



Modernisation of Existing Fuel farm facility

Technical Specification for Dry type Resin cast
Transformer. 322538 ETD-005

July 2015

Delhi Aviation Fuel Facility Pvt. Ltd



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Aviation Fuelling Station, Shahbad, Mohammad pur, IGI Airport, New Delhi-
110061

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1 Introduction and scope of work

- M/s Delhi Aviation Fuel Facility Private Limited (DAFFPL) is a joint venture between Indian Oil Corporation Limited (IOCL), Bharat Petroleum Corporation Limited (BPCL) & Delhi International Airport Limited (DIAL). M/s Indian Oil Sky Tanking Limited (IOSL) is responsible for running day to day operations of receiving the Jet fuel, storing the same in Fuel Farm and refuelling the Air Crafts.
- DAFFPL has avail design, engineering, procurement assistance and construction management services from Mott MacDonald which has been retained to provide consultancy services for the same.
- Existing Fuelling System i.e. Fuel Farm of Delhi Aviation Fuel Facility Pvt. Ltd. (DAFFPL) for refuelling the aircrafts at IGI Airport, New Delhi is slated for modernization and up-gradation so as to conform to International Standards for receipt, storage and dispensing of Jet A1 fuel.
- At DAFFPL fuel farm, Jet A1 fuel is brought aboveground/underground pipe from Oil Terminals of IOCL and BPCL and also by road tanker. This fuel is stored in the Cone Roof Vertical Tanks installed in the fuel farm. Presently, the aircrafts are being refuelled by hydrant pumps through underground Jet A1 fuel hydrant pipe line.
- This document specifies the minimum acceptable requirements set by the Purchaser for design, engineering, procurement, fabrication, assembly, inspection, testing, commissioning and delivery to site of 33kV/.433kV, 2000 KVA, Resin cast Epoxy, Dry type Transformer for its installation including earthing by connecting suitable earth strips to the existing earth pits/grid within the Fuel Farm of DAFFPL, IGI Airport, New Delhi.
- Energising the Transformer and testing with connected load in the building.
- Obtaining approval related to Transformer & HT Panel from Electrical Inspectorate if required.
- At present, there is an Existing 33kV/.433 kV, 1600 kVA, Oil filled Outdoor Transformer as one source of supply from 33 kV HV panel which is available in Electrical Substation. The existing Transformer is 33 years old, hence Transformer disconnection, dismantling, transit to store / location as directed by owner shall be kept in safe area is in the scope of bidder prior to installation of new Transformer.
- 33 kV HT Cable, laying, termination and connection to 33 kV HT panel & Transformer Primary shall also be in the scope of bidder along with the required length of Cable.
- LT Bus duct connection and termination to Transformer secondary & Existing Bus duct shall also be in the scope of bidder.
- Existing 11 kV panel shall be shifted in the HT room as per the layout drawing and connecting to existing earthing pits/grid shall be in the scope of bidder.
- 11 kV HT Cable, laying, termination and connection to 11 kV HT panel & Existing 2500 kVA Transformer Primary shall also be in the scope of bidder along with the required length of Cable.
- 11 kV HT Cable, rerouting, laying, termination and connection to 11 kV HT panel
- Control Cable, laying, termination, testing and connection to 11 kV HT panel & Existing 2500 kVA Transformer Marshalling panel with the required length of Cable.
- Civil/excavation & back filing, sand and bricks laying work required for 33KV HT cable & 11 kV HT cable shall be in the scope of bidder.

2 Environmental Conditions

2.1 Location

The site is located at Shahbad Mohammadpur adjoining to Indira Gandhi International Airport, New Delhi. The site is approachable by road.

2.2 Topography

The whole Site is levelled surface, with a nominal gradual slope.

2.3 Environmental Design Parameters

Elevation above M. S. L. : 237 metres. Above Sea level

Metrological data (Based on climatologically data of Delhi)

- a) Ambient temperature
 - (max.) : (+) 48.4°C
 - (min.) : (-) 2.2°C
- b) Relative humidity, % : Max: 100%; Min 25%
- c) Rainfall intensity : 20-30mm in one hr intensity in Delhi
- d) Design Wind speed : 47 m/s
- e) Area Classification : Non Hazardous – Admin. & Pump House :
Hazardous – Tank Farm & Product Pump House
- f) Earthquake Zone : Zone IV (as per IS:1893)
- g) Site Access : By Road, By Rail, By Air (Nearest Airport – Delhi)
- h) Unit Installed : Indoor

2.4 Design Temperature

The Maximum Design is considered as 50° C. This is an appropriate margin above the Maximum Operating Temperature of 48.4° C.

