ANNEXURE-I

Technical Specification of

1) 500kVA, 11/0.433kV, 50Hz, Three phase transformer

2) 250kVA, 11/0.433kV, 50Hz, Three phase transformer

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Clause No.	TECHNICAL SPECIFICATION
1.0	**FOREWORD** Central Power Research Institute (herein after referred to as CPRI) intends to establish 40,000A temperature rise test facility at High Power Laboratory (HPL) in Bengaluru in order to perform the temperature rise test upto 40kA on MV Bus ducts, MV/HV Circuit Breakers, MV/HV Switchgear and Control gear, HV Switches and HV Disconnectors. This Specification covers the supply of 1) 500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)1 2) 250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)2 complete with all accessories, for establishment of 40,000A Temperature Rise Test Facility at High Power Laboratory, CPRI-Bengaluru, India.
2.0	**GENERAL**
2.1	500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) and 250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) covered by this specification will form part of the new 40,000A Temperature Rise Test Facility in High Power Laboratory, CPRI, Bengaluru, India.
2.2	The features of such transformer are; 250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)2 is an auxiliary transformer for 40,000A Temperature Rise Test Laboratory. 500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)1 is able to deliver continuous input to 250kVA, 440V, 50Hz, Three phase Static Frequency Converter. The output of SFC (0-400V, 250kVA, 50 and 60Hz) is step up to 3.3kV using 250kVA, 0.4/3.3kV, 50 and 60Hz, Three phase transformer (01 No.) – TR(3.3). The output of this transformer is connected to 40kA transformer in temperature rise test on MV Bus ducts, MV/HV Circuit Breakers, MV/HV Switchgear and Control gear, HV Switches and HV Disconnectors.
3.0	**SCOPE**
3.1	This specification covers the design, engineering, manufacture, assembly, stage inspection, testing at manufacturer's works, Type and Special tests, design inputs for foundation, packing and transportation, insurance, supply, loading, unloading, handling, storage, erection installation, site testing and commissioning of 1) 500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)1 2) 250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)2 complete with all fittings, and spares for establishment of 40,000A Temperature

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	Rise Test Facility at High Power Laboratory, CPRI-Bengaluru, India.
3.2	The supplier shall be responsible for the following activities: • Design and engineering • Manufacturing • Factory tests • Type and Special tests • Transportation to site, unloading, handling and proper storage at the site • Erection • Site tests • Commissioning of the new transformers complete with all fittings, accessories and spares.
3.3	The transformers shall be operated continuously in three phase configuration and single phase configuration and will be fed by 11kVrms (Line to Line) laboratory supply for transformers (TR(11)1 & TR(11)2) and 0.4kV for transformer (TR(3.3)) as shown in fig (1).
3.4	**Interfaces to be provided by CPRI:** CPRI shall provide the following interfaces: **(a) Electrical interfaces:** • 11kV, 50Hz, Line to Line supply from 11kV substation through XLPE cable • 400V, 50 and 60Hz, Line to Line supply from SFC output • 415 V, 3-phase supply and 230 V single phase supply for all control and measurement system **(b) Mechanical/Civil interfaces:** • Foundation (transformer foundation details shall be provided to CPRI for civil works) **(c) Control interfaces:** • Interface with the laboratory automation and protection system.
4.0	**CLIMATIC CONDITIONS**
4.1	500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)1 and 250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)2 and their accessories shall be designed for satisfactory operation under tropical climatic conditions prevailing in India.

<table>
<tr><th>Clause No.</th><th>TECHNICAL SPECIFICATION</th></tr>
<tr><td>4.2</td><td>The climatic conditions prevalent at the site of the operation are as follows;
<table>
<tr><td>Altitude above Mean Sea Level</td><td>: 920 m</td></tr>
<tr><td>Maximum ambient temperature</td><td>: 50°C</td></tr>
<tr><td>Minimum ambient temperature</td><td>: 10°C</td></tr>
<tr><td>Average Humidity</td><td>: 81%</td></tr>
<tr><td>Special corrosion conditions</td><td>: Nil</td></tr>
<tr><td>Solar Radiation (DNI)</td><td>: 4.5-5.0 kWh/Sq. m/Day</td></tr>
<tr><td>Atmospheric UV radiation</td><td>: High</td></tr>
<tr><td>Pollution level</td><td>: Moderate</td></tr>
<tr><td>Snow fall</td><td>: Nil</td></tr>
<tr><td>Seismic Zone</td><td>: Zone-II</td></tr>
<tr><td>Wind Speed</td><td>: Average 5.6 km/h</td></tr>
<tr><td>Annual rainfall</td><td>: 1000mm-1500mm</td></tr>
</table>
4.3
The site location is situated in the CPRI campus located adjacent to Indian Institute of Science. The site can be approached
a) By Train: Nearest Railway station: Yeshwanthpur
b) By Air: Kempegowda International airport 33 km away from site.
c) Nearest Sea Port: Chennai</td></tr>
<tr><td>5.0
5.1</td><td>SYSTEM PARTICULARS
1) 500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)1
2) 250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)2 and shall form part of the unit system of various apparatus as shown in Figure 1, page 17 of 20 of this document.</td></tr>
<tr><td>6.0
6.1</td><td>STANDARDS
500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)1 and
250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)2
along with accessories shall comply with the requirements of the latest edition of the following Standards and requirements of this specification :
1) IS Standard IS 1180 (Part 1) : 2014, Outdoor Type Oil Immersed Distribution Transformers upto and including 2500kVA, 33kV Specification– Part 1: Mineral oil immersed.
2) IS Standard 2026-1:2011 (Reaffirmed 2016), Power Transformers – Part 1: General</td></tr>
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<table>
<tr><th>Clause No.</th><th>TECHNICAL SPECIFICATION</th></tr>
<tr><td></td><td>3) IS Standard 2026-2:2010 (Reaffirmed 2020), Power Transformers – Part 2: Temperature rise
4) IS Standard 2026-3:2018/IEC 60076-3:2013, Power Transformers – Part 3:
Insulation levels and dielectric tests
5) IEC Standard 60076-4, Power Transformers – Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors
6) IS Standard 2026-5:2011 (Reaffirmed 2016), Power Transformers – Part 5: Ability to withstand short circuit
7) IS 2026 : Part 10 : 2009/IEC 60076-10 : 2001, Power transformers - Part 10: Determination of sound levels
8) IEC Standard 60137, Insulated bushings for alternating voltages above 1000 V
9) IEC Standard 60296, Fluids for electro-technical applications – Unused mineral oils for transformers and switchgears.</td></tr>
<tr><td>6.2</td><td>In the matter of conformity, the following order shall be binding:
• The requirements of this specification
• The latest versions of IS/IEC Publication
• To the latest versions of other national/international standards/codes as applicable to the relevant equipment or component or the material used in the manufacture of the same.
• In the event a requirement is not covered by any of the above mentioned documents the same will be decided by mutual agreement between the purchaser and the supplier.
• Moreover reference has to be made to all applicable Indian laws.</td></tr>
<tr><td>7.0</td><td>MAIN TECHNICAL CHARACTERISTICS
The below Tables summarizes the main technical characteristics of
1) 500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)1 and
2) 250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)2.
Table 1 - Main technical requirements of
500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)1
<table>
<tr><th>Characteristics</th><th>Ratings</th></tr>
<tr><td>Type</td><td>Outdoor, Oil immersed, ONAN,
Non-Sealed Type Transformer</td></tr>
<tr><td>Rated power</td><td>500 kVA</td></tr>
<tr><td>Number of phases</td><td>3</td></tr>
<tr><td>Number of windings</td><td>2</td></tr>
<tr><td>Operating frequency</td><td>50 Hz</td></tr>
</table>
</td></tr>
</table>

Clause No.	TECHNICAL SPECIFICATION		
	Winding characteristics:	Primary	Secondary
	Rated voltage	11000.0 V	433.0 V
	Taps	+7.5% to -7.5% insteps of 2.5% each	-
	Rated current	26.24 A	656.1 A
	Insulation	Uniform	
	Highest System voltage	12 kV	1.1 kV
	Power Frequency (PF)	28 kV_{rms}	3 kV_{rms}
	Lighting Impulse (LI)	75 kV_{peak}	-
	Vector group	Dyn11	
	Neutral terminal	Accessible	
	Terminals characteristics:	Primary	Secondary
	Type	Porcelain Bushing	Epoxy Bushing
	Rated voltage	17.5 kV	1.1 kV
	Minimum external phase to phase and phase to earth clearances of bushing terminals shall be	255mm (phase to phase) 205mm (phase to earth)	75.0 mm (phase to phase) 55.0 mm (phase to earth)
	Power Frequency (PF)	28.0 kV_{rms}	5 kV_{rms}
	Lighting Impulse (LI)	95.0 kV_{peak}	20 kV_{peak}
	Terminal Details of connection: suitable for	12 kV cable - Bushings inside air-insulated Cable box	440V cable - Bushings inside Cable box
	Short-circuit impedance on Principal tap at 75˚C at rated 250 kVA	4.0% ± IS tolerance	
	Total Losses (No load losses + Load losses at 75˚C)	4300.0 W (Maximum) at 100% load 1510.0 W (Maximum) at 50% load (Energy efficiency Level 2 as per IS:1180-1(2014))	
	Installation	Outdoor	
	Voltage variation through	Off Circuit Tap Changer (OCTC) switch with tap positions on HV side	
	Duty cycle	Continuous	
	Type of cooling	ONAN	
	Average winding temperature rise limit	45°C above the ambient temperature	

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Average oil temperature rise limit	40°C above the ambient temperature
Audible maximum permissible sound levels (decibels) at rated voltage and frequency	56.0 dB

Table 2 - Main technical requirements of

250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) – TR(11)2

Characteristics	Ratings	
Type	Outdoor, Oil immersed, ONAN, Non-Sealed Type Transformer	
Rated power	250 kVA	
Number of phases	3	
Number of windings	2	
Winding characteristics:	Primary	Secondary
Rated voltage	11000.0 V	433.0 V
Taps	+7.5% to -7.5% insteps of 2.5% each	-
Rated current	13.12 A	333.4 A
Insulation	Uniform	
Highest System voltage	12 kV	1.1 kV
Power Frequency (PF)	28 kV_{rms}	3 kV_{rms}
Lighting Impulse (LI)	75 kV_{peak}	-
Vector group	Dyn11	
Neutral terminal	Accessible	
Terminals characteristics:	Primary	Secondary
Type	Porcelain Bushing	Epoxy Bushing
Rated voltage	17.5 kV	1.1 kV
Minimum external phase to phase and phase to earth clearances of bushing terminals shall be	255mm (phase to phase) 205mm (phase to earth)	75.0 mm (phase to phase) 55.0 mm (phase to earth)
Power Frequency (PF)	28.0 kV_{rms}	5 kV_{rms}
Lighting Impulse (LI)	95.0 kV_{peak}	20 kV_{peak}
Terminal Details of connection: suitable for	12 kV cable - Bushings inside Air-insulated Cable box	433V cable - Bushings inside Air-insulated Cable

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		box
	Frequency	50 Hz
	Short-circuit impedance on Principal tap at 75˚C at rated 250 kVA	4.0% ± IS tolerance
	Total Losses (No load losses + Load losses at 75˚C)	2930.0 W (Maximum) at 100% load 980.0 W (Maximum) at 50% load (Energy efficiency Level 2 as per IS:1180-1(2014))
	Installation	Outdoor
	Voltage variation through	Off Circuit Tap Changer (OCTC) switch with tap positions on HV side
	Duty cycle	Continuous
	Type of cooling	ONAN
	Average winding temperature rise limit	45°C above the ambient temperature
	top oil temperature rise limit	40°C above the ambient temperature
	Audible maximum permissible sound levels (decibels) at rated voltage and frequency	56.0 dB

8.0 **DESIGN RECOMMENDATIONS AND SAFETY MEASURES**

The equipment has to be designed, manufactured and tested in accordance with the best international engineering practices under stringent quality control to meet the requirement stipulated in the technical specifications. Adequate safety margin with respect to thermal, mechanical, dielectric and electrical stress etc. are to be considered during design, selection of raw material, manufacturing process.

The manufacturer shall take all necessary measures to ensure the safety of the test operator during the execution of the tests.

The construction details of 500kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) and 250kVA, 11/0.433kV, 50Hz, Three phase transformer (01 No.) shall be in accordance with the requirements given in the following paragraphs.

8.1 **Construction details of Transformers:**

The construction details of Transformers concerns the following requirements:

8.1.1 **Tank:**

The Transformer tank shall be provided with:

a) Four symmetrically placed lifting lugs through which it is possible to lift the complete transformer when filled with oil without structural damage to any part. The lifting lugs shall be so arranged and located as to be accessible for use when the Transformer is loaded on the transport vehicle.

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	A minimum of four jacking pads in accessible position to enable the transformer, filled with oil, to be raised or lowered using hydraulic jacks. Each jacking pad shall be designed to support with an adequate factor of safety for at least half of the total mass of the transformer filled with oil allowing in addition for maximum possible misalignment of the jacking force to the centre of the working surface. b) Suitable haulage holes. The tank shall be designed in such a way that it can be mounted either on the plinth directly or on rollers, as per manufacturer's standard practice. The base of the tank shall be so designed that it shall be possible to move the complete Transformer unit by skidding in any direction without injury when using plates or rails. c) Conventional plain tank shall be constructed. The Transformer tank and cover shall be fabricated from good commercial grade low Carbon Steel suitable for welding & of adequate thickness. The tank wall should be of thickness 4.0 mm. Top and bottom plate should be of 6.0 mm thickness. Tolerance as per IS : 1852 shall be applicable. d) Painting & Finishing: Steel surface shall be prepared by sand / shot blast or chemical cleaning including Phosphating, as per IS 3618. Inside of tank shall be painted with varnish or oil resistance paint with 30 microns (minimum). For external surface, one coat of thermo-setting powder paint or one coat of epoxy primer Total Dry film thickness of 60 microns (minimum) as per IS 1180 Part-1 2014.
8.1.2	**Core:** The core shall be constructed with prime quality, non-ageing, cold rolled, grain oriented (CRGO), silicon steel laminations to meet specific no-load losses at rated voltage operation. No load current shall not exceed 2% of full load current by energizing the transformer at rated voltage and rated frequency. Flux density at rated voltage and frequency of core and yoke shall not be more than 1.55 Tesla. The Over fluxing shall be limited to 12.5% of rated value and flux density at 112.5% of rated voltage does not exceeds by 1.9 Tesla. The design of the magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earthed clamping structure and production of flux component at right angles to the plane of laminations which may cause local heating. The supporting framework of the core shall be designed to avoid presence of pockets which would prevent complete emptying of tank through drain valve or cause trapping of air during oil filling. Adequate lifting lugs will be provided to enable the core and windings to be lifted.

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	In case core laminations are divided into sections by insulating barriers or cooling ducts parallel to the plane of the lamination, tinned copper bridging strips shall be inserted to maintain electrical continuity between sections. A drawing including the details of the internal earthing design shall be included in the user manual.
8.1.3	**Windings:** The primary and secondary windings of transformer shall be separated to assure a galvanic insulation. The conductor of each transformer winding shall be of electrolytic copper, free from scales and burrs. Copper conductor current density shall not be more than 2.5 A/sq.mm.
8.1.4	**Cooling arrangement:** The transformer shall be suitable for loading of 100% continuous maximum rating with 'ONAN' cooling without exceeding the thermal limit at all tap positions.
8.1.5	**Buchholz relay:** A double float/reed type Buchholz relay shall be provided. Any gas evolved in the transformer shall collect in this relay. The device shall be provided with two electrically independent ungrounded contacts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure. The use of pipe or relay aperture baffles shall not be used to decrease the sensitivity of the relay. The relay shall not mal-operate for through fault conditions or be influenced by the magnetic fields around the transformer during the external fault conditions.
8.1.6	**Oil temperature indicator:** The transformer shall be provided with dial type thermometer for top oil temperature indication. The thermometer shall have adjustable, electrically independent ungrounded alarm and trip contacts. The setting of alarm and tripping contacts shall be adjustable at site and the typical values are given below, to be confirmed by the manufacturer: • Alarm: 95°C • Trip: 105 °C
8.1.7	**Pressure Relief Device:** Adequate number of pressure relief device/s shall be provided at suitable locations and shall be of sufficient size for rapid release of any pressure that may be

