



PURCHASE SPECIFICATION FOR
ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV /xxx – xxxV
INVERTER DUTY TRANSFORMER

PS 439-1304

REV. No. 00

PAGE 1 OF 17

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TECHNICAL SPECIFICATION

FOR

ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV

INVERTER DUTY TRANSFORMER

Page no 2 : LV voltage will vary between 580 volt to 680 volt

Page no 5 & 10 :In LV SIDE there will be 5 runs per phase of 1C X630sqmm aluminum conductor, armoured, XLPE insulation, PVC sheath as per IS: 7098.

REVISION: 01
page 2 ,
Page 5&10

Approved:

Prepared

Issued

SC&PV-Engg



**PURCHASE SPECIFICATION FOR
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PS 439-1304

REV. No. 00

PAGE 2 OF 17

1.0 INTRODUCTION

This document details the technical specifications, supply conditions, erection and commissioning and post-commissioning requirements for ONAN type, 5.5 MVA, 33kV/ xxxV-xxxV, 3-phase, 3-winding, inverter duty transformers for solar PV grid connected power plants.

2.0 LIST OF ITEMS

2.1	<p>ONAN type, 3-phase, 3-winding, Inverter Duty Transformer with two identical LV windings and one HV winding - Rating 5500 kVA, 33kV / xxxV-xxxV</p> <p>1) HV Voltage: 33kV 2) LV voltage : xxx-xxxV ** 3) Vector group: YNd11d11 ** xxx Volts - Value shall vary between 500V and 700V depending on the output of the Inverter. Exact voltage shall be informed during detailed engineering. However, there shall be no change in the price quoted by vendor on account of the same.</p>	<p>Qty as per BHEL tender requirement</p>
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2.2	<p>Spares shall be offered as per list below:</p>																																					
	<table border="1"> <thead> <tr> <th>#</th> <th>Spares</th> <th>Qty</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>HV Bushings with metal parts and gaskets</td> <td>1 sets (3 Nos)</td> </tr> <tr> <td>2</td> <td>LV Bushings with metal parts and gaskets</td> <td>1 set (6 Nos)</td> </tr> <tr> <td>3</td> <td>HV Neutral Bushing</td> <td>1 set (1 Nos)</td> </tr> <tr> <td>4</td> <td>Set of valves (Each set shall represent complete qty of different types of valves used in one transformer. Total list of valves shall be indicated by vendor during detailed Engg)</td> <td>1 set</td> </tr> <tr> <td>5</td> <td>Pressure Relief Device with trip contacts</td> <td>1 No</td> </tr> <tr> <td>6</td> <td>Winding temperature indicator with alarm & trip contacts along with 4-20mA transmitter</td> <td>1 No</td> </tr> <tr> <td>7</td> <td>Oil temperature indicator with alarm & trip contacts along with 4-20mA transmitter</td> <td>1 No</td> </tr> <tr> <td>8</td> <td>Buchholz Relay (complete unit)</td> <td>1 No</td> </tr> <tr> <td>9</td> <td>Magnetic Oil Level Gauge (MOG)</td> <td>1 No</td> </tr> <tr> <td>10</td> <td>Set of Gaskets (Each set shall represent complete qty of different types of gaskets used in one transformer. Total list of gaskets shall be indicated by vendor during detailed Engg)</td> <td>1 set</td> </tr> <tr> <td>11</td> <td>Transformer Oil</td> <td>10 % of total quantity of extra oil required for all the transformers</td> </tr> </tbody> </table>	#	Spares	Qty	1	HV Bushings with metal parts and gaskets	1 sets (3 Nos)	2	LV Bushings with metal parts and gaskets	1 set (6 Nos)	3	HV Neutral Bushing	1 set (1 Nos)	4	Set of valves (Each set shall represent complete qty of different types of valves used in one transformer. Total list of valves shall be indicated by vendor during detailed Engg)	1 set	5	Pressure Relief Device with trip contacts	1 No	6	Winding temperature indicator with alarm & trip contacts along with 4-20mA transmitter	1 No	7	Oil temperature indicator with alarm & trip contacts along with 4-20mA transmitter	1 No	8	Buchholz Relay (complete unit)	1 No	9	Magnetic Oil Level Gauge (MOG)	1 No	10	Set of Gaskets (Each set shall represent complete qty of different types of gaskets used in one transformer. Total list of gaskets shall be indicated by vendor during detailed Engg)	1 set	11	Transformer Oil	10 % of total quantity of extra oil required for all the transformers	
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**PURCHASE SPECIFICATION FOR
ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 3 OF 17

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Notes:

- a) Vendor shall provide a complete list of spares showing item-wise unit price, quantity and total price.
- b) BHEL reserves the right in selection and inclusion of the spares in the final scope of supply.

2.3

Installation and commissioning support for the transformers at site:

BHEL scope of activities at site for installation and commissioning:

- (1) Movement and positioning of transformers on their respective foundations. BHEL shall arrange all necessary labour, machinery and tools.
- (2) Erection / assembly of transformer fittings and accessories. BHEL shall arrange all necessary labour, machinery and tools.
- (3) Laying of LV/HV cables, erection of HV termination kits and cable terminations at the LV/HV cable boxes. BHEL shall arrange all necessary labour and tools.

Vendor scope of activities at site for commissioning:

- (1) Supervision of erection / assembly of transformer fittings and accessories including marshalling box wiring. This shall include providing technical guidance to BHEL erection team wherever required.
- (2) Commissioning / service engineer(s) shall be available at site at the time of commissioning of the power plant. All necessary guidance / support in overcoming technical problems (if any) related to the transformers.

A single lump-sum price on per-transformer basis shall be offered. The lump-sum price shall include all the costs that will be incurred by the vendor towards the above activities including travel, boarding, lodging and any other contingency expenses.

1 AU per transformer

1 AU (Activity Unit) =

I&C Support for 1 No. transformer

2.5

Service during Warranty

Vendor shall enclose, along with technical bid, the complete scope, terms and conditions of the warranty.

During the warranty period, whenever a technical problem is encountered with transformers, BHEL will report the same to the vendor. All parts of the transformers shall be covered under warranty. Replacement of all defective material during warranty period shall be in scope of the vendor.

Vendor shall ensure that the problem is attended to by their service engineer within two days from the date of reporting.



**PURCHASE SPECIFICATION FOR
ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 4 OF 17

3.0 Technical specification

#	Technical parameter	BHEL specification	
1	Transformer type	Outdoor, oil-immersion type ONAN, Inverter Duty. Inverter Transformer shall be designed for at least 5% total harmonic distortion (THD)	
2	IP class	Transformer, including the cable box and marshalling box shall be of IP55 .	
3	Application	Grid-connected solar photovoltaic power plant.	
4	Governing Standards	Power Transformer	IS: 2026, IS: 6600, IEC:60076, CBIP
		Fittings and Accessories	IS: 3639
		Insulating Oil	IS:335 , IEC: 60296
		Bushings	IS: 2099, IEC: 60137, IS 20650 IEC 144, IEC 137
		Bushing CTs	IS:2705
		Degree of protection	IS: 2147, IEC 76
		Tests and tolerance of guaranteed particulars	IS: 2147, IEC 76
		Buchholz relay	IS: 3637
		Electrical insulation classified by thermal stability	IS: 1271, IEC 85
		Climate proofing	IS: 3202, IEC 354
		Indian Electricity Act 2003 & CEA regulations/notifications	
5	Rating in KVA	5500 kVA	
6	No. of phases	3	
7	Frequency	50 Hz, +/- 3%	
8	HV winding	One 3-phase winding with Star connection. HV voltage: 33KV	
9	LV windings	Two independent 3-phase windings, each with Delta connection. LV voltage: as defined at Cl. 2.1. Each winding shall have an identical and equal rating (each winding shall be rated at 50% of overall transformer rated kVA). Design shall be such that transformer shall have identical performance for both the LV windings. Even when one LV winding is not fed from solar generation side, performance of the other (operational) LV winding shall remain unaffected.	
10	Winding material	Electrolytic grade copper for both HV and LV windings.	

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INVERTER DUTY TRANSFORMER

PS 439-1304

REV. No. 00

PAGE 5 OF 17

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11	Winding Insulation	Class A
12	Neutral on HV side	Neutral terminals of HV windings shall be brought out separately through bushings.
13	Vector Group	YNd11d11
14	Rated Thermal Short time current withstand time	25kA for 3 sec
15	% Impedance on principal tap, at 2.75 MVA base at 75deg C and 50 deg C	HV - (LV1 + LV2): 7 % HV - LV1 / LV2 : 7 % LV1 - LV2 : 11% (min) Tolerance shall be as per IS 2026
16	Termination HV/LV/Orientation	Air insulated cable box with disconnecting chamber, for both HV and LV sides. Cable box / Cable box / 180°.
17	Cable entry on HV side	<ul style="list-style-type: none">- Bottom entry of cables.- Cable size: 1 run per phase of 1Cx300 sq-mm, 33kV grade, aluminum conductor, armoured, XLPE insulation, PVC sheath as per IS: 7098.- Cables, lugs, glands, etc shall be in VENDOR scope.- termination KIT in BHEL scope- Vendor shall provide hole on the bottom-side gland-plate of HV side cable box for cable entry.- Cable OD will be intimated to the vendor at the time of manufacturing.
18	Cable entry on LV side	<ul style="list-style-type: none">- Three wire system.- Bottom entry of cables- Cable size: 9 runs per phase of 1CX630 sqmm, aluminum conductor, armoured, XLPE insulation, PVC sheath as per IS: 7098.- Cables, lugs, glands etc shall be in VENDOR scope.- Vendor shall provide holes in the busbars and on the bottom-side gland-plate of LV side cable box for placement of glands.- Cable O.D shall be informed to vendor during drawings approval by BHEL. <p>Cables shall enter the cable box straight upwards and get connected to the bus bars. After entry into cable box, cables shall not undergo any bends or turns.</p>
19	Tapping on HV winding	Off circuit tap changer (OCTC) switch with tap positions range from -10% to +10% in steps of 2.5%.
20	Loading Capability	Continuous operation at rated MVA on any tap with voltage variation of +/-10%. Transformer shall be capable of being loaded in accordance



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ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 6 OF 17

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		with IS: 6600 / IEC 60076-7 upto a load of 150%. There shall be no limitation imposed by bushings etc. or any other associated equipment.
21	Ambient temperature	Max 50 deg C
22	Temperature rise	For top oil: Max.50 deg C by thermometer method. For winding: Max. 55 deg C by resistance method. Both rises shall be over an ambient temperature of 50 deg C irrespective of tap position.
23	Flux density	Not to exceed 1.9 Wb/sq.m at any tap position with +/-10% voltage variation from voltage corresponding to the tap. Transformer shall also withstand following over-fluxing conditions due to combined voltage and frequency fluctuations: a) 110% for continuous rating b) 125% for at least one minute c) 140% for at least five seconds Vendor shall furnish over-fluxing characteristics upto 150% during detailed engg. The transformer shall also be capable of withstanding without damage during the time, for a duration of at least two seconds the stresses caused by short circuit limited only by the transformer impedance with 110% rated voltage maintained at source end.
24	Air Clearances	As per CBIP
25	Harmonics	Shall be designed to suppress harmonics especially 3rd & 5th. Inverter Transformer shall be designed for at least 5% total harmonic distortion (THD)
26	Noise level	As per NEMA TR-1 standard
27	Highest system voltage	LV side: 1.1kV HV side: 36 kV
28	Insulation Class (Winding and bushing)	As per relevant IS / IEC standard LV side winding and bushing insulation class shall be of at least 1.1kV
29	Insulation levels Rated Lightning Impulse withstand voltage / Short duration power frequency withstand voltage	As per relevant IS / IEC
30	Painting	Shall be finalized during drawing approval.
31	Constructional features	As per clause 4.0 of this specification



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ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 7 OF 17

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32	Fittings and accessories	As per clause 5.0 of this specification	
33	Provision of shield	Shield winding shall be provided between LV & HV windings. Each LV winding must be capable of handling non-sinusoidal voltage with voltage gradient as per applicable standards. Also, shield winding shall be taken out from tank with separate connection for each LV with shield bushing and same shall be brought down along with support insulator from tank & copper flat upto the bottom of the tank for grounding. Shield bushing shall be rated for 1.1kV.	
34	No load current at rated voltage and frequency	Vendor to indicate value (%)	
35	Efficiency at 75°C at UPF	Minimum 98.5% at full load Vendor to indicate value	
36	Maximum Efficiency (%) and load at which it occurs (kVA)	Vendor to indicate value	
37	Overall dimension in mm Length x Breadth x Height	This shall be provided by vendor.	
38	Oil capacity (in Litres)	Vendor to mention Oil capacity	
39	Weight of transformer (kg)	This shall be provided by vendor.	
40	Minimum creepage distance	31mm/ kV	

4.0 Constructional features and details of transformer components

4.0	<i>Governing standard</i>	<i>IS: 2026, IEC 60076 and IS: 3639 or equivalent international standard.</i>
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4.1 Tank

4.1.1	The transformer tank and cover shall be fabricated from high grade low carbon plate steel of tested quality. The tank and cover shall be of welded construction and there should be provision for lifting by crane.
4.1.2	At least two adequately sized inspection hole(s) with welded flange(s) and bolted cover(s) shall be provided, one at each end of the tank. The inspection hole(s) shall be sufficient size to afford easy access to the lower ends of the bushings, terminals etc.
4.1.3	The exterior of tank and other steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather-resistant nature, preferably of distinct colour from the prime and finish coats. The final coat shall be of with 2 coats of glossy, oil and weather resistant non-fading epoxy based paint of colour shade RAL 7032.



**PURCHASE SPECIFICATION FOR
ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 8 OF 17

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4.1.4	The interior of the tank shall be cleaned by sand blasting and painted with two coats of heat resistant and oil insoluble insulating varnish of white shade.
4.1.5	All bolts and nuts exposed to atmosphere shall be galvanized. All bolted connections to the tank shall be fitted with suitable oil-tight gaskets that shall give satisfactory service under the operating conditions for complete life of the transformer, if not opened for maintenance at site.
4.1.6	Transformer tank shall be mounted on bi-directional rollers for rail gauge suitable as per IS / CBIP. Suitable locking arrangement shall be provided to prevent accidental movement of transformer. Tank shall also be provided with lifting lugs and minimum four jacking pad.
4.1.7	The tank together with radiators, conservator, bushings and other fittings shall be designed to withstand the following conditions without permanent distortion: (i) Full vacuum (mm of Hg – value as per latest CBIP Manual), for filling with oil by vacuum. Internal gas pressure of 0.35 Kg/cm ² (5 lbs/sq.in) with oil as at operating level. (ii) The transformer shall have conservator tank of adequate capacity to accommodate oil preservation system and volumetric expansion of total transformer oil. The conservator shall be bolted into position so that it can be removed for cleaning purposes. (iii) The conservator shall be of single compartment type. The top of the conservator shall be connected to the atmosphere through indicating type cobalt free silica gel breather (in transparent enclosure). Silica gel shall be isolated from atmosphere by an oil seal. (iv) The tank cover shall be suitably sloped so that it does not retain rain water. The material used for gaskets shall be cork, neoprene or approved equivalent.

4.2 Core

4.2.1	The magnetic circuit shall be of core type. The core shall be constructed from high grade, non-ageing, cold rolled, super grain oriented silicon steel laminations (CRGOS) equivalent to M4 grade steels or better.
4.2.2	The insulation structure of the core to clamp plates shall be such that it withstands a voltage of 2kV (rms) for one minute in air.
4.2.3	Adequate lifting lugs will be provided to enable the core & windings to be lifted.

4.3 Windings

4.3.1	Windings shall be of electrolytic grade copper free from scales and burrs.
4.3.2	Windings shall have uniform insulation.
4.3.3	Tapping shall be so arranged as to preserve the magnetic balance of the transformer at all voltage ratios.
4.3.4	The completed core and coil assembly shall be dried in vacuum and shall be immediately impregnated with oil after the drying process to ensure elimination of air and moisture within the insulation.
4.3.5	Windings shall be made in dust proof and conditioned atmosphere.

4.4 Internal earthing



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ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER

PS 439-1304

REV. No. 00

PAGE 9 OF 17

4.4.1 The frame work and clamping arrangements of core and coil shall be securely earthed inside the tank by copper strip connection to the tank.

4.5 Bushings

4.5.1 Bushings shall be designed and tested to comply with the applicable standards. If type test certificates are not available, these tests shall also be carried out in addition to the routine tests. Bushings rated for 400A and above shall have non-ferrous flanges and hardware. Bushings shall be supplied with terminal connector clamp suitable for connecting the cables.
Bushings below 52 kV shall be of silicone composite / condenser / oil communicating type.

4.6 Cables boxes and disconnecting chambers

4.6.1 Cable boxes shall be supplied with gland plates having holes to suit BHEL specified cables.

4.6.2 Cable boxes / disconnecting chambers shall be provided with body earth terminals.

4.6.3 LV cable boxes shall be provided with necessary LV bushings, bus bars, bus bar supports for making cable terminations.

4.6.4 HV cable boxes shall be provided with necessary HV bushings and terminals for making cable terminations.

4.6.5 Cable boxes shall be provided with suitable gaskets to ensure the specified protection class requirement (IP55). Cable boxes / disconnecting chambers shall be provided with necessary arrangements to prevent entry of rain water into the same.

4.6.6 **Disconnecting chambers:**
(1) Disconnecting chambers shall be provided to enable the transformer to be removed without unsealing the cables or draining oil from the main tank.
(2) Disconnecting chamber shall be air insulated and complete with seal-off bushings, removable flexible connectors / links and removable covers.
(3) Phase-to-phase and Phase-to-ground clearances within the chamber shall be such as to enable either the transformer or cable to be subject separately to HV tests.

4.6.7 Internal surface of cable boxes shall be painted with epoxy enamel white paint. The minimum dry film thickness (DFT) shall be 100 microns.

4.6.8 **Cable Entry on LV SIDE**
. **Three wire system**
. **Bottom Entry of cables**

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ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 10 OF 17

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.cable size : 9 runs per phase 1CX630SQMM Aluminium conductor un armoured XLPE Insulation .
.cable shall be in BHEL Scope
.Cable Gland Lugs and SS hardware for connecting cable on LT bus bar Shall be in vendor scope . Vendor Shall provide hole on the bottom side gland plate of HV Cable box for cable entry
. Cable Gland is nickle plated brass gland of double compression type of reputed make . Cable OD will be intimated to the vendor during detailed engineering

4.6.9 Cable Entry on HV Side
. Bottom Entry of cable
.3RUN OF 1CX300 sqmm 33KV grade Aluminium Conductor armoured XLPE insulation

. Cable termination KIT are in BHEL scope
. Cable Gland Lugs and SS hardware for connecting cable on HT bus bar Shall be in vendor scope . Vendor Shall provide hole on the bottom side gland plate of HV Cable box for cable entry
. Cable Gland is nickle plated brass gland of double compression type of reputed make . Cable OD will be intimated to the vendor during detailed engineering

4.7 Neutral bushings

4.7.1 The neutrals of the star-connected HV windings shall be brought out to separate bushing terminals.
 The neutral bushings shall be provided on the tank at location that facilitates connecting to the earth chamber. Neutral shall solidly be earthed during normal operation.

4.8 Marshalling box

4.8.1 Marshalling box shall be tank mounted, outdoor and weather/vermin/dust proof (protection class IP55), sheet-steel (2mm thick minimum) enclosure, with hinged door having padlocking facility and painted.
 Marshalling box shall have proper lighting and thermostatically controlled space heaters.
 All doors, covers and plates shall be fitted with neoprene gaskets. Bottom shall be at least 450 mm above floor level and provided with gland plate and cable glands as required. Top surface shall be sloped to drain off water falling on the box.

4.8.2 It shall be in the vendor scope to provide the interconnection cabling between the marshalling box and all the accessory devices of transformer by either PVC insulated unarmoured cables routed through GI conduit (or) PVC insulated, armoured cables.

4.8.3 Necessary cable glands shall be provided at the marshalling box for the above mentioned cables as well as for terminating the incoming cables from remote panels.



**PURCHASE SPECIFICATION FOR
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INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 11 OF 17

4.8.4	One dummy terminal block in between each trip wire terminal shall be provided. The terminal blocks shall be ELMEX 10 mm ² or approved equal. At least 20% spare terminals shall be provided on each panel. The gasket used shall be of neoprene rubber. Wiring scheme (TB details) shall be engraved in a stainless-steel plate with viewable font size and the same shall be fixed inside the Marshalling Box door.
4.8.5	Internal surface of marshalling box shall be painted with epoxy enamel white paint. The minimum dry film thickness (DFT) shall be 100 microns.

4.9 Transformer oil

4.9.1	Transformer Oil shall conform to the requirements of IS:335 Transformers shall be supplied complete with transformer oil. No inhibitors shall be used in the oil.
4.9.2	In case transformer is supplied partially filled with oil, oil required for topping up shall be supplied in non-returnable sealed containers along with main consignment to avoid any shortage of oil at the time of topping up of oil at site.

4.10 Valves

4.10.1	All valves upto and including 50 mm shall be of gun metal or of cast steel. Larger valves may be of gun metal or may have cast iron bodies with gun metal fittings. Sampling & drain valves should have zero leakage rate.
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4.11 Gaskets

4.11.1	Gasket shall be fitted with weather proof, hot oil resistant, rubberized cork gasket.
4.11.2	If gasket is compressible, metallic stops shall be provided to prevent over compression
4.11.3	The gaskets shall not deteriorate during the life of transformer if not opened for maintenance at site. All joints flanged or welded associated with oil shall be such that no oil leakage or sweating occurs during the life of transformer. The quality of these joints is considered established, only if the joints do not exhibit any oil leakage or sweating for a continuous period of at least 3 months during the guarantee period. In case any sweating / leakage is observed, vendor shall rectify the same & establish for a further period of 3 months of the same. If it is not established during the guaranteed period, the guaranteed period shall be extended until the performance is established.

5.0 Fittings and accessories

Following fittings per transformer shall be provided. In case of non-compliance or deviation, vendor shall indicate and provide comments.

#	Nomenclature of fitting / accessory	Qty
1	Oil conservator with equalizer pipe	1 set
2	HV cable box	1 set
3	HV disconnecting chamber	1 set
4	LV cable box	2 sets

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INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 12 OF 17

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5	LV disconnecting chamber	2 sets
6	Off circuit tap changing switch (OCTC) with operating knob, tap position marking and locking facility, with warning plate "Tap switch to be operated only with the transformer de-energized".	1 set
7	Earthing terminals with hardware suitable for connecting 50x6 GI earth strips. Separate terminals shall be provided for cable boxes, tank etc.	1 set
8	Radiators (detachable type) with drain value at the bottom, relief valve at the top, air plug, shut-off valves at every point of connection to the tank and lifting lugs.	4 sets
9	Double float Buchholz relay with alarm and trip contact. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation. Buchholz relay shall be provided with 2 nos. shut-off valve (on conservator side and tank side) of size 50 mm for transformer rating up to 10MVA and 80 mm for rating 10MVA and above.	1 set
10	Provision for collecting gas and oil from Buchholz relay	1 set
11	Silica gel dehydrating breather with oil cup; indicating type cobalt free silica gel breather in transparent enclosure. (maximum height 1400 mm above ground level)	1 set
12	Magnetic oil level gauge (MOG), dial type, with alarm contact, minimum and maximum filling level markings. Contact shall be suitable for 110V/220V DC. The oil level at 30 deg C shall be marked on the gauge.	1 set
13	Prismatic / toughened glass oil level gauge for transformer and tap changer chamber with min and max markings.	1 set
14	Spring operated Pressure relief valve with alarm/trip contacts. Location of this valve shall be such that the hot oil discharge shall not fall on the transformer or any of its parts. This shall include all necessary arrangements to facilitate proper discharge of PRV through discharge pipes away from the transformer.	1 set
15	Explosion vent (double diaphragm) with sight glasses and equalizing pipe connection to conservator	1 set
16	Thermometer pocket for OTI	1 No
17	Temperature sensor for OTI	1 No
18	Thermometer pocket for WTI	1 No
19	CT for WTI	1 No
20	Oil temperature indicator, 150 mm dial type, with alarm and trip contacts, maximum reading pointer & resetting device. Oil temperature range: 0-150 deg C (resolution 1 deg C) Oil temperature accuracy: Minimum 1.5% RTD PT-100 temperature sensor for OTI (IEC 751). Analog output of 4-20mA for remote indication of OTI. Maximum height 1500mm above ground level.	1 No



PURCHASE SPECIFICATION FOR
ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER

PS 439-1304

REV. No. 00

PAGE 13 OF 17

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21	Winding temperature indicator, 150-mm dial type, with alarm and trip contacts, maximum reading pointer & resetting device. Winding temperature range: 0-150 deg C (resolution 1 deg C) Winding temperature accuracy: Minimum 1.5% Analog output of 4-20mA for remote indication of WTI. WTI shall be provided for HV winding and one of the LV windings. Maximum height 1500mm above ground level.	3 Nos (1HV+ 2LV)
22	Marshalling box (IP55) shall be provided with removable gland plates and glands for cable entry from bottom side. Marshalling box shall be provided with OTI, WTI, transmitters (for 4-20mA output of OTI and WTI), space heater, thermostat, lamp (LED type), MCBs, power socket, switch for WTI, terminal connectors and all other attachments that are necessary to meet its functional aspects. Terminal connectors for the following signals / connections shall be made available. Number of terminal connectors for each case shall be as per connection requirements: PT-100 sensor from thermometer pocket 1) 4-20mA output for OTI 2) 4-20mA output for WTI 3) WTI CT secondary 4) Alarm contact of WTI 5) Trip contact of WTI 6) Alarm contact of OTI 7) Trip contact of OTI 8) Buchholz relay alarm 9) Buchholz relay trip 10) Magnetic oil level gauge alarm 11) Pressure relief valve alarm 12) 90-260V DC power supply (external source) 13) 240V AC supply (external source) 14) Spare connectors: Eight terminals Note: Alarm and trip contacts shall be rated for 110 / 220V DC which will be confirmed during detailed engineering.	1 set
23	Inspection window with cover	1 set
24	Cover lifting lugs / eyes	2 Nos
25	Core and winding lifting lugs / eyes	2 Nos
26	Tank lifting lugs / eyes for the entire transformer	4 Nos
27	Jacking pad with hauling eyes, to enable transformer with oil to be raised or lowered using hydraulic or screw jacks.	4 sets
28	LV cable box supports with mounting plates	2 sets
29	HV cable box supports with mounting plates	2 sets
30	Bi-directional flat rollers	4 sets
31	Base channel with towing holes / lugs	2 sets
32	Air release hole with plug	1 No



**PURCHASE SPECIFICATION FOR
ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 14 OF 17

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33	Oil filling hole with cap	1 No
34	Top filter cum sampling valve with threaded male adapter (blanking plug)	1 No
35	Bottom filter valve with threaded male adapter (blanking plug)	1 No
36	Drain valve for conservator, with blanking plug	1 No
37	Shut-off valves for conservator	2 Nos
38	Bottom Sampling valve, with blanking plug	1 No
39	Shut-off valves for radiators, with open and close markings	8 Nos
40	Drain / Sludge valve at bottom most point of tank to be provided for easy flush out / removal of sludge during maintenance	1 No
41	Valve schedule plate made of stainless steel or aluminium (anodized)	1 No
42	Rating and diagram plates made of stainless steel or anodized aluminium (Hindi and English)	2 Nos
43	Terminal marking plates	1 Set
44	Core to frame earthing hood (2kV isolation)	1 No
45	Earthing pads	2 Nos
46	Rain hoods on Buchholz, MOG and PRD with entry points of wires suitably sealed	1 set
47	Bolts & nuts - G.I / S.S - For all current carrying parts, S.S hardware shall be provided and all other places, G.I hardware shall be provided.	1 set
48	Protected type Mercury or alcohol in glass thermometer	1 No
49	Gas sampling pet cock for Buchholz Relay	1 No
50	Shielding Bushing along with copper flat and insulators	2 set
51	Valves on transformer tank for NIFPS connection	1 set
52	Provision for connecting Isolation valve (TCIV) of NIFPS System between transformer tank and conservator	1 set
53	Mounting arrangement on transformer tank for NIFPS control box mounting	1 set
54	Mounting arrangement on transformer tank for mounting of fire detectors for NIFPS	1 set

6.0 Inspection and testing of transformers at vendor works

6.1	Vendor shall provide inspection call to BHEL for all routine, type and special tests are per relevant clauses. Prior to the call, vendor shall submit the detailed manufacturing quality plan (MQP) format for approval. Inspection shall be carried out jointly by BHEL and customer.
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7.0 Routine, Type & Special tests (as per CBIP and IS: 2026 latest amendment)



**PURCHASE SPECIFICATION FOR
ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 15 OF 17

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7.1	<p>Routine Tests (On all transformers):</p> <p>1) All routine tests as per IS: 2026 shall be conducted on 100% transformers in the scope of supply of this tender.</p> <p>2) In addition to the above, the following test as per procedure below has to be conducted on all transformers as per IS 2026/ CBIP: -Oil Leakage Test on completely assembled transformer - All tank & oil filled compartment shall be tested for oil tightness by being completely filled with oil of viscosity not greater than that of specified oil at the ambient temperature & applying pressure equal to the normal pressure plus 35 KN/sq.m measured at the base of the tank. The pressure shall be maintained for a period of not less than 24 hours during which time no sweating shall occur.</p>
7.2	<p>Type Tests (On 1 No. Transformer)</p> <p>1) Type Test of the transformer shall be carried out in accordance with IS: 2026</p> <p>2) In case the transformer manufacturer has conducted all type tests required as per IS 2026 within last ten years as on the date of bid opening, the type test reports have to be submitted to BHEL/BHEL Customer for waiver of conductance of such type test(s). These reports shall be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) shall have been either conducted at an independent laboratory or shall have been witnessed by a client.</p> <p>3) In case the Contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the vendor shall conduct all such tests under this contract free of cost to the Employer and submit the reports for approval.</p>
7.3	<p>Special Tests (1 No. Transformer)</p> <p>1) Temperature Rise test as per IS 2026</p> <p>2) Tank Vacuum & Tank Pressure Test as per CBIP</p> <p>Note: All above specified tests are mandatory and no separate charges for the same is applicable. BHEL / BHEL customer shall witness these tests at vendor works</p>

8.0 Tests at Site:

8.1	<p>After erection at site all transformer(s) shall be subjected to the following tests:</p> <ul style="list-style-type: none"> i. Insulation resistance test. ii. Measurement of Voltage Ratio iii. Polarity test. iii. Magnetic Balance test iii. Dielectric test on oil. iv. Physical check.
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**PURCHASE SPECIFICATION FOR
ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 16 OF 17

v. Breakdown voltage on transformer oil. Oil filtration (if Oil BDV is not satisfactory)

These tests shall be conducted under the supervision of transformer manufacturer.

9.0 Documents to be submitted along with offer

- 9.1 Following documents shall be submitted to BHEL along with technical offer:
- (1) Filled in values/details wherever the same is asked for in BHEL technical specifications
 - (2) Confirmation of NIL deviation to BHEL Purchase Spec. In case any deviation is taken, vendor shall indicate the clause no., BHEL requirement as per the subject clause and the deviation taken.

10.0 Documents to be submitted after receipt of purchase order

- 10.1 Following documents shall be submitted for BHEL approval within seven days from date of purchase order.
- (1) Drawings
 - (a) Overall General Arrangement (plan, elevation, end view) with overall dimensions and BOM.
 - (b) Rating plate details
 - (c) Valve schedule plate details with elevation & side view showing valve positions
 - (d) HV cable box with disconnecting chamber, bushings, gland plate, cable termination details etc.
 - (e) LV cable box with disconnecting chamber, bushings, gland plate, cable termination details etc.
 - (f) Marshalling box GA (front view, side view, bill of items) and wiring diagram
 - (g) Foundation plan
 - (h) Bill of material of transformer
 - (i) Untanking details (removal of core and assembly from tank)
 - (j) Type Test Reports
 - (3) Guaranteed technical specification of transformer in line with Appendix-B (schedule of technical particulars to be furnished by manufacturer) of IS: 2026 Part-1. Over and above the same, any details asked for as per Annexure-1 shall be included.
 - (4) Manufacturing Quality Plan (routine tests, type tests, test certificates) covering Incoming materials, in-process checks during manufacturing, final inspection, finished goods, packing and forwarding.
 - (4) Manufacturing clearance shall be subject to approval of the above documents by BHEL/customer.

11.0 Documents to be submitted along with consignment

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**PURCHASE SPECIFICATION FOR
ONAN TYPE, 3-PHASE, 3-WINDING, 5.5 MVA, 33KV / xxxV – xxxV
INVERTER DUTY TRANSFORMER**

PS 439-1304

REV. No. 00

PAGE 17 OF 17

11.1	Following documents shall be submitted to BHEL at the time of delivery of the consignment: (1) As built drawings of transformer (2) Routine test reports on transformer (3) Type test reports of transformer (4) Test certificate for transformer oil (5) Operations and maintenance manual of transformer in hard + soft copy
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12.0 Support from vendor during document approval phase

12.1	During the phase of approval of design / engineering / quality documents (GA, GTP, BOM, MQP, Test report etc), it will be required to hold in-depth discussions with BHEL/customer to provide clarifications through clear understanding of technical queries. Accordingly, when needed, vendor shall hold direct (across-the-table) discussions with BHEL (Bangalore office) and customer to eliminate undue time delays.
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