3 Codes and Standards

The design, manufacture and performance of transformer shall comply with all currently applicable statutory regulations and safety codes in the locality, where the equipment will be installed. Nothing in this specification shall be construed to relieve the vendor of his responsibility.

Unless otherwise specified, equipment shall conform to the following latest applicable Standards and equivalent IEC Standards.

Codes			Description
IS	11171	1985	Specification of Dry Type Power Transformers
IS	2026 Part I	2011	Specification of Power Transformers
IS	2026 Part 2	2010	Temperature Rise
IS	2026 Part 3	2009	Insulation levels and Dielectric Tests
IS	2026 Part 4	1977	Terminal Markings, Tapping and connections
IS	2026 Part 5	2011	Transformer / Reactor Bushings - Minimum External clearance in Air Specification
IS	10028	1985	Code of practice for Installation & Maintenance of Transformers.
IEC	60076-1	2011	Power Transformer Part 1 – General.
IEC	60076-2	2011	Power Transformer Part 2 – Temperature Rise.
IEC	60076-3	2013	Power Transformer Part 3 – Insulation level and Dielectric test.
IEC	60076-3-1	1987	Power Transformer Part 3-1 – External clearances in air.
IEC	60076-4	2002	Power Transformer Part 4 – Tapping and connections.
IEC	60076-5	2011	Power Transformer Part 5 – Ability to withstand short circuit.
IS	2099	1986	Bushings for alternating voltages above 1000 Volts.
IS	3347	1979	Dimensions for Porcelain and transformer bushing.
IS	3639	1966	Fitting & Accessories for Power Transformers
IS	1271	2012	Thermal evaluation and classification of electrical insulation.

NEMA	TR1	2013	Transformers, Step Voltage Regulators and Reactors
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3.1 System Characteristics & Electrical Details

- 33 KV Primary
 - Voltage variation : 33 KV \pm 10%
 - Frequency : 50Hz \pm 5%
 - Combined variation : \pm 10%
 - Fault level : 26.24kA for 1 sec.

- 433 V Secondary
 - Voltage : 433V \pm 10%
 - Frequency : 50Hz \pm 5%
 - Combined variation : \pm 10%
 - Fault level : 50 kA for 1 sec.

- Earthing system
 - System Neutral Earthing (33KV) : ---
 - System Neutral Earthing (415V) : Solidly earthed

4 Technical Data

4.1 Rating

The rating, voltage ratio, vector group and type of cooling of transformer, tap changing gear are specified as Appendix A data sheet.

Transformer shall also meet the requirements of Indian Electricity Rules, Fire Insurance Association and Electrical Inspectorate.

4.2 Temperature Rise

Temperature rise by resistance of winding shall not exceed as per specified value in data sheet over an ambient temperature of specified value in data sheet.

4.3 Temperature indication devices and alarm

1. Winding temperature indicator (4 inches dial type thermometer) shall be provided with two electrical contacts (one for alarm and one for trip). CT of suitable ratio shall be provided for WTI.
2. The tripping contacts of winding temperature indicators shall be adjustable to close between 60°C and 120°C and alarm contacts to close between 50°C and 100°C accordance to class of insulation class and both shall reopen when the temperature falls about by 10°C.
3. All connection of control / power & communication cable Connections shall be brought from the device to marshalling box by capillary tube, cables etc. as applicable.

4.4 Condition of Installation

Transformer shall be suitable for indoor installation as specified in data sheet.

4.5 Operation under Overload Conditions

It shall be possible to operate the transformer for overload of 150% and there shall be no limitations imposed by bushings, tap changers, auxiliary equipment etc. to meet this requirement.

5 Construction Features

5.1 General

Epoxy-resin dry-type transformers shall be provided for indoor applications. These transformers shall be supplied by the original transformer manufacturer. License products etc. are not acceptable.

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

- i. The design shall be based on site and service conditions as specified.
- ii. 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 as specified in Data Sheet.
- iii. The transformers shall be capable of operating continuously at full load at any tap position within their temperature rise limit
- iv. The transformers shall be capable of withstanding external short circuits for at least 1 seconds
- v. Neutral points shall be brought out and grounded.
- vi. Noise level shall be limited to 68 dB as per NEMA standard TR1.
- vii. Doors shall be suitable to be opened from outside.
- viii. There should be minimum three hinges per door from top to bottom.

