

INSTITUTE FOR PLASMA RESEARCH

Technical Specifications

Design/engineering, manufacture, inspection, testing at vendor's site, delivery at site of resin cast dry type Cast Resin Transformer 2500kVA, 11kV/433V, 50 Hz with required spares and accessories.

I - PROJECT INFORMATION & AUXILIARY FACILITIES

1.	Purchaser	Institute for Plasma Research Village Bhat, Gandhinagar Dt. PIN-382 428 Gujarat, INDIA Phone: +91-79-23962000 Fax: +91-79-23969017 Web: www.ipr.res.in
2.	Site elevation (average)	55 meters above MSL
3.	Ambient temperature	Max. (annual): 47 °C Min. (annual): 4°C Average (annual): 35 °C
4.	Relative humidity	Max.: 90 % Min.: 17 %
5.	Rainfall	823 mm average (annual) June-August
6.	Wind data	Max. wind speed: 130 kmph Prevailing direction: SW to W Design wind pressure: 100 kgm ⁻²
7.	Seismic data	0.04 g as per IS:1893-1973
8.	Accessibility road:	By Upto site (on Hansol-Gandhinagar H-way) By rail : Ahmedabad Rly. Stn. (12 km.) By sea : Bombay Harbor (525 km.) By air : Ahmedabad Airport (6 km.)
9.	Auxiliary power supply (each of the voltages can be made available at one point of connection to the sources)	a) AC 415 ± 10 % V, 3 phase, 50 ± 5 % Hz, 4 wire system b) DC 220 ± 20 % V, 2 wire, floating
10.	Expected completion period	Delivery: Within 3 months from the date of approval of drawings Installation & Commissioning: Within 2 months from the date of site clearance from IPR.

II - TECHNICAL PARTICULARS**SCOPE:**

This specification covers the design/engineering, manufacture, inspection and testing at vendor's works and delivery at site and supervision during erection, pre-commissioning and commissioning tests of one no. of resin cast dry type Cast Resin Transformer 2500 kVA, 11 kV/433V, 50 Hz with required spared and accessories, as per the technical specification.

CODES - STANDARDS:

- a) The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes.
- b) Except where modified by this specification, wherever applicable all material and equipment shall conform to the requirements of latest Indian Electricity Rule (IER) and below given standards including all amendments.

S.No.	Description	Standard
1.	Dry type transformer	IS 11171 and IS 2026
2.	Current transformer (PS class)	IS 2705
3.	Degrees of Ingress Protection for control gear	IS 12063
4.	Bushing for Alternating voltage above 1000 V	IS 2099
5.	Thermal Evaluation and Classification of Electrical Insulation	IS 1271
6.	Fittings and Accessories	IS 3639
7.	Measurement of transformer and reactor sound levels	IEC 60076-10 or NEMA TR -1

GENERAL CONSTRUCTIONAL FEATURES:

The dry type cast resin transformers shall be AN (Air Natural) cooled and shall be provided for indoor applications.

The mechanical and electrical design of the transformers shall be based on the following conditions and requirements:

- a) The design shall be based on site and service conditions as specified.
- b) The maximum permissible temperature rise of the transformer windings is to be selected by the transformer manufacturer in accordance with the thermal classes of the insulation.
- c) The transformers shall be capable of operating continuously at full load at any tap position within their temperature rise limit.
- d) Neutral points shall be brought out and grounded.
- e) Doors shall be suitable to be opened from outside.

- f) All the materials used shall be of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting-up of undue stresses in any part and also without affecting the strength and suitability of the various parts for the work which they have to perform.
- g) Similar parts, particularly removable ones, shall be interchangeable.
- h) Nuts, Bolts and pins used inside the transformer and tap changer shall be provided with lock washers or lock nuts.
- i) Labels shall be provided for all identifiable accessories like relays, valves, CT, thermometer pockets, switches etc.
- j) All internal connections and fastenings shall be capable of operating under overloads and over excitations allowed as per specified standards, without injury.
- k) The transformers must be of suitable size so as to be installed in a room of dimensions 6 m x 6 m x 4 m. Care shall be taken to provide appropriate clearances on all sides as per the latest standards and practices.

