivity*

**SIGNATURE OF BIDDER**

**DATE:**

**PLACE:**

**COMPANY'S ROUND SEAL**

## DOCUMENT TO BE SUMMITTED WITH TECHNICAL BID

[A] The bidders shall have to confirm:

<b>Sr. No.</b>	<b>Particulars</b>	<b>Confirmation</b>
(i)	that they shall offer the core for inspection and approval by the purchaser during the manufacturing stage. Bidders' call notice for this purpose should be accompanied with the following documents as applicable as a proof towards the use of prime core material: (a) Invoice of the supplier (b) Mills Test Certificate (c) Packing List (d) Bill of lading (e) Bill of entry Certificate to customs	YES / NO
(ii)	that the core material shall be directly procured either from the manufacturer or through their accredited marketing organization of repute and not through any agent.	YES / NO
(iii)	that they have in-house core cutting facilities for better control of quality and to avoid possibility of mixing prime core material from second grade core material. In the event if the bidder is sending the core to their sub-vendor for cutting purpose, in that case, they shall have to confirm that they will provide documentary evidence and other means (manufacturer's original seals provided to the CRGO rolled sheet) to prove that the prime core material is not being mixed with second grade core material or second grade core material is not used by their sub-vendor during the cutting process of the core material.	YES / NO
(iv)	that they have in-house facility for drawing out the required cross section of copper winding material. They also have to confirm that they will furnish the details such as name, address, contact persons, phone number etc. of their sub-supplier from where they procure the required cross section of the copper winding materials. Also, the sub-supplier must be authorized by the original manufacturer for supply of such copper winding materials.	YES / NO
(v)	that they agree to submit copy of test certificate of copper winding material purchased from the original manufacturer.	YES / NO
(vi)	that the EHV grade transformer oil to be used in the power transformers will be Nephthenic based.	YES / NO

**[B] STATEMENT OF RAW MATERIALS:**

The bidder should submit the statement of raw materials to be utilized during manufacturing of specified power transformers as per following format. The raw materials should be procured directly from the manufacturer or through accredited marketing organization of repute.

The raw materials shall include CRGO, Copper, Insulating Paper, Power Oil, Steel, HV, LV and Neutral Bushings, OLTC, Radiators etc. to be utilized in offered power transformer.

Sr. No.	Item	Make	Grade / Type
1.	CRGO silicon steel laminations (Core material)		
2.	Electric grade copper used for (a) HV winding (b) MV winding (c) LV winding		
3.	Insulating Paper		
4.	Power oil		
5.	Steel used for (a) Yoke (b) Main Tank (c) Other accessories		
6.	HV Bushings (i) Complete bushing (ii) Hollow insulator		
7.	LV & Neutral bushings		
8.	OLTC		
9.	Radiators		
10.	Gasket		
11.	<b>Any other item as per New Technology and / or innovative solutions</b>		

The bidder may mention various reputed make of raw material, but the test certificates will have to be submitted for the exact make at the time of drawing approval. ***The gaskets to be used shall have been purchased not earlier than one year and bidder has to submit the proof of purchase at the time stage inspection.*** The bidder will not be permitted to use any other make material at later date without approval, once make is indicated / confirmed.

**SIGNATURE OF BIDDER****DATE:****PLACE:****COMPANY'S ROUND SEAL**



**[C] List of documents attached with technical bid:**

Bidder shall invariably attach the following documents and clearly marked and duly flagged in technical bid. In absence of these documents offer will be evaluated as a non submission.

Sr. No.	Particulars of document	Whether attached with tech bid
1	Drawings in AutoCAD format	
2	Drawings hard copies as indicated in specification	
3	Manual in PDF format	
4	QAP for manufacturing process in SOFT format	
5	QAP for manufacturing process in Hard format	
6	FQP in SOFT format	
7	FQP in Hard copy	
8	Type test Reports in hard copies	
a	for transformer	
b	for OLTC	
c	for control cabinet	
d	for clamps & connectors	
e	for Air cell	
9	Confirmation regarding type tests as per clause no. 25 page no. 30 – “IMPORTANT NOTE”	
10	Calculation of Thermal stability to withstand short circuits	
11	Calculation of Dynamic ability to withstand short circuits	
12	Cooling calculation	
13	Guaranteed Technical Particulars, completely filled in	
a	for transformer	
b	for OLTC	
c	for control cabinet	
d	for clamps & connectors	
e	for Air cell	
14	Any other essential documents	

**SIGNATURE OF BIDDER****COMPANY'S ROUND SEAL****DATE:****PLACE:**

## ANNEXURE – IV

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### SECTION: I

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## DETAIL SPECIFICATION OF FLEXIBLE SEPARATOR (AIR CELL)

### GENERAL TECHNICAL REQUIREMENTS

#### 1.1 SCOPE:

1.1.1 This section covers the design, manufacture, assembly, testing at manufacturer's works, supply and delivery of the Flexible Separator (Air cell) as detailed in the Schedule – A of the commercial bid, complete with all accessories required for satisfactory and trouble free operation of the equipment.