5.2 Core

- i. The magnetic core shall be made of laminations of non-ageing, cold-rolled, grain-oriented, silicon steel of high permeability without burrs. Each lamination shall be insulated with high quality insulation coating.
- ii. The joints of limbs and yokes shall be designed and constructed to keep the no-load losses and the hot spot temperature in the magnetic core as well as the noise level as low as possible.
- iii. The core and its clamping plates shall form a rigid unit structure, which shall maintain its form and position under the severe stresses encountered during shipment, installation and short circuits.

- iv. Care shall be taken to secure uniformly distributed mechanical pressure over all the laminations to prevent setting of the core and to limit noise and vibrations to a minimum under service conditions.
- v. The maximum magnetic flux density in the legs and yokes of the core shall not exceed 1.72 Tesla at rated voltage and frequency.

5.3 Earthing

- i. 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.
- ii. Flexible earthing braid shall be provided between all metal parts, joined with gaskets.
- iii. 2 Nos. separate Earthing pad/terminal shall be provided on the cable box for armour earthing from inside and Owner Earthing grid connection from outside.
- iv. Earthing strip from Earthing Bushing up to earthing terminal shall be provided.
- v. Doors shall be earthed by suitable PVC insulated multistranded copper wire of suitable size.

6 Winding

- The transformers shall be Delta-Star connected, and the vector group shall be Dyn11 in accordance with IS 2026 (2011).
- All HV windings shall be insulated & values shall be furnished in Technical Data Sheets.
- The windings shall be made of copper of high conductivity to increase the capability of the transformer of withstanding the stresses under short-circuit conditions. Modern technology in design and construction shall be applied, and the current density shall not exceed 2.48 A/mm² in any part of the windings.
- The insulation material shall be based on an epoxy-resin/ powdered quartz mixture, which makes the windings maintenance-free, humidity-resistant and tropicalized as well as fire-resistant and self-extinguishing. The insulation material of windings and connections shall be free from insulation compounds subject to shrinking or collapse during service.
- The thermal class shall be "F" for all windings, and the temperature rise limits shall be limited to 90 K.
- The coils must be capable of withstanding movement and distortion caused by all operating conditions. Adequate barriers shall be provided between windings and core as well as between high voltage and low voltage windings.
- All leads or bars from the windings to the termination points shall be rigidly supported. Stresses on coils and connections must be avoided.
- PT 100 RTD should be embedded inside the coil of each phase and it should be wired upto a junction box. 1.5 Sq.mm copper Teflon insulated lead shall be used for connection between junction box and scanner. The scanner shall be mounted inside the Marshalling box. The scanner shall be provided with RS-485 port. Auxillary supply shall be suitable for 230 V AC.
- All HV & LV winding lead connections shall be provided with check nuts.

7 Housing

- The unit shall be housed in protective steel housing with sufficient ventilation offering a degree of protection class minimum IP23. The unit shall be fitted with plain bi-directional rollers.
- Protective housing shall be made of zinc coated sheet steel. The unit with housing shall form one moveable and lift able unit (with transformer). Adequate ventilation shall be provided by vermin proof louvers.
- The performed bottom plate shall have sufficient clearance from the floor level to guarantee sufficient flow of natural air ventilation. Hand hole shall be provided with transparent cover to operate the tap changer. The hand hole cover shall be operatable with special Key/Tool only.
- A danger sign with cautionary notice both in regional language and in 'ENGLISH' shall be fixed on the cover. Temperature indicator and alarm shall be provided in easy-accessible location. Facility shall be available to install the alarm remote to the unit.
- Housing shall be provided with door limit switch, such that in event of opening of any door of the Transformer housing, the limit switch shall give trip command to switchgear. Wiring from limit switch to marshalling box shall be carried out by the vendor.

8 Structure

- The structure shall consist of suitable C-profiles rigidly fixed onto the upper and lower yoke of the core. Four lifting lugs shall be provided on the upper frame as well as traverses under the bottom as a mounting base. Two earthing terminals of adequate size shall be provided and installed diagonally at the lower frame.
- Lifting lugs shall be required for lifting core coil assembly.
- Bi-directional flat wheels with blocking facilities shall be provided. Appropriate support metal/rubber elements for structure-borne noise insulation of the transformer shall be installed underneath the rollers.

9 Temperature Monitoring

- To protect the transformer against overheating two temperature monitoring systems (alarm and trip) shall be provided each to be connected to the LV windings by sensors to be selected according to the thermal class of insulation involved.
- Separate MCBs shall be provided for control supply for alarm and trip circuits. The control supply shall not be taken from secondary side of the transformer.

10 Name Plates and other Designation Plates

- The following plates made of engraved polished stainless steel shall be supplied (to be subject for approval):
- A rating plate in accordance with IS 2026 (2011).
- A diagram plate shows in an approved manner the connections and, in addition, a plan views of the transformer giving the correct physical relationship of the terminals. This terminal marking plate for phases and neutral on HV/LV sides shall be of stainless steel and engraved as above and shall be permanently fixed.

11 Terminals

- The transformer housing shall be fitted with cable boxes. The cable bushings on both HV and LV sides shall allow cable termination from the bottom.
- The HV cable terminals shall have clamp and holes suitable for terminating relevant type & size cable as indicated in data sheet
- The LV cable terminals shall be suitable for terminating relevant type & size cable / Bus duct as indicated in data sheet.
- The transformer shall be supplied complete with dry type heat shrinkable termination of approved make along with all the necessary cable lugs, grip type glands, etc. Cable support shall be provided in such a way as to relieve the strain on cable termination.
- The HT cable box shall not be detachable and shall have bottom entry only.
- The LT box shall have removable gland plates so that entry can be made from the bottom as well as top.
- Phase color coding required on insulating sleeves on both HV & LV side terminals.
- The Link connection should be properly marked. The link connection diagram in separate metal sheet rather than on the cast resin HV winding so as to avoid any burning of the links and resin arising out of loose connection due to frequent changing of the links or due to human error and same should also be mentioned in Rating & Diagram plate.

12 Method of Cooling

The transformer itself shall be provided with a self-cooled type of cooling system (AN).

13 Off-circuit tap changing Equipment

- The off-circuit tap changing shall be maintained by means of suitable terminal links to enable the transformer to be matched to the prevailing system conditions. Off circuit tapping range shall be provided as specified in Data Sheet.
- Off circuit Tap changing links shall be shrouded with cover made from insulating material to prevent deposit of dust.

14 Marshalling Box

- A sheet steel vermin proof well ventilated and weather proof cabinet marshalling box shall be provided for transformer ancillary apparatus.
- The marshalling box shall accommodate temperature indicators, control and protection equipment in marshalling box, along with terminals and gland plates for incoming & outgoing cables.
- Marshalling box shall be provided with toughened glass visor to facilitate the reading of temperature indicators.
- Marshalling box shall be provided with cubicle illuminating lamp along with control switch & door limit switch.
- Marshalling box shall be provided with locking facility

15 Painting

Steel surfaces exposed to the weather shall be thoroughly cleaned and applied first coat of zinc chromate, second coat of oil and weather resistant paint and final coat of glossy oil and weather resistant non-fading paint of shade as specified in data sheet. The overall paint thickness shall be 100 microns (minimum) for Transformer & all accessories.

16 Accessories

- Transformer shall be provided with all necessary accessories like Winding temperature indicator, Rollers, Two earthing pads, Lifting lugs, Jacking pads, Off-circuit Tapping switch, Terminal marking plate, additional neutral bushing, Marshalling Box, Rating & Diagram Plate etc.
- Rating and diagram plate shall be provided near Marshalling box.
- Details for above items shall be as specified in this specification.

17 Impedance, Losses and Efficiency

- Impedance value and allowable limit of tolerance shall be provided as per IS 2026 (Part 1) (1977).
- No-Load & Copper Losses value shall be limited to value as specified in data sheet. Allowable limit value of tolerance shall be provided as per IS 2026 (Part 1) (1977).
- Transformer shall be designed to achieve Maximum efficiency at 50% loading.

18 Tests, Inspection and Guarantee

18.1 Routine Tests

- i. Measurement of voltage ratio at all tap positions
- ii. Check of vector group by voltmeter method
- iii. Measurement of winding resistance at all tap positions
- iv. Measurement of impedance voltage on all taps
- v. Measurement of no-load losses
- vi. Measurement of load losses at principal tap and maximum current tap as specified in the IEC standards
- vii. Measurement of insulation resistance at 2500 V, DC
- viii. Induced over voltage withstand test with measurement of partial discharges
- ix. Separate source AC voltage withstand test
- x. Applied over-voltage test at 2000 V AC, 60 sec. on wiring and supervisory.
- xi. Magnetic Balance Test.
- xii. Measurement of capacitance & Tan Delta for HV & LV bushings.
- xiii. Polarity test

18.2 Type Tests

- i. Lightning impulse test on HV windings. The test shall be performed with positive polarity for all applications not installed in closed rooms under real indoor conditions. The test voltages shall be measured via appropriate voltage dividers and shall be clearly indicated by peak-voltmeters and/or in oscillographic or digital records.
- ii. Steady state temperature rise test. Transformers to be finally installed in a protective housing at site have to be installed in this housing during test and in final original arrangement during temperature rise test, and at least three temperature sensors for measurement the ambient air temperature shall be distributed in an approved distance around this housing.

- iii. Each rating of the transformers have to be type tested, including noise level measurement short-circuit test in any recognized international testing laboratory. All type test certificates shall have to be submitted with the offer. Offers without short circuit and HV impulse withstand certificates will be rejected. However, a short-circuit tested transformer shall not be part of delivery

18.3 Inspection

- i. The Owner/ Consultant or his authorized representative reserves the right to witness all the above tests and the vendor shall give two weeks' notice of tests, prior to commencement, to the Owner/ Consultant or his authorized representative.
- ii. All apparatus, instruments, etc. required for tests shall be provided by the vendor and shall have been checked and tested for accuracy during the twelve month prior to the test, bearing tag of competent authority.

18.4 Guarantee

Vendor shall guarantee design materials/workmanship and performance for a period of Twelve (12) months from the date of commissioning for satisfactory operation of the equipment or Twenty Four (24) months from the date of receipt of material at site, whichever is later.

19 Drawings and Instruction Manuals

After the order is placed, Vendor shall submit within three weeks, four set of following drawings for approval:

- i. General arrangement drawing, showing plan, elevation and side view, indicating all dimensions, transformer fittings & accessories etc
- ii. Civil foundation drawing for transformer.
- iii. Rating and Diagram plate.
- iv. Tap Changing Diagram Plate.
- v. G.A. of Marshalling box.
- vi. G.A. of Primary & Secondary cable box as applicable.
- vii. Bus throat connection diagram if applicable.
- viii. Primary and Secondary Bushing drawing.
- ix. Schematic wiring diagram of marshalling box.
- x. Index Sheet of the above drawing.

All the above drawings shall contain following data for reference:

- i. Owner P.O. / Contract reference No. & Date.
- ii. Plant and location of plant.
- iii. Consultant's Name and Consultant Job No.

One print of each drawing will be returned to vendor after marking all the necessary corrections, changes and required clarifications. Vendor shall incorporate these and send within fifteen days, four (4) prints of each drawing marked "Certified for Record and Use".

Vendor shall also submit one (1) set of CDs each to customer and consultant containing all drawings sketches etc in CAD REL 14/2000 and data in MS office/WIN 98/2000.

Instruction Manuals

Vendor shall submit three (3) copies of instruction manuals on installation, maintenance and operation of transformer and control devices mounted on the transformer and final as per approved drawings.

20 Others

20.1 Data Sheet

The enclosed Appendix A data sheets indicate detailed technical and quantity requirements.

20.2 Make of Switchgear Components

Make of switchgear component for Transformer accessories shall be as per approved list of owner standard.

20.3 Quality Assurance

Vendor shall submit their internal quality assurance plan followed for manufacturing of the equipment for approval of owner / consultant this shall be adhered to and shall be monitored by owner consultant during manufacture.

20.4 Spare Parts

Following spare part shall be provided with transformer. Vendor shall quote separately for the same.

i.	Primary Bushing	-	1 No.
ii.	Secondary Bushing	-	1 No.
iii.	Neutral Bushing	-	1 No.
iv.	Winding Temperature Indicator	-	1 No

Also vendor can recommended and quote for any extra spares, which need to be maintained by owner.

20.5 Deviation

Deviation from specification must be stated in writing at the quotation stage.

In the absence of such a statement, it will be assumed that the requirements of specification are met without any deviation.

Appendix A. Data Sheet

Sr. No.	Description	Specified	Vendor Data
1	General		
a	Make	Voltamp/Universal Power/Emco / Electrotherm(India)/ Crompton Greