

Annexure-‘A’

Specification & scope of work for Supply of 3 Phase 11000 V / 433 V, 500 kVA Distribution Transformers (Outdoor type)

A. Constructional features & design aspects:

- 1.1 The specification covers Supply of 04 nos. of 11 /0.433 kV, 500 KVA, 3 phase, 50 Hz, double copper wound, plinth mounted, off load tap changer, Delta-star (vector group- Dyn-11) outdoor type, ONAN, **energy efficient transformer, the no load losses and load losses should not exceed 900 Watts. & 5500 Watts. respectively.** The transformer should be supplied complete with all accessories.
- 1.2 Location: The transformers are required to supply at the Store of SSE/Const./HQ Jabalpur (MP).
- 1.3 The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.4 It is not the intent to specify herein complete details of design and construction. The Equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. The design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E.Act and other statutory provisions. No positive tolerance in losses is allowed.
- 1.5 The Tenderer/supplier shall bind himself to abide by these considerations to the entire satisfaction of the purchaser and will be required to adjust such details at no extra cost to the purchaser over and above the tendered rates and prices.
- 1.6 Tolerances:
Tolerances on all the dimensions shall be in accordance with provisions made in the relevant Indian/IEC standards and in these specifications. Otherwise the same will be governed by good engineering practice in conformity with required quality of the product.

2 System Particulars:-

2.1	Nominal System Voltage:	11 kV	433 V
2.2	Corresponding Highest System Voltage:	12 kV	-
2.3	Frequency:	50 Hz with 3 % tolerance	
2.4	Number of Phase:	3	
2.5	Neutral earthing :	Solidly earthed	

3.0 The equipment offered shall be as per specification detailed below:

Technical data:

No. of phases	: Three
Frequency	: 50Hz.
Type of winding	: Double wound Copper.
Class of insulation for winding	: Class-A
Rated output	: 500 kVA
Inter phase connection on HV side	: Delta
Inter phase connection on LV side	: Dyn-11
<u>Voltage ratio:</u>	
High voltage	: 11000V (At no load
Low voltage	: 433V condition)

4 SERVICE CONDITIONS:

4.1 Equipment supplied against the specification shall be suitable for satisfactory operation under the following tropical conditions:-

i	Max. ambient air temperature	: 50 Deg. C
ii	Max. relative humidity	: 100 %
iii	Max. annual rainfall	: 1450 mm
iv	Max. wind pressure	: 150 kg/sq.m.
v	Max. altitude above mean sea level	: 1000 mtrs.
vi	Isoceraunic level	: 50
vii	Seismic level(Horizontal acceleration)	: 0.3 g.
viii	Climatic Condition	: Moderately hot and humid tropical climate conducive to rust and fungus growth.
ix	Reference Ambient Temperature for temperature rise	: 50 deg C

4.2 The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.

5 Applicable Standards:-

- 5.1 Unless otherwise modified in this specification the transformers shall comply with the Indian Standard Specification IS 2026 latest or relevant International Standard acceptable to the purchaser.
- 5.2 Equipment offered shall comply with all currently applicable statutory requirements, regulations and safety codes applicable for design, quality of material and construction, manufacture, inspection and performance.
- 5.3 In case of conflict arising out due to variations between the applicable standard and the standards specified herein the provisions of this specification shall prevail.

6.0 Temperature Rise;

- i The temperature rise for top oil over an ambient temperature of 50 Deg.C should be 50 Deg. C maximum (measured by thermometer in accordance with IS 2026 or relevant International Standard).
- ii Temperature rise for winding over an ambient temperature of 50 Deg. C should be 55 Deg. C maximum (measured by resistance in accordance with IS 2026 or relevant International Standard).

6.1 No load voltage ratio:-

The no load voltage ratio corresponding to the principal tapping shall be 11,000/433 Volts.

6.2 Flux density:-

Flux density should not be more than 1.55 Tesla at the rated voltage and frequency. Transformer core should be designed in such a way that it will not get saturated for any value of V/f (Voltage/frequency) ratio to the extent of 112.5% of rated value of V/f ratio (i.e. 11000/50, 433/50).