ELECTRICAL AND PERFORMANCE REQUIREMENTS:

- a) The transformer shall operate without injurious heating at the rated kVA at any voltage within $\pm 10\%$ of the rated voltage of that particular tap.
- b) The transformer shall be capable of overloading as per IS. The continuous and short time over loading capacities shall be furnished in detail. Over loads shall be allowed within the condition defined in the applicable standard. Terminal, taps or any other auxiliary equipment shall not limit such over loading.
- c) The manufacturer should guarantee that no deterioration to insulation system or life results on account of such an overloading pattern.
- d) The neutral terminal of windings with star connection shall be designed for the highest over-current that can flow through this winding.
- e) The bidder shall ensure that the design and manufacturing of the transformer shall be such as to reduce noise and vibration level. The sound level of the transformer with its enclosure in position shall not exceed the value in accordance with NEMA TR-1 standard.
- f) The transformer HV winding shall be suitable for vacuum circuit breakers switching.
- g) All other performance requirement as per the relevant standards and codes shall be met with condition specified above.

CORE:

- a) Transformer design shall be core type. The core shall be constructed from high grade cold rolled non ageing grain oriented (CRGO) silicon steel laminations. The core shall be painted and insulated with suitable resin to protect it against corrosion. The lamination shall be free from burrs and sharp projections.

- b) The yoke laminations shall be interleaved and carefully assembled to avoid air-gaps in the magnetic circuit. The core shall be earthed as per the relevant standards.
- c) The insulation structure in between core to bolts and core to clamp plates shall withstand a minimum voltage of 2500 V, for one minute.
- d) All steel sections used for supporting the core shall be free from burrs.
- e) 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.
- f) The finally assembled core with all the clamping structures should be free from deformation and shall not vibrate during operation.
- g) The core clamping structure shall be designed to minimize eddy current losses and bolts passing through core laminations shall not be used for any purpose. Epoxy coated fibre-glass tapes shall be used for clamping core laminations.

INTERNAL EARTHING:

- a) Internal earthing of all metal parts of transformer with the exception of the individual core laminations, core bolts associated individual clamping plates shall be earthed.
- b) Single point earthing shall be used for the magnetic circuit.
- c) Flexible earthing braid shall be provided between all metal parts, joined with gaskets.
- d) 2 Nos. separate Earthing pad/terminal shall be provided on the cable box for armour earthing from inside and other Earthing grid connection from outside.
- e) Earthing strip from Earthing Bushing up to earthing terminal shall be provided.
- f) Doors shall be earthed by suitable PVC insulated multi-stranded copper wire of suitable size

WINDINGS:

- a) The Cu-ETP-grade copper conductor shall be used for transformer HV and LV windings and their insulation shall be such as to ensure uniform distribution of the voltage surges among all the coils of the windings.
- b) The windings shall be provided with Class-F epoxy resin cast insulation. The insulation shall have high tensile and dielectric strength. Enough measures shall be taken during casting to avoid the void formation, cracking and crazing etc. of the cast coils.
- c) Both HV and LV windings of each phase shall be separately cast on rigid tubular coil co-axially arranged under vacuum in to molds. The epoxy resin insulation system shall be fiber glass strengthened. LV winding should be prepeg insulation materials and should be cured under require temperature.
- d) The resin used for winding insulation shall be non-hygroscopic to prevent the penetration of moisture into windings. It should be possible to energize the transformer without pre-drying even after a long period of service

interruption. The resin used shall be non-inflammable, self-extinguishing, void free and suitable for tropical climate with 100% relative humidity. In the case of windings provided with taps, the inter-turn insulation of tapped windings shall be reinforced to obtain uniform stress distribution. No filler materials are allowed to use in Resin Mixture.

- e) The transformer shall be able to withstand short circuits as well as switching and lightning/atmospheric impulse voltages as specified in the IS 11171 standard. The leads and connections shall be mechanically strong and adequately brazed to withstand short circuit forces and transportation shocks.

CORE AND COIL ASSEMBLY:

The cast coils are inserted on to the core limbs. The resin cast spacer blocks, end blocks and separators shall be used as required. The coils should be placed on the anti- vibration insulation materials.

TAPPING:

Off circuit tap changing link shall be provided with total tapping range of +5% to -5% in steps of 2.5%. The tapings shall be on high voltage side. The transformer shall be capable of delivering its rated output at any tap position without damage.

TERMINAL BOX ARRANGEMENT:

- a) The HV side termination facility of the transformers shall be designed for connecting 11 kV XLPE insulated armoured cable terminated in crimping type lugs and heat shrinkable sleeves or pre-molded cast resin push on type terminations. Suitable undrilled gland plate shall be provided for terminating HV cables. HV terminals shall be extended up to the cable terminals and the bus bars shall be located at a convenient height. The cable entry shall be from the bottom. Preferably the bus-bars shall be supported by the supporting insulators from the top fram of the enclosure. The winding delta formation on HV side shall he in supplier's scope.
- b) The LV side terminals and the LV termination box of transformers shall be suitable for cable connection of approx. 3 runs of 1000 sqmm, single core per phase and 2 runs for neutral (Total cables are 11 runs of 1000 sqmm, single core) . The earthing stud shall be provided on LV termination box for clamping earthing conductor. The winding star formation on LV side shall be in supplier's scope.
- c) The LV neutral terminal of the star connected winding shall be brought out at two separate insulated terminals. One neutral terminal shall be provided by side of the phase terminals for connecting neutral to neutral bus-bar in the LV termination box. Second neutral terminal shall be provided to facilitate the earth conductor down to the ground level. The terminal shall be suitable for connecting two numbers of earth conductors (75mm x 10mm GI) for neutral earth connection with two separate earthing pads.

SUPPORT INSULATORS:

- a) Support insulators shall be designed and tested to comply with the applicable standards.
- b) HV terminals rated for minimum current 400 A shall have non-ferrous and non-magnetic flanges and hardware.
- c) Air clearance and creepage distances shall be maintained as per the relevant standard.
- d) Preferably the material for support insulators shall be Porcelain or epoxy resin cast.

CURRENT TRANSFORMER (CT):

- a) The REF (Restricted Earth Fault) CT shall be epoxy resin casted under vacuum and having ratio of 3200/1A, class PS, 10 VA. The CT shall have minimum V_{knee} 400V, maximum 30 mA I_{mag} at $V_{knee}/2$ and R_{ct} less than 7 Ohm. This CT shall be provided in the common portion of the LV neutral (Before branching to LV neutral to earth connection). Class of insulation system of the CT shall be class F.
- b) CT secondary leads shall be brought to the marshalling box.
- c) CT details shall be indicated on name plate of the transformer.

TEMPERATURE SENSOR AND WINDING TEMPERATURE INDICATORS (WTI):

- a) Temperature sensors: Two (2) numbers, reputed make simplex type (Platinum) PT 100 shall be provided in each phase at suitable place for measuring hot spot temperature.
- b) A multi-channel digital winding temperature indicator shall be provided to display the temperature of the windings.
- c) The indicating instrument shall be provided with four adjustable electrically independent ungrounded contacts brought out to separate terminals for winding temperature alarm and trip. One indicating instrument shall be provided for each phase. Contacts shall be suitable for 220V DC rated minimum 0.5A. Instrument shall be suitable for 220V D.C auxiliary power supply if required.

MARSHALLING BOX:

- a) The weather proof marshalling box shall be mounted on the transformer housing. All doors, covers and plates shall be provided with neoprene gaskets. Bottom of the marshalling box shall be at least 600 mm above floor level and provided with removable bolted and undrilled gland plate etc. The required number of knock-out punches shall be provided for outgoing control cables.
- b) All contacts for alarm, trip and indication circuits shall be electrically potential free, wired for auxiliary supply as specified and brought out to separate terminals at terminal blocks in the marshalling box. If required, separate MCBs shall be provided for protection isolation and distribution of AC and DC control supplies in the marshalling box. Wiring shall be with PTFE insulating (Insulation for wire & cable shall be in consistence

with the ambient temperature in the housing). The wiring conductor shall be stranded copper and of sizes not less than 4 sq. mm for CT circuit and 2.5 sq. mm for other control circuits. CT terminals shall be provided with standard shorting facility. The wires shall be drawn through neatly clamped conduits. Engraved identification ferrules, marked as per the approved wiring diagrams shall be provided on each wire. Ferrules shall be of yellow colour with black lettering. Preferable the terminals shall be stud type and provided with crimping type cable sockets.

ENCLOSURE FOR TRANSFORMER:

- a) The core and coil assembly shall have CRCA sheet steel MS enclosure. The purpose of having the enclosure is to provide safety from live parts, protect and make the equipment suitable for outdoor conditions, prevent ingress of foreign matters, vermin and rodents etc. the minimum number of louvers shall be provided on the sides of enclosure and the louvers should be covered with SS or galvanized sheet fine (openings not more than 2.5mm) mesh. The enclosure should have structural steel framework with lockable hinged door on HV and LV termination sides of the transformer. The gasketed doors shall facilitate the inspection of the transformer.
- b) The enclosure frame shall be fabricated using suitable CRCA pressed and shaped sheet steel of thickness not less than 2.0 mm.
- c) All panel edges and door edges shall be reinforced against distortion/deformation by rolling, bending and addition of welded reinforcement members.
- d) The complete structure shall be rigid, self-supporting and shall be suitable for connecting ventilation hood on the top. To remove heat from the transformer, its metallic enclosure shall have sufficient heat dissipation capability in outdoor conditions, throughout the year without any additional cooling arrangement. GI or SS wire mesh shall be provided in the gap in between enclosure and ventilation hood to prevent entry of birds etc. Powder/enamel paint coated 3mm thick perforated MS mesh shall be provided for enclosing the bottom side.
- e) The enclosure shall not have degree of ingress protection less than IP 23.
- f) Door switch with 2 NO + 2 NC auxiliary contacts of required rating shall be provided. It will be used for providing interlock in the HV breaker circuit.
- g) Painting:** After thorough metal treatment enclosure surface shall be given two coats of enamel/powder paint. Double coat of corrosion resistant primer shall be applied before painting. The inside of the enclosure shall have semi-glossy paint finish. All metal parts not accessible for painting shall be made of corrosion resistant material. All paints shall be carefully selected to withstand heat and tropical weather conditions. The color of painting shall be Light Grey Shade 633 of IS-5.

FITTINGS AND ACCESSORIES:

Following fittings and accessories shall be provided:

- a) HV/LV terminals suitable for the purchaser's external conductors.
- b) Rating, terminal marking and danger plates.

- c) Three earth terminals per transformer, each suitable for earth conductors of size 2 nos. 75 x 10 mm GI strip for earthing of the body of the transformers and its enclosure.
- d) Lifting lugs for
 - Complete transformer (with enclosure)
 - Core-coil assembly
- e) The under base shall be provided with channels etc.
- f) Four bi-directional rollers in base frame for movement of complete transformer assembly. The stopper arrangement to lock the transformer in the required position shall also be provided.
- g) Enclosure with provision for dismantling.
- h) Marshalling box
- i) Neutral earth terminal with lugs.
- j) Six number PT 100 RTDs with WTI display
- k) Off circuit tap links.

INSTALLATION SUPERVISION:

The bidder shall depute a qualified engineer for supervision of installation, witnessing pre-commissioning and commissioning tests. The equipment shall be commissioned in the presence of the bidder's qualified engineer.

