

Annexure -1

1	Introduction	Bharat Heavy Electricals Limited (BHEL), Hyderabad is setting up a 1MWh Battery Energy Storage System. The plant employs outdoor, oil-immersion type, ONAN, 3-phase, 2-winding 650 kVA transformer to step up the Inverter non sinusoidal output connected at 415 V LV side, to 6.6 kV HV level. This document details the technical specifications of the required transformer
2	Scope for the Vendor	1) Supply of Outdoor, Oil-immersion type, 3-phase, 2-winding with one LV winding and one HV winding, 650 kVA, 6.6kV /415 V Transformer Spares shall be offered as below: 1) Winding temperature indicator with alarm and trip contacts 2) Oil temperature indicator with alarm and trip contacts 3) Gaskets 4) Buchholz relay with alarm and trip contact 5) Pressure relief valve with alarm and trip contact 6) Magnetic oil level gauge 7) Tap changer contacts 8) diaphragm of explosion vent Vendor shall provide unit price for the individual items Item-wise price per unit (Number / Set) shall be offered.
3	Technical Specifications	Vendor should provide compliance with the specifications given by BHEL. In case of non compliance or deviations, vendors should provide their comments
	Transformer type	Outdoor, oil-immersion type
	IP class	Transformer, including the cable and marshalling boxes, shall be of IP55. Transformer will be placed directly under sunlight without any shelter or shade.
	Type of cooling	ONAN
	Governing Standard	IS: 2026 / 1977
	Rating in KVA	650 kVA
	No. of phases	3
	Frequency	50 Hz, +/- 3%
	Vector group	Dyn11
	HV winding	One 3-phase winding with Delta connection. HV voltage: 6.6 kV (LL)
	LV windings	One 3-phase winding with Star connection. LV voltage: 415 V (LL)
	Winding material	Electrolytic grade Copper for both HV and LV windings
	Winding Insulation	Class A
	Neutral on LV side	Neutral terminals of the winding to be brought out separately to facilitate making external connections such as earthing.
	Termination HV/LV	Cable box / Cable box with suitable Cable Glands .
	Cable entry on HV side	Bottom entry of cables.
	Cable entry on LV side	Bottom entry of cables.
	Taping on HV winding	Off circuit tap switch with +5%, +2.5%, 0, -2.5%, -5% tap provisions. (totally, five positions).
	Ambient temperature	Max 50 deg C
	Temperature rise	For 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
	Load loss at principal tap at 75 C, with IS tolerance	This shall be provided by vendor.
	No Load loss at rated voltage on principal tapping and at rated frequency, with IS tolerance	This shall be provided by vendor.
	No load current at rated voltage and rated frequency	This shall be provided by vendor. To be indicated as percentage of full load
	Efficiency at 75 C, UPF	Minimum 98.5% at full load (100%). Efficiencies at 75% and 50% loads to be indicated by vendor.
	Harmonics	The application is grid-connected Battery energy storage system. HV side (6.6 kV) of transformer is connected to already existing and operational grid supply. LV side winding is fed by Inverter of rating 650KVA. The output of the inverter is not pure sinusoidal. Harmonics upto 5th order can be injected and the design has to be done accordingly .
	Vibration & noise	Noise level shall be according to NEMA TR-1 standard
	Percentage impedance	<6 %
	Oil quantity required to be filled in transformer (in Liters)	This shall be provided by vendor. This is for purpose of future maintenance of transformer.
	Weight of transformer in Kg and Overall dimensions in mm	This shall be provided by vendor