1.1.2 When it is an item purchase, the scope of work shall be design, manufacture, assembly, testing at manufacturer's works, supply and delivery of Flexible Separator (Air cell) & its all required accessories.

**OR**

when it is job work of providing and fixing, then the scope of work shall be design, manufacture, assembly, testing at manufacturer's works, supply, delivery, including all required fabrication, fittings, valves, gauges, pipes etc., and complete erection, testing and successful commissioning for a given transformer conservator indicated in Schedule – A of the commercial bid.

#### 1.1.3 GUARANTEE:

The bidder shall among other things guarantee the following:

- i) Quality and strength of materials used.
- ii) The bidder shall give the guarantee as satisfactory working of the complete transformer for 36 months from the date of commissioning of Flexible Separator (Air cell) or 42 months from the date of receipt of at site, whichever is earlier.

It may be noted that the service guarantee would be applicable even when the Flexible Separator (Air cell) is erected and operated through any other agency appointed by the GETCO.

#### 2.0 CONSTRUCTION:

The construction of Flexible Separator (Air cell) shall be of Polymide/nylon fabric coated on both side with synthetic rubber and meeting the complete requirement of this specification.

Adhesives used shall be compatible with air and transformer oil at 100°C. All the joints shall be properly designed & suitably vulcanized. Further, Flexible Separator (Air cell) shall be reinforced at bottom face to avoid damage due to contact with magnetic oil gauge float. There shall not be any patch work in Flexible Separator (Air cell). Adaptor used shall be made from structural steel conforming to Fe-410-S to IS:226. Adaptor and bolts shall be cadmium plated and passivated (CD-8 of IS:1572) or Zinc plated and passivated. (Fe Zn 12.5 of IS:1573). The width of the overlap at the joints shall be such that there is no possibility of joint opening and leakage. Minimum width shall be 75 mm.

### 3.0 FUNCTIONAL REQUIREMENTS:

- i) The function of Flexible Separator (Air cell) is to line the inside of the conservator tank in transformer, allowing for changes in volume, while protecting the oil from any type of contamination or external corrosive agents like ozone, nitrogen, humidity etc.
- ii) Flexible Separator (Air cell) shall be suitable for continuous use in transformer oil at -20°C to 100° C.
- iii) Inside coating shall be very good enough to resist weather and ozone. Outside coating shall be transformer oil resistant. Compounds used for coating shall not deteriorate during service.
- iv) Flexible Separator (Air cell) shall be suitable for inflation and deflation due to change in oil volume in the conservator. Further, Flexible Separator (Air cell) shall be designed to collapse slowly as oil level rises in the conservator.
- v) Flexible Separator (Air cell) shall not develop cracks even at -20°C.
- vi) Fixation lugs and adaptor shall be provided on the Flexible Separator (Air cell).
- vii) Flexible Separator (Air cell) shall have excellent impermeability to oil, gases and water vapor.
- viii) Flexible Separator (Air cell) shall have high mechanical resistance.
- ix) Flanges provided shall meet any of our requirements indicated.

### 4.0 GENERAL:

The Flexible Separator (Air cell) shall be suitable for conservator of diameter, length & shape indicated in schedule – B, attached separately, with the tender. The suitability & size of Flexible Separator (Air cell) to be provided shall be supported by necessary calculation for given size and shape of conservator.

The Flexible Separator (Air cell) conform to relevant IS or international standards shall be indicated in the bid. The type tests and routine/acceptance tests shall be carried out accordingly and report shall be submitted with the bid.

The work of providing and fixing shall be carried out as per availability of shut down of particular transformer at site. Necessary tools tackles, accessories, manpower, etc required shall be managed by contractor.

The guaranteed technical particulars as listed in Section II, but not limited to shall be invariably submitted with the technical bid.