The bidder shall ensure that his personnel are present at site and supervise when the following activities are being carried out:

- a) Unloading of the distribution transformers at IPR, Gandhinagar site.
- b) Erection and installation of transformer and its accessories. Wiring of instruments up to marshaling panel.
- c) Grounding of neutral, tank, Bus duct, etc. including supply of all hardware and connectors.
- d) IR testing of transformer for HV-LV, HV-E & LV-E.
- e) Tap changer operation.
- f) Checking of all the protection systems.
- g) Pre-commissioning and commissioning tests on transformer.
- h) Transformer load test with customer loads (if made available on commissioning date).

ACCEPTANCE:

The acceptance of the transformer shall be given only after the transformer has been successfully installed and commissioned.

LIST OF SPARES:

Sr. No.	Description	Quantity
1	Winding temperature indicator (WTI)	1 No.
2	LV Bushing	1 set
3	HV Bushing	1 set

III - TESTING/INSPECTION

Purchaser and their authorized representatives shall have access to the manufacturer or sub-manufacturer works for the purpose of witnessing, tests and ascertaining that the transformer being supplied conform to the requirements of the specification. The stage-wise inspection shall be performed during fabrication stage. The bidder shall provide the detailed activity schedule for stage inspection. The bidder shall inform the purchaser at least 15 days advance the testing due date and ask for their representative's availability. The detailed test schedule shall also be submitted after the placement of the order.

The transformers shall be demonstrated as capable of performing satisfactorily the suppliers guarantee. All tests required by the specification including repeated tests and inspection that may be necessary owing to the failure to meet any tests specified, shall be carried out.

If the transformer fails to pass the tests specified, the Engineer shall have the option to reject the unit. Additional tests shall be made to locate the failure and after rectification, all tests shall be repeated to prove that the rebuilt transformer meets the specification in all respects.

a) Routine Tests:

- a) Measurement of voltage ratio at all tap positions and Check of voltage vector relationship
- b) Measurement of winding resistance.
- c) Measurement of impedance voltage (principal tap), short circuit impedance and load loss at rated current.
- d) Measurement of no-load losses and current.
- e) Induced over voltage withstand test.
- f) Separate source voltage withstand test

The entire test as per standard IS-11171 shall be conducted, on completed transformer assembly. The acceptable values shall be in accordance with the relevant standard.

b) Type Tests

The test reports for the type tests (Lightning impulse and Temperature rise) as per IS 11171 shall be submitted along with the offer. Test reports shall be from a NABL/CPRI/ERDA/Govt. approved laboratory. These reports shall be of a transformer of similar rating and same voltage class and shall be conducted in the past 5 financial years. (2012-13, 2013-14,2014-15,2015-16,2016-17). If such reports are not available with the bidder he shall get the transformer tested in an NABL accredited laboratory at his own cost.

c) Tolerances:

Allowable tolerance for other parameters except losses shall be as per the IS 2026 Part-I. The losses in the guaranteed Technical particulars (GTP) submitted by the supplier shall be the reference for percentage loss and bid evaluation.

d) Acceptance Criteria after the testing:

Successful testing as per the clause mentioned above

IV- DOCUMENTATION

The bidder shall submit the documents at different stages as given below.

1. With Bid (Technical/Part-1)

- a) Detailed catalogue/datasheet and literature indicating technical specifications.
- b) The documents mentioned in the eligibility criteria.
- c) Duly Filled GTP as per the format given in this specification

2. After placement of purchase Order:

The following documents shall be submitted for IPR approval within 3 weeks of placement of order, before taking up fabrication.

- a) Detailed activity schedule for stage inspection of the manufacturer
- b) Detailed transformer drawings along with LV and HV termination box dimensions.
- c) Earth terminals, marshalling panel details and bill of material etc.
- d) Graph of core loss in watt/kg versus flux density (wb/sq.m) for the transformer core material.
- e) Continuous and short time over loading details.

3. On Completion:

Five (5) sets of bound manuals of final detailed drawings, control drawings (marshaling panel), test reports, technical catalogues, installation instructions, O&M instructions, guarantee certificate and compliance report etc. along with their soft copy.

V- DELIVERY PERIOD:

The bidder shall quote for minimum deliver period. In this regard, a detailed activity bar chart shall be submitted by bidder for manufacturing, testing at works, transportation and delivery at IPR.