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	generated in the tank and which may result in damage to equipment. The device shall operate at a static pressure less than the hydraulic test pressure of the transformer tank. It shall be mounted directly on the tank. One set of electrically insulated contacts shall be provided for alarm/tripping. Discharge of pressure relief device shall be properly taken through pipes that vent outside of the segregation where the Transformer is located. Concerning of the degree protection the terminal box/boxes of Pressure Relief Device should be in compliance with IP-55 of IEC- 60529.
8.1.8	**Cable Boxes:** HV/LV terminations are to be made through cables the transformer shall be fitted with suitable air-insulated cable box on 11 kV side and 0.433kV side as per transformer voltage ratings. The bidder shall ensure the arrangement of HT & LT air-insulated Cable box so as to prevent the ingress of moisture into the box due to rain water directly falling on the box as per the requirement of IP55. The internal surface of cable boxes shall be painted with epoxy enamel with paint. The minimum dry film thickness (DFT) shall be 100 microns. The bushings of the cable box shall be fitted with nuts and stem to take the cable cores without bending them. The stem shall be of copper with copper nuts. The cross section of the connecting rods shall be stated and shall be adequate for carrying the rated currents. HT/LT Cable support clamp should be provided to avoid tension due to cable weight. HT/LT cables entry from the bottom of cable box. Cable size is one run per phase. Cable OD shall be intimated to the bidder at the time of manufacturing.
8.1.9	**Gaskets** Gasket shall be fitted with weather proof, hot oil resistant, rubberized cork gasket. 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.
8.2	**Fittings:** The following minimum fittings shall be provided: • Rating and diagram plates on Transformer and auxiliary apparatus • Earthing terminals • Terminal marking plates • HV cable box • LV cable box

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	• Conservator for main tank with oil filling hole and cap, isolating valves, drain valve, magnetic oil level gauge with low level alarm contacts and dehydrating silica gel breather • Oil preservation equipment • Bottom and top filter valves with threaded male adaptors, bottom sampling valve and drain valve • Air release plug • Buchholz relay with alarm and trip contact • Pressure relief device • Oil temperature indicator for local and remote output • Radiators for cooling purpose • Valves, plugs etc. suitable for connection to the oil treatment plant and vacuum pump, etc. • Valves schedule plates • Marshalling box (IP55) shall be provided with OTI, WTI and its associated equipment
8.3	**Terminal Marking:** The terminal marking and their physical position shall be as per IEC 60076-1.
8.4	**Specific requirements for Transformer:** 500kVA, 11/0.433kV, 50Hz, Three phase transformer – TR(11)1 is the main source to 250kVA, 440V, 50/60Hz Static frequency converter (SFC) and the output of 250kVA 440V, 50 and 60Hz Static frequency converter (SFC) is fed to the 250kVA, 0.4/3.3kV, 50/60Hz, Three phase transformer – TR(3.3). SFC is in the scope of CPRI.
9.0	**TESTS TO BE PERFORMED** The routine, type, special and acceptance tests to be performed on Transformers are listed in the following paragraphs and cost of the test charges are added to the equipment cost.
9.1	**Routine tests:** All the below listed routine tests in accordance with latest issue of IS Standard 2026 shall be carried out: a) Measurement of winding resistance b) Measurement of voltage ratio and check of phase displacement c) Measurement of short-circuit impedance and load loss d) Measurement of no-load loss and current e) Dielectric routine tests (IEC 60076-3) f) Measurement of insulation resistance g) Pressure test (as per clause 21.5 of IS 1180 (Part 1) : 2014).