7 Core Lamination & coils:-

The grade of core laminations to be used shall be **M4 or better**.

The purchaser reserves the right to get sample of the core material tested at any Government recognized laboratory.

- i. The transformer may be of core type. The core shall be built up with interleaved grade magnetizing, low loss, high permeability, grain – oriented cold rolled silicon steel lamination, properly treated for core materials. The coil shall be manufactured from electrolytic copper of suitable grade. This should be properly insulated and stacked.
- ii. Coils shall be insulated with proper insulating material of required insulation level so that impulse and power frequency voltage stresses are minimum.
- iii. Coil assembly shall be suitably supported between adjacent sections by insulating spacers and barriers. Branching and other insulation used in the

assembly of the winding shall be arranged to ensure a free circulation of oil and reduce the hot spot of the windings and shall be limited to IS : 2026 or latest.

- iv. All leads from the windings to the terminals and bushings shall be rigidly supported to prevent injury from vibrations and short circuits and stresses. Guide shall be used where applicable.
- v. The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformers or under short circuit stress.

7.1 Current Density:

The current density for HV & LV windings should not exceed 250 A/sq.cm. on any working tap including extreme tap.

7.2 Magnetizing Current:-

The magnetizing current at normal voltage & frequency shall be limited to 1% of full load current.

8 TAPPINGS –

- i. OFF- circuit tap changing switch five positions (i.e. -5%,-2.5%, Normal, +2.5%, +5%) with locking arrangement + 5% to -5% in step of 2.5% Off load Tap changer.
- ii. The transformer shall be capable of operation at rated output at any tap position provided the voltage does not vary by more / less than $\pm 5\%$ of the rated voltage corresponding to the normal tape of the transforms.
- iii. The winding including the taping arrangement shall be designed to maintain the electro – magnetic balance between HV and LV windings at all voltage ratios.
- iv. The tapings shall withstand the fault level as per latest ISS for 11 KV and 433V.

9 Impedance Values-

The percentage impedance at 75 ° C. shall be 4% subject to tolerance as per IS 2026-1997 or latest.

10 Losses:-

The losses shall not exceed the values given below:

KV	NO LOAD LOSSES (Watts)	LOAD LOSSES (Watts)
500	900	5500

11 Terminal Arrangement:-

- 11.1 Transformers shall be provided with bushing insulators on both HV & LV sides. The bushings shall be located on opposite sides as per latest version of IS 2026.
- 11.2 The HV insulators should be suitable for connecting jumpers and having bimetallic lugs for jumper connection and the LV side, there shall be arrangement of cable terminal box (three phase and one neutral) suitable for

connecting 3 and ½ core 630/400 sq.mm XLPE/PVC cable. Box shall have water tight sealing all the side and fixing by means of G.I. nuts & bolts.

11.3 The electrical characteristics of bushing insulators shall be in accordance with IS 2029 latest version or relevant International Standard.

11.4 The minimum creepage distance for all the bushings shall not be less than 25 mm per kV.

12 Tolerance:

The tolerance of guaranteed performance figures shall be as specified in the latest issue of IS 2026 except wherever specified otherwise in this specification.

13 Axles and wheels:

The transformers shall be provided with unidirectional heavy duty wheels.

14 Fittings:

Unless otherwise specified in the order, the following standard fittings shall be provided.

The fittings shall be in accordance with the details to the extent these are specified in latest IS: 2026.