Fabrication/manufacturing shall be started only after final approval of the submitted documents by IPR.

Expected supply of the transformer shall be 3 months from the date of approval of drawings.

Installation and Commissioning shall be completed within 2 months from the date of site clearance from IPR.

VI - GUARANTEE PERIOD:

The Transformers shall be guaranteed for a period of 2 (Two) years from the date of acceptance at IPR.

V - Technical Specifications for Transformers

Technical Particulars		
1	Application	For distribution to Assorted loads
2	Quantity	1
3	No. of windings	Two winding
4	Rating (continuous)	2500 kVA
5	Frequency	50 Hz +/- 3%
6	No. of Phases	3 (three)
7	Rated Voltage (i) HV (ii) LV	11000 V with +/- 10 % tolerances 433 Volts
8	Winding connections (i) HV (ii) LV	Delta Star
9	Vector Group	Dyn11
10	Direction of Power Flow	HV to LV
11	Primary Connection	Delta
12	Secondary Connection	Yn11 (Star)
13	Service	Indoor
14	Other service conditions	As per IS 11171/2026
15	Class of insutalton	minimum class - F
16	Allowable Max. temp. rise of windings	90 °C
17	Tapping	+5% to - 5% in step of 2.5%
18	%Impedance voltage at principal tap	6.25%
19	Type of cooling	AN
20	Terminal arrangement (i) HV (ii) LV	HV Termination will be cable box LV Termination will be cable box.
21	Sound level in transformer	As per NEMA TR-1
22	System voltage (i) HV side (a) Nominal system voltage (b) Highest system voltage (ii) LV side (a) Nominal system voltage (b) Highest system voltage	11kV 12kV 433V 500V
23	System earthing	Solidly grounded
24	System fault level	25 kA for 1s at 11 kV

Technical Particulars		
25	Insulation withstand voltages a) Impulse b) Power frequency HV c) Power frequency LV	75 KV (peak) 28KV(rms) 3 KV (rms)
26	Tappings a) Tapping on winding b) Tap changer type c) Tapping range d) Tapping Step	HV Off-circuit - 5 % to + 5 % 2.5% each
27	Short time rating:	as per IS
28.	Transformer Losses (at 75 deg C)	As per ECBC 2009 standards Maximum : 4.1kW (NL) 20.6kW (LL)
29.	Clearances	Various electrical clearances like phase to earth and phase to phase clearances on the transformer, inside cable terminating boxes, disconnecting chambers, etc. shall be in accordance with applicable standards and Indian Electricity Rules.

ANNEX-1
GUARANTEED TECHNICAL SPECIFICATION SHEET

The bidder shall submit the filled GTP along with the technical bid

Sr. No.	Description	Detail/parameter
1	Name of manufacturer	
2	Model & Type	
3	Service (Indoor/Outdoor)	
4	Rated KVA	
5	Cooling	
6	Standard followed by the manufacturer	
7	Rated no load voltage a) HV b) LV	
8	Frequency	
9	Rated current a) HV b) LV	
10	Tapping: +5% to -5% in steps of 2.5% on HV side, through off circuit tap links.	(yes/No)
11	Vector Group reference	
12	Terminal arrangement,HV/LV	
14	Performance a) No load loss,Kw b) Load loss,Kw c) Impedance,% MIN	
15	% Efficiency at 75degC/Unity P.F. a) At 100% load	
16	% Efficiency at 75degC/0.8 P.F. a) At 100% load	
17	% Regulation at full load a) Unity P.F. b) At 0.8 P.F.	
18	Short Circuit Withstand Capacity	
19	Approximate L*B*H,mm	
20	Approximate weights, kg a) Total weight,kg b) Core Coil weight, Kg	
21	Enclosure protection class	
22	Insulation class	
23	Insulation Level kVp/kV rms HV LV	
24	Transformer acoustic level (measured as per standards IEC 60076-10 or NEMA TR-1)	
25	Guarantee period (Two years)	
26	Accessories	