## ANNEXURE – IV

### SECTION: II

#### GUARANTEED TECHNICAL PARTICULARS Flexible Separator (Air cell)

##### Sr. No.      Particulars

1	Item description	:
2	Name of manufacturer	:
3	Type & designation	:
4	Shape	:
5	Size of conservator	Diameter :
		Length :
6	Size of Flexible Separator (Air cell)	:
a.	Length (mm) Fully inflated	:
b.	Length (mm) Fully deflated	:
c.	Width (mm) Fully inflated	:
d.	Width (mm) Fully deflated	:
e.	Distance between axes	:
	i.e. pitch distance of lugs (mm)	:
f.	Expansion volume (litre)	:
g.	Occupation rate (%)	:
7	Material of Flexible Separator (Air cell)	:
a.	Basic fabric	:
b.	Coating compound	:
c.	Oil side coating	:
8	Inside coating Material	:
9	Outside coating Material	:
10	Thickness	:
11	Resistance to perforation	:
12	Warp breaking strength	:
13	Weft breaking strength	:
14	Warp elongation breaking	:
15	Weft elongation breaking	:
16	Seam resistance	:

17	Perforation	:
18	Permeability to Oxygen	:
19	Permeability to water vapor	:
20	Resistance to Ozone gas for 96 hrs at 40°C	:
21	Attachment details	:
22	Flange details	:
23	Lugs	:
24	vulcanizing process	:
25	Reinforcement at bottom	:
26	Suitable for maximum temperature	:
27	Minimum width of over lap (mm)	:
28	Material of adaptor and bolts	:
29	Guarantee period	:
30	Accessories and fittings	:
	(Give list with details)	:
31	Any other information	:

**SIGNATURE OF BIDDER**

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**DATE:**

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### ***Annexure – A***

- 1) The intended transformer shall be suitable for operation under SCADA system in all respect. Any equipment / accessories required for SCADA operation shall have to be provided by the bidder as a part of supply. Bidder shall invariably confirm and indicate the same in the technical bid.
- 2) The minimum analog & digital input / output requirement shall be as follow:

<b>Typical I/O List for SCADA Compatibility of 66/11 KV TRF</b>				
<b>Sr. No.</b>	<b>PARAMETERS</b>	<b>DI Hard wired</b>	<b>DO</b>	<b>AI (4-20mA)</b>
1	OLTC Main Supply ON	√		
2	OLTC Main Supply OFF	√		
3	Transformer Winding Temperature			√
4	Transformer Oil Temperature			√
5	Tap Position Indication			√
6	Tap Changer Out of Step	√		
7	Tap Changer in progress	√		
8	OLTC ON LOCAL	√		
9	OLTC ON REMOTE	√		
10	Tap Changer Raise		√	
11	Tap Changer Lower		√	

- 3) The AVR relay suitable for SCADA shall also be supplied & provided in conventional RTCC panel. The technical specifications for AVR relay are attached herewith as Annexure – B.

## ***Annexure – B***

### ***AUTOMATIC VOLTAGE REGULATING RELAY***

1. **Automatic voltage control shall be initiated by a voltage regulating relay of an approved make and suitable for flush and/or wall mounting / DIN-rail /rack mounting.**
2. The relay shall operate from the nominal reference voltage derived from a circuit mounted 1 phase / 3 phase Voltage transformer (VT).
3. The AVR relay shall be Microprocessor based Numerical relay having large LCD display 128x128 *or higher*
4. The relay shall have 4 selectable set point voltages.
5. The AVR relay shall have the following methods as option for the compensation of voltage.
  - Apparent Current (Z-Comp.)
  - Line drop compensation (LDC)
  - Active Current
  - Reactive current
6. The relay bandwidth shall be adjustable to set point voltage *to suit per step voltage of 1.25%*
7. The relay shall have following options regarding time behavior with Time factor selectable from 0.1 to 30.
  - Linear
  - Integral
  - Fast integral
8. The relay shall incorporate an under voltage / over voltage blocking facility which shall make the control inoperative if voltage falls / rises by percentage value of set point value (as mentioned in Guaranteed technical particulars) with automatic restoration of control when nominal voltage rises / falls to value as mentioned in the Guaranteed technical particulars.
9. The AVR relay shall have integrated features for the display of following parameters
  - Integrated tap changer position display
  - Nominal Voltage
  - Load current
  - Bandwidth
  - Measuring values V, I, Active power, Reactive power, Apparent power, phase angle, Power factor, Reactive current and frequency
10. The AVR relay shall have facility to compensate the VT and CT-errors.
11. The AVR relay shall have facility to register the tap changer statistics. In the statistics mode, the relay shall display the no. of tap changing operations occurred on each tap.
12. The AVR relay shall have facility to recode the voltage and current with respect to time. Each of voltage value shall be measured for 100ms and averaged for 1 second. The recorded values shall be presented in graphical format on the device.
13. The AVR relay shall have integrated feature to make the parallel operation of 10 transformers working in parallel. The relay shall be self sufficient and shall not require any additional devices like parallel balancing module etc. *At least* following principal shall be available in the relay as standard.

- *Master Follower / Master Slave*
- *Circulating current*

14. The AVR relay shall have facility to monitor or control the following parameters
  - Monitoring of life time consumption of transformer
  - Monitoring of operating hours of Tap changer, Fans and Pump
  - Control of cooling levels of transformer
  - Recording of Hot spot temperature
15. The AVR relay shall have facility to record specific events (Event-Recorder) like under voltage, over voltage, over current, Auto/Manual, local/remote etc. with date and time stamping.
16. The AVR relay shall have facility to make selection of Auto/Manual and Local/Remote.
17. The AVR relay shall have different LEDs to indicate Service and Blocked condition.
18. It is preferred that 12 nos of freely programmable LEDs duly *tagged or stickered* shall be available to indicate different Operations / Alarm / Faults condition. *If stickers are provided, then 5 sets of such stickers shall be supplied free of cost for future replacement.*
19. The AVR relay shall have freely programmable Binary Inputs, Binary outputs, Analog Inputs and Analog Outputs.
20. The AVR relay shall have software to make the parameter settings of the device and it shall also be possible to do the parameter setting through keyboard of relay.
21. The AVR relay shall have suitable interface to make communication with higher level SCADA system. The following ports a minimum shall be available on the device.
  - a. Rs 232 port (COM 1) for doing the parameter setting and local communication with device.
  - b. RS 232 port (COM 2) for communication with higher level SCADA with optional protocols like MODBUS, SPABUS, PROFIBUS DP, LON, IEC 60870-5-101, -103 and -104, IEC 61850 in preparation.
22. It shall be possible to communicate via bus with all similar devices located at different location by making communication link with any one device through its *RS 485- port or Fiber optic port meant for SCADA* communication.
23. It shall have facility by which a customer specific software programme can be written and incorporated as feature in the relay.



### **Annexure – V – Specification of polymer bushing**

***Bushing for 52 kV & above shall be OIP/RIP type with Porcelain or Composite Polymer insulator if indicated in schedule - A of respective tender. In case not mentioned, OIP condenser type with Porcelain shall be supplied.***

***36 KV & Lower Class bushing shall be composite polymer housed oil communicating type / RIP composite polymer housed bushing if indicated in schedule-A of respective tender. In case not mentioned, Solid Porcelain or Oil Communicating type shall be supplied.***

Polymer / composite insulator shall be seamless sheath of a silicon rubber compound. The housing & weather sheds should have silicon content of minimum of 30% by weight. It should protect the bushing against environment influences, external pollution and humidity. It shall be extruded or directly moulded on the core. The interface between the housing and the core must be uniform and without voids. The strength of the bond shall be greater than tearing strength of polymer. The manufacturer shall follow non destructive technique (NDT) to check the quality of jointing of the housing interface with the core. The technique being followed with detailed procedure and sampling shall be decided during finalisation of MQP.

The weather sheds of the insulators shall be of alternate of shed profile as per IEC 60815-3. The weather sheds shall be vulcanized to the sheath (extrusion process) or moulded as part of the sheath (Injection moulding process) and free from imperfections. The vulcanization for extrusion process shall be at high temperature and high pressure. Any seams / burrs protruding axially along the insulator, resulting from the injection molding process shall be removed completely without causing any damage to the housing. The track resistance of housing and shed material shall be class 1A4.5 according to IEC 60587. The strength of the weather shed to sheath interface shall be greater than the tearing strength of the polymer. The composite insulator shall be capable of high pressure washing.

End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively, sealed to prevent moisture ingress, effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth with the projecting points or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.

The hollow silicon composite insulators shall comply with the requirements of the IEC publications. IEC 61462 and the relevant parts of IEC 62217. The design of the composite insulators shall be tested and verified according to IEC 61462 (type and routine test).

All type test & routine test as per applicable standards for OIP Porcelain or Composite Insulator bushing shall be submitted for approval. Spare bushings (draw lead / draw rod) shall be supplied along with lead / rod.