- i Inspection covers.(Thickness of inspection cover shall be same as Top of the tank)
- ii Rating and diagram plate to be riveted.
- iii Terminal marking plate.
- iv Two earthing terminals with crimping lugs.
- v Lifting lugs for core and tank.
- vi Radiators.
- vii Conservator with drain plug.
- viii Dehydrating breather (Silica gel type)
- ix Thermometer pocket.
- x Oil level gauge indicating three positions of oil marked as under
 - a) Minimum (-) 5 ° C
 - b) 30 ° C
 - c) Maximum 98 ° C
- xi Oil filling hole with cap.
- xii Pressure relief device.
- xiii Filter valves (lower valve to be also used as drain valve).
- xiv Wheels.
- xv Jacking lugs.
- xvi Sampling valve.
- xvii Marshaling Box: Vermin proof with required glands, locks, glass door, terminal Board, heater with switch, illumination lamp with switch, terminal connectors etc.

TEMPRATURE INDICATORS –

- i. One set of winding temperature indicators shall be supplied for the transformer. The set shall be fitted locally in the marshaling box so as to be readable as a standing height from the ground level.
- ii. The local winding temperature indicators shall be provided with necessary contacts to take care of the following –
 - a. Alarm of high temperature
 - b. Trip on high temperature.
- iii. One set of top oil temperature indicator with maximum reading pointer and electrically separate sets of contact for alarm and trip shall be mounted locally in the marshaling box so as to be readable at a standing height from the ground level.
- iv. Dial type thermometer of suitable range with maximum reading pointer and 2 Mtr capillary tubing.
- v. Explosion vent.

15 Transformer Oil

Transformer oil to be used in all the transformers shall comply with the requirements of latest IS 335 or relevant.

16 Tank

- 16.1 The transformer tank and cover shall be fabricated from good, commercial grade, low carbon steel plate of minimum 6 mm thick for side wall and 8 mm thick for top and bottom cover.
- 16.2 The tank and cover shall be of welded construction. All seams shall be welded and wherever practicable, they shall be double welded. The tank weld shall be reinforced by stiffeners of structural steel for general rigidity. The tank shall have sufficient strength to withstand without permanent distortion under following conditions:
 - i Oil filling under vacuum.
 - ii Continuous internal gas pressure of 35 KPa with oil at operating level.
 - iii Normal Mechanical shock during transportation, loading and unloading operations.
 - iv Manufacturer shall provide copy of type test certificate.
- 16.3 The tank cover shall be bolted to the tank and the transformer design shall be such that the tank will not be split between the lower and upper cooler connection for unloading.
- 16.4 The tank of the transformer shall be complete with all accessories and shall be designed so as to allow the complete transformer filled with oil to be lifted by crane or jack transported by road, rail or water way without over straining any joints and without causing subsequent leakage of oil.
- 16.5 The main tank body excluding tap changing compartments, radiators and coolers shall be capable of withstanding following vacuums.

Vacuum gauge pressure (KN/sq.m.)	mm of Hg
68.0	500

- 16.6 The base of each tank shall be so designed that it shall be possible to move the complete transformer unit by skidding on plates or rails in any direction without injury.
- 16.7 Suitable guides shall be provided for positioning the core.
- 16.8 All Control cabinets and marshalling kiosks being supplied as transformer accessories. No cabinet or marshalling kiosk shall be mounted on radiators.
- 16.9 The thermometer pockets shall be fitted with captive screwed top to prevent the ingress of water.
- 16.10 The thermometer pockets shall be located in the position of maximum oil temperature at continuous Maximum rating and it shall be possible to remove the instrument bulbs without lowering the oil in the tank.
- 16.11 The tank cover and the inspection covers shall be provided with suitable lifting arrangements. Inspection covers shall not weigh more than 25 Kg. each.
- 16.12 Cleaning and Painting.
- i Before painting or filling with oil, the external surfaces of transformer tank and structural steel work shall be completely cleaned and made free from rust, scale and grease by applying shot blasting or sand blasting. Cavities on castings shall be filled by metal depositions.
 - ii The interior of transformer tank, other oil filled chambers and internal structural steel work shall be cleaned of all the scales and rust by application of standard approved methods. There after these surfaces shall be painted with hot-oil resistant varnish or paint.
 - iii Except for nuts, bolts and washers which may have to be removed for maintenance purposes all external surfaces shall receive minimum of four coats of paint. The total paint thickness shall be in the range of 52 to 60 microns.
 - iv The 1st and 2nd coats of painting shall be of primer and shall be applied immediately after cleaning. The 3rd coat shall be of an oil and weather resisting quality, preferably given a fungicide treatment and of a shade or color easily distinguishable from the primary coats and shall be applied after the primary coats have been touched up where necessary. The final coats shall be of glossy oil finish and weather resisting non-fading paint (Olive Green) of latest IS or relevant International Standard. Primer paint shall be ready mix Zinc chromates. Intermediate and final coat of paint shall be as per IS 2932 or relevant International Standard.