	Painting	Painting (Transformer and accessories): Epoxy Shade: 631 as per IS 5
	Constructional features	Transformer shall be constructed in accordance to IS: 2026 or equivalent international standard. All materials used shall be of best quality and of the class most suitable for working under the conditions specified. These shall withstand the variations of temperature and atmospheric conditions, overload, over-excitation, short-circuits as per specified standards without distortion or deterioration, without development of stresses in any part and also without affecting the strength and suitability of the various parts for the work that they have to perform. Tank : The transformer tank and cover shall be fabricated from high grade low carbon plate steel. Core:The magnetic circuit shall be constructed from high grade cold rolled non-ageing super grain oriented silicon steel laminations (CRGOS) and shall be of 'core' type. Windings:Windings shall be of electrolytic grade copper. 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. Termination:Transformers shall be fitted either with with cable boxes / cable box with disconnection chambers Bushings shall be designed and tested to comply with the applicable standards. Vendor shall provide a marshalling box and marshal to it all the contacts / terminals of electrical devices mounted on the transformer.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 wires in GI conduit or PVC insulated, armoured cable. Oil:Transformers shall be supplied complete with transformer oil. The new insulating oil before pouring into the transformer shall conform to the requirement of IS: 335.
4	Fittings and accessories (Reference standard: IS 3639)	Following fittings per transformer shall be provided. Vendor shall indicate compliance (Yes / No) for each line item. In case of non-compliance or deviation, vendor shall indicate and provide comments 1) Oil conservator with equalizer pipe 2) HV cable box 3) HV disconnecting chamber 4) LV cable box 5) LV disconnecting chamber 6) Off circuit tap changing switch with operating knob, tap position marking and locking facility, with warning plate "Tap switch to be operated only with the transformer de-energized". 7) Neutral bushings for earthing of LV windings 8) Earthing terminals with hardware suitable for connecting earth strip. Separate terminals shall be provided for cable boxes, tank, etc. 9) Radiators with drain, air plug, top & bottom shut-off valves, lifting lugs 10) Buchholz relay with alarm and trip contact 11) Provision for collecting gas and oil from Buchholz relay 12) Silica gel dehydrating breather with oil cup 13) Magnetic oil level gauge (dial type) with alarm contact, minimum and maximum filling level markings. 14) Prismatic oil level gauge with min and max markings 15) Pressure relief valve with alarm contacts. Location of this valve shall be such that the hot oil discharge shall not fall on the transformer or any of its parts. 16) Explosion vent (double diaphragm) with sight glasses and equalizing pipe connection to conservator 17) Thermometer pocket for OTI 18) Temperature sensor for OTI 19) Thermometer pocket for WTI 20) OTI and WTI indicators 21) MarshalMarshalling box (IP55) provided with removable gland plates and glands for cable entry from bottom side. Alarm and trip contacts shall be suitable for 240 V ac and contacts shall be of potential free digital status output 22) Inspection window with cover 23) Cover lifting lugs 24) Core and winding lifting lugs / eyes 25) Tank lifting lugs for the entire transformer 26) Jacking pad with hauling eyes, to enable transformer with oil to be raised or lowered using hydraulic or screw jacks 27) Bi-directional flat rollers 28) Base channel with towing holes / lugs 29) Air release hole with plug

		30) Oil filling hole with cap 31) Top filter valve with blanking plug 32) Drain valve (top of the tank) 33) Shut-off valves for conservator 34) Sampling valve, with blanking plug 35) Drain valve for conservator, with blanking plug 36) Shut-off valves for radiators, with open and close markings 37) Bottom filter valve,
5	Inspection and testing of transformer at vendor works	Vendor shall provide inspection call to BHEL for the type and routine tests. Prior to the call, vendor shall submit the detailed quality plan, at least one month in advance
5.1	Routine tests as per IS 2026	Following tests shall be carried out on 100% basis. BHEL will witness the tests at vendor works. 1) Measurement of winding resistance 2) Measurement of voltage ratio 3) Vector group check 4) Polarity check 5) Measurement of no-load loss and current 6) Measurement of impedance voltage / short-circuit impedance, load loss 7) Measurement of insulation resistance 8) Dielectric tests a. Separate source voltage withstand test b. Induced overvoltage withstand test
5.2	Type tests as per IS 2026	Temperature rise test Heat run test
6	Documents to be submitted after receipt of PO	Following documents shall be submitted within seven days from date of purchase order. (1) Detailed transformer drawings for (a) Overall General Arrangement (plan, elevation, end view) with overall dimensions and bill of accessories. (b) Rating plate details (c) Valve schedule plate details with elevation and 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 (front view, side view, bill of items) and wiring diagram (g) Foundation plan (j) Untanking details (removal of core and assembly from tank) (2) Guaranteed technical specification of transformer in line with Appendix-B (schedule of technical particulars to be furnished by manufacturer) of IS:2026 (part-1)-1977. (3) Quality assurance plan (routine tests, type tests, test certificates) covering incoming materials, stagewise inspection during manufacturing, finished goods, packing and forwarding
7	Documents to be submitted along with the consignment	Following documents shall be submitted to BHEL at the time delivery of the consignment. (1) As built drawings of transformer (2) Routine test reports on transformer (3) Type test reports on transformer (4) Operations and maintenance manual