Clause No.	TECHNICAL SPECIFICATION
	h) Oil leakage test (as per clause 21.5 of IS 1180 (Part 1) : 2014).
9.2	**Type and special tests:** The bidder can submit reports of type and special tests issued by any independent accredited test laboratories as per IEC/ISO 17025, performed on similar equipment provided that a full demonstration is given that such similar equipment are fully representative of the supplied equipment and the test charges shall not be included in the price bid. Nevertheless, the bidder has to perform the type and special tests on the supplied equipment at their own cost. Referring to IS Standard the following type tests are to be carried out: a) Temperature-rise test (IS 2026-2) b) Dielectric type tests (IS 2026-3) In addition to the above mentioned tests, the following special tests as per IS Standard 2026 shall be performed: a) Ability to withstand dynamic effects of short circuit test b) Measurement of zero sequence impedance c) Determination of sound level d) Test on oil samples as per IEC Standard 60296 High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly. Concerning the point d) above, the oil supplied with transformer shall have the parameters for unused new oil conforming to IEC 60296 while tested at oil Bidder's premises. No inhibitors shall be used in oil. **10% extra oil shall be supplied for topping up after commissioning in non-returnable containers.** The bidder shall inform Employer of the Tests program fifteen (15) days prior to inspection and shall allow CPRI representatives to witness them. The inspection expenditures of CPRI representatives shall be borned by CPRI.
9.3	**Acceptance Tests:** The Acceptance Tests at CPRI site are aimed to demonstrate that the supplied equipment is correctly assembled, fulfils its technical specification, the operation and the handling of the system and complies with the relevant standards. The bidder shall be made available all the reports concerning the routine, type and special tests performed on each transformer before commencement of acceptance tests. The Acceptance Tests shall be considered successful if the following items are

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	fulfilled: • Check of the content of delivery for completeness and for proper condition of all components and auxiliary devices (User manual, contract drawings) • Check of dimensions, fitting and accessories • Routine tests including losses shall be repeated on each transformer at CPRI test facility and results shall comply Guaranteed Technical Specification. • Each Transformer shall be energised on no-load condition for checking satisfactory operation for duration of 24 hours.
10.0	**INSPECTION AND QUALITY ASSURANCE PLAN** The Bidder shall carry out a comprehensive inspection and testing programme during manufacture of the equipment. An indication of inspection envisaged by the Employer is given below. This is however not intended to form a comprehensive programme as it is Bidder's responsibility to draw up and carry out such a programme in the form of detailed quality plan duly approved by Employer for necessary implementation. Inspection checklist / quality plan and recommended field quality plan for transformer has to be submitted to CPRI for approval after placement of order and any changes required by CPRI for the same shall be incorporated and adhered to by the bidder without any commercial implications. The bidder shall draw his own quality plans in line with these requirements and his standard practices and implement such programme after approval by the Employer. Manufacturing quality plan will detail out, for all the components and equipment, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder/Bidder's quality control organization, the relevant reference document and standards, acceptance norms and inspection documents raised etc. during all stages of material procurement, manufacture, assembly and final testing/performance testing. The bidder, along with quality plan, shall also furnish copies of the reference documents/plant standards/acceptance norms/test and inspection procedure etc. referred by him in quality plans. These quality plans and reference documents/standards etc. will be subject to Employer's approval and will form a part of the contract. In these approved quality plans, Employer shall identify customer hold points (CHP), indicating tests/checks which shall be carried out in presence of the Employer's engineer or authorized representative and beyond which work will not proceed without consent of Employer's Engineer/ authorized representative in writing. No materials/equipment shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection including

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	verification of records of all previous tests/inspections by Employer's Engineer /authorized representatives, or such pre-dispatch final inspection is waived by the Employer and dispatch is authorized after review of test reports. All materials used or supplied shall be accompanied by valid and approved material certificates and test and inspection reports duly approved by the Employer. These certificates and reports shall indicate the acceptable identification number of the material they proposed to certify. The material certified shall also have the identification details stamped on it. Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder and their sub-vendors for quality management and control activities. The Bidder shall provide all necessary assistance to enable the Employer carry out such audit and surveillance. The Bidder shall undertake an inspection and testing programme during manufacture in his works and that of his sub-Bidders to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identification and acceptability of all materials, parts and equipment. In addition to tests as per the approved quality plan, the Bidder shall also carry out all tests/inspection required to establish that the items/equipment conform to requirements of this specification and the relevant codes/standards specified in this specification. The Employer/ Engineer and/or his duly authorized representative shall have at all reasonable times access to the Bidder's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and part of the work being manufactured or assembled on other's premises or works. The Bidder shall obtain for the Engineer and his duly authorised representative the permission to inspect as if the components were manufactured or assembled on the Bidder's premises or works. The Bidder shall give the Engineer/ Inspector, written notice of any material being ready for testing fifteen (15) days prior to inspection. Such tests shall be to the Bidder's account except for the expenses of the Inspector. The Engineer/Inspector unless the inspection of the tests is virtually waived, shall attend such tests immediately after or fifteen (15) days from the date of notification by the Bidder, failing which, the Bidder may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.
11.0	**TECHNICAL INFORMATION TO BE SUPPLIED BY THE BIDDER** The following technical information shall be included in the bid:

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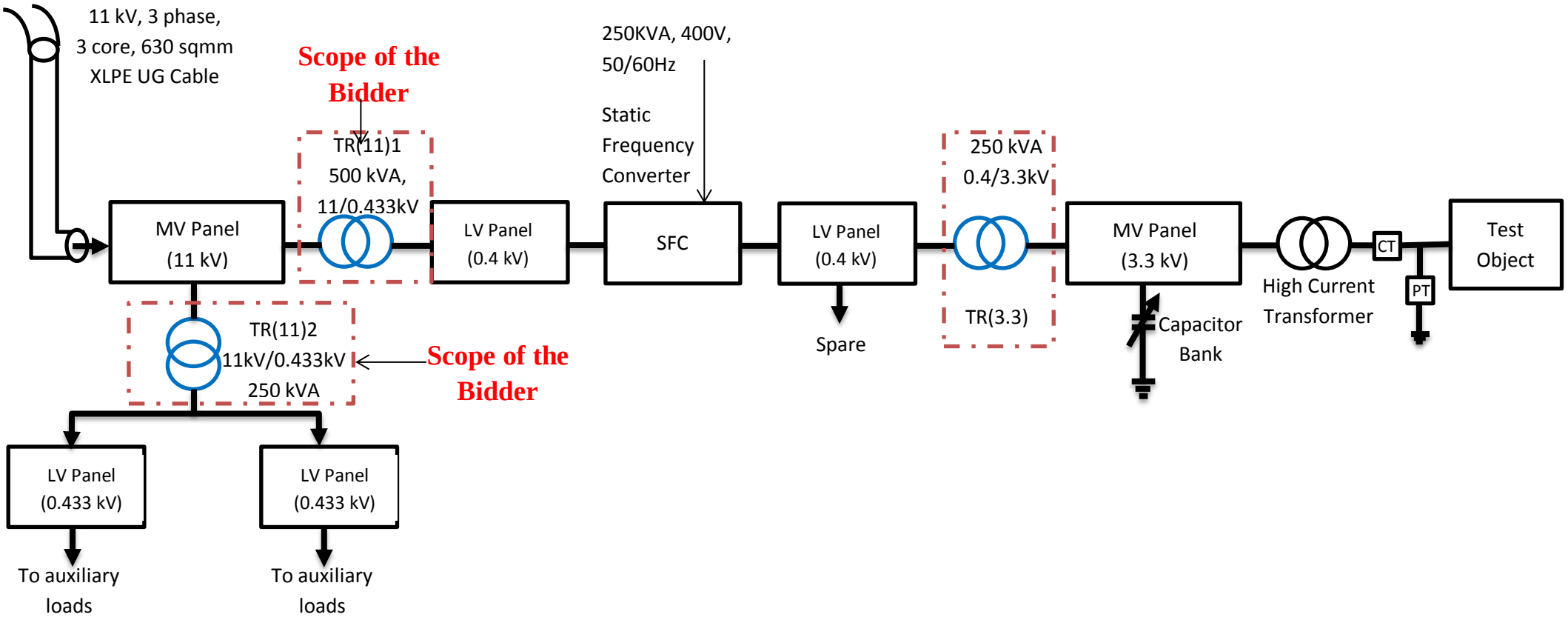
	1) Type of transformer: (core or shell-type) 2) Type of core and winding arrangement 3) Short-circuit impedance value (percent value) 4) Design insulation levels between windings and ground to ensure the required insulation levels 5) No-load loss at rated voltage and frequency (50 Hz) as per applicable 6) Load losses at rated voltage and current (50 Hz) as per applicable 7) Tests certificates relevant the type and special tests specified in sub-clause 10.1 8) Masses [kg]: • total mass without oil • oil • total mass in service condition 9) Mass of the heaviest piece for transportation [kg] 10) Dimensions in operation conditions (length, width, height) [mm] 11) Dimensions of the heaviest piece for transportation (length, width, height) [mm] 12) List of the suggested spare parts. The following documents shall be provided along with the supply: 1) General drawings, electrical schemes, installation drawings 2) HV and LV cable box 3) Operational manual and Maintenance manual: These manuals shall include specific instruction relevant to the handling, installation, troubles shooting and servicing 4) Reports on inspection during manufacturing 5) Reports of routine, type, special and acceptance tests. All documents shall be issued in English language and provided both on paper and software copy.
12.0	**INSTALLATION AND COMMISSIONING** The supply shall include the installation and commissioning activities performed by a team of specialized workers of the bidder. These activities will be performed in a period defined by the Employer, in order to avoid interferences with other works.
13.0	**PERFORMANCE GUARANTEE** The transformers shall have to comply with guaranteed technical parameters of this specification.
14.0 **14.1**	**SPARE PARTS AND MAINTENANCE** The Bidder shall provide the mandatory spares along with the supply of

Clause No.	TECHNICAL SPECIFICATION
14.2	transformers. Mandatory spares shall be considered for Bid evaluation. Any other spares which bidder feels essential for trouble free operation of transformers for at least 10 years may be listed as recommended spares with price and validity as an option. The recommended spares shall not be considered for Bid evaluation. The Bidder shall indicate the proposed maintenance schedule during the guarantee period and the life period of the transformers.

FIGURE

FIGURE 1

BLOCK DIAGRAM OF 40,000A TEMPERATURE RISE TEST FACILITY



Appendix- 1

TRANSFORMER CHARACTERISTICS TO BE FILLED BY THE BIDDER

No.	Description	Conditions	Units	@ 50Hz
	Rating:			
1	Rated power		KVA	
2	Primary voltage		kV rms	
3	Secondary voltage		kV rms	
4	Voltage ratio			
5	Primary current		kA	
6	Secondary current		kA	
7	Impedance voltage at rated power for all voltage ratios		%	
8	Short-circuit reactance at rated current		Ω	
9	Resistance at rated (related to the load loss)			
10	Type of transformer			
	Core:			
11	Type			
12	No-load loss at rated voltage		kW	
13	No load current at rated voltage		A	
14	Maximum induction level at rated voltage		T	
15	Core material			
	a) Type			
	b) Thickness		mm	
	c) Total loss	Basis f=50Hz, at operating flux density	W/kg	
	d) Weight		kg	
	Windings			
16	Primary			
	a) Type			
	b) Conductor • number of strips • cross section			
	c) Number of turns			
	d) Type of insulation			

No.	Description	Conditions	Units	@ 50Hz
	e) Insulation level • power frequency withstand voltage • induced overvoltage level • lightning impulse withstand voltage		kV	
17	Secondary			
	a) Type			
	b) Conductor • number of strips • cross section			
	c) Number of turns			
	d) Type of insulation			
	e) Insulation level • power frequency withstand voltage • induced overvoltage level • switching impulse withstand voltage • lightning impulse withstand voltage			
18	Forces			
	a) calculation of forces			
	b) clamping of windings and connections			
	Cooling			
19	Type			
20	Number of radiators			
21	Size			
	Temperature rise			
22	• Oil • Windings		°C	
	Bushings			
23	Type			
24	Manufacturer			
25	Weight		kg	
26	size			
	Overall Dimensions			
27	Length		mm	
28	Breadth		mm	
29	Height		mm	
30	Untanking height		mm	
	Masses			

No.	Description	Conditions	Units	@ 50Hz
31	Core and windings		kg	
32	Tank fitting and accessories		kg	
33	Oil		kg	
34	Total Mass		kg	
35	Capacity of the crane for untanking		kg	
	Transport			
36	Mass of heaviest package		kg	
37	Dimension of largest package • Length • Breadth • Height		 mm mm mm	

Note: Bidders are required to fill in the Appendix-1 (Technical Data Sheet) as per the format and submit along with bid. The technical information to be supplied by the bidder as per clause No. 11.0 of this document are also enclosed along with bid.