17 Lifting and Haulage facilities:

- 17.1 Lifting eyes or lugs shall be provided on all parts of the transformer, which require independent handling during loading, unloading, assembly or dismantling. In addition, the transformer tank shall be provided with lifting lugs, bosses and jacking pads properly secured to the sides of the tank for lifting the transformer complete with oil either by crane or by jacks.
- 17.2 The transformer shall also be provided with suitable haulage holes on the four sides with suitably braced, pulling eyes for haulage of the transformer in longitudinal as well as transverse directions.

18 Windings:

- 18.1 Insulation of L.V. winding shall be adequate to withstand surge voltages appearing across them as a result of transfer due to an impulse striking on HV terminals.
- 18.2 The stacks of windings shall receive adequate shrinkage treatment before and after final assembly. Adjustable devices if necessary shall be provided for taking up possible shrinkage of coils if any, in service. The provisions made in this respect shall be clearly brought out in the Bid.
- 18.3 The conductor used for the coil shall be electrolytic grade copper conforming to the relevant Indian Standard specification.
- 18.4 The conductors shall be transposed at suitable intervals in order to minimize eddy current and to equalize the distribution of current and temperature alongwith windings.
- 18.5 The winding shall be so designed that all coil assembly of identical voltage rating shall be interchangeable and field repairs to the windings can be made without special equipments.

19 Minimum clearances:

Following minimum clearances in air and oil shall be maintained

Voltage	Phase to phase	Phase to ground	
		Out of Oil.	In Oil
433 V	85 mm	40 mm	12 mm
11 kV	280 mm	140 mm	25 mm

20 Conservator vessels, Oil Gauges & Breathers:-

- 20.1 A conservator complete with sump and drain valves shall be provided in such a position as not to obstruct the electrical connections to the transformer, having a capacity between the highest and the lowest visible levels to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment from the minimum ambient temperature i.e. -5 Deg. C to 98 Deg.C. The minimum indicated oil level shall be with the feed pipe from the main tank covered with not less than 25 mm depth of oil and the indicated range of oil level be from minimum to maximum.
- 20.2 Conservator will have volumetric capacity of at least 10 % of total volume of oil in the tank. Moreover the oil in conservator upto the minimum level mark on the oil level gauge should be at least 3 % of the total volume of oil in the

transformer. The conservator shall also be provided with oil filling hole, cap, drain valve, 15-mm air release plug and silica gel breather. The size of the drain valve shall be 15 mm for Conservator diameter of 650 mm and below. For higher size of the Conservator, the drain valve shall be of 25 mm size. It shall be possible to completely drain the oil from Conservator when it is installed in its normal position on the transformer.

- 20.3 Equaliser pipe shall be provided.
- 20.4 The oil connection from transformer tank to the Conservator Vessel shall be arranged at a rising angle of 3 to 9° to the horizontal up to the Bucholz Relay and shall consist of 50 mm. inside diameter pipe as per latest IS 3639 or equivalent International Standard.

21 Bushing Insulators and Terminals:-

- 21.1 The transformer shall be fitted with bushing insulators having suitable characteristics.

Preference will be given to vertically mounted bushings. The main winding and neutral leads shall be brought out through out-door type of bushings which shall be so located that full flash over strength will be utilized. Wherever neutral current transformers are required, accommodation for the same is required to be provided on the neutral terminal bushing and the bushing shall be so arranged that it can be removed without disturbing the current transformer, secondary terminals and other connections or pipe work.

- 21.2 Each terminal, including the neutral, shall be distinctly marked on both primary and secondary in accordance with the connection diagram fixed upon the transformer which shall conform to latest IS 2026 (Part IV).

22 Gasket Joints:-

For gasket joints wherever used, nitrite betel rubber gasket or Neoprene cork gasket shall be used. The gaskets shall be placed in properly machined grooves with adequate space for accommodating the gaskets under compression. Suitable mechanical stops shall be provided to prevent crushing of gaskets.

23 Over Loading:-

The transformer shall be suitable for operating under overload condition as specified in IS 6600 and a separate Over Loading chart should be submitted.

24 Rating and Diagram Plate & Valve Schedule Plate.

- 24.1 The transformer shall be provided with non-corrosive, legible (in Hindi and English) rating and diagram plate of minimum 18 SWG Brass material. Rating and diagram plate shall be riveted to the transformer tank. The rating and diagram plate shall bear data as specified in Part-3 of IS 2026 or relevant International Standard. The plate shall also bear Name of purchaser viz. West Central Railway in full.

24.2 A plate showing the location and function of all valves and air release cocks or plugs shall be provided.

24.3 In addition to the above a plan of the transformer giving the correct physical relationship of the terminals shall be clearly indicated on the rating and diagram plate.

25 Test and Inspection:-

25.1 Routine Tests:-

All transformers shall be subjected to the following routine tests at the manufacturer's works. The tests are to be carried out in accordance with the details specified in IS 2026 or as agreed upon between the purchaser and the manufacturer.

- a) Measurement of winding resistance.
- b) Ratio, polarity and phase relationship.
- c) Impedance voltage.
- d) Load losses.
- e) No-load losses and No-load current.
- f) Insulation resistance.
- g) Induced over voltage withstand.
- h) Separate source voltages withstand.
 - i) Oil leakage gas collection, oil surge and voltage tests on gas and oil actuated relays.
 - ii) All the routine tests shall be conducted in the suppliers' laboratory at their cost.
 - iii) Heat run test shall be arranged free of cost on the manufacturing unit.**

26 Type Tests:-

26.1 The successful tenderer shall furnish the following successful type tests reports of NABL or other recognised laboratories. (Latest but should not be more than 5 years) (alongwith General arrangement drawing, Rating and Diagram Plate and Internal Constructional drawing).

- i. Impulse – Voltage withstand test, for which zerox copy of the certificate on the test carried out on a similar voltage ratio transformer will be accepted.
- ii. Temperature rise test to be conducted before dispatch.
- iii. Short circuit Test report of similar voltage rating.

27 Vacuum Test: -

The tank of a Transformers (excluding tap changing compartment, radiators and coolers) shall be able to withstand a vacuum gauge pressure of 68.0 KN/sq.m. (500 mm. of Hg).

28 Transformer oil:-

To ascertain the quality of the transformer oil, the original manufacturer's test report should be submitted at the time of inspection. Also arrangements should

be made for testing of transformer oil, after taking out the sample from the manufactured transformer.

29 Rejection:-

29.1 Apart from rejection due to failure of the transformer to meet the specified test requirements the transformer shall be liable for rejection on any one of the following reasons.

- i No load loss exceeds the values mentioned in this specification.
- ii Load loss exceeds.
- iii Impedance voltage value exceeds the specified values.
- iv Type test are not carried out as per specification.
- v Drawings are not submitted as per the specification.
- vi GTP not submitted as per the specification.

30 Inspection:-

30.1 RITES will be the Inspecting authority.

30.2 RITES will depute his representative at the time of inspection. Inspecting authority will inspect the transformer at different stages during manufacturing viz Core lamination as per clause mentioned at 5.6, winding process, vacuum test etc and any other stage as deemed fit by inspecting authority and certificate in this effect will be produced.

30.3 The transformer will be tested for acceptance tests at factory, in the presence of Rites representative, before dispatch.

30.4 The successful tenderer shall grant free access to the inspection authorities/representatives at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications and shall not prevent subsequent rejection if the equipment is found to be defective.

31 Drawings & manuals:-

A set of following drawings shall be submitted by the tenderer.

- i General Dimensional drawing.
- ii Core details drawing.
- iii Rating & Diagram Plate Drawing.
- iv HV/LV Bushings drawing
- v Marshaling Box with connection diagram.
- vi O&M Manual in Duplicate.

31.1 The tenderer should also supply alongwith his offer the pamphlets/literatures etc. for Oil surge relay, Breather etc.

31.2 The tenderer should adhere to the design once offered during execution of the order, if placed with him and no changes shall be made without prior approval of the purchaser.

32 SPECIAL CLAUSE –

The transformers shall be identical in all respects. The tender shall be accompanied with the schedule of technical particulars as per Annexure – I attached.

Tender shall indicate the make, and also furnish complete technical details illustrated descriptive literature.

The successful tenderer shall furnish dimensional drawing for the transformer with all the fittings to Dy.CEE/C/WCR JBP for prior approval.

33. Packing and Marking –

The transformers shall be dispatched securely packed in wooden crates suitable for handling during transit by rail / road so as to avoid any loss or damage during transit.

B. Guarantee:

- (a) The guarantee clause shall be applicable as per IRS conditions.
- (b) During the period of guarantee the contractor shall provide an experienced engineer and necessary equipment to attend to any defects with in 72 Hrs from the time of information conveyed to the supplier by any means. In case if any time delay happened on the part of the supplier to rectify/attend any defects within the guarantee period, the administration reserves the right to take appropriate action and impose penalty as deemed fit on the supplier.
- (c) During the period of guarantee, the contractor shall be liable for the replacement any parts at site which may be found defective, whether arising from faulty design, materials, workmanship or negligence in any manner on the part of the manufacturer/supplier provided always that such defective parts as are not repairable at site are promptly returned to the contractor if so required by him at his (supplier's) own expenses.
- (d) The repaired or renewed parts shall be delivered and erected on site free of charge at site within reasonable time.

C. Payment terms

The payment terms shall be governed as under.

95% payment of shall be made on proof of dispatch and inspection certificate of RITES and balance 5% payment after receipt and acceptance of material by the consignee.

- D. The contract shall be governed by all applicable clause as per IRS.

ANNEXURE – I

500 KVA TRANSFORMER

- 1. Name of manufacturer

2.	Service	Continuous / Intermittent
3.	Ratings	
	(i) Rated	.....KVA
	(ii) Rated voltage of HV	.....KV
	(iii) Rated voltage of LV	.....KV.
	(iv) Temperature rise in oil resistance of winding	.....°C
	(v) Rated frequency	.....Hz.
4.	No. of phase.	.....
	Connections –	
	(i) High Voltage	.....
	(ii) Low voltage	.....
	(iii) Vector group reference	.....
5.	Taping (High voltage) %
6.	No. of load loss at rated voltage and frequency	.....Watts.
7.	Load loss at rated current at 75° C	.....Watts.
8.	Impedance at rated current and frequency at 75° C %
9.	Reactance at rated current and frequency%
10.	Efficiency at at 75° C at unity power factor.	
	(i) At full load %
	(ii) At ¾ th Full load %
	(iii) At ½ full load %
11.	Regulation at full load At 75° C	
	(i)At unity power factor.%
	(ii) At 0.5 power factor lagging%
12.	No load current at rated voltage and frequency%
	Approximate weight	
	(i) Core and winding	..... Kg.
	(ii) Tank and fittings	..... Kg.
	(iii) Oil	..... Kg.
	(iv) Total weight	..... Kg.
13.	Approximate quantity of oil	..... Ltrs.
14.	Approximate overall dimensions –	
	(i) Length	..... mm
	(ii) Breadth	..... mm
	(iii) Height	..... mm.
15.	Terminal arrangement	
	(i) High voltage.	.....
	(ii) Low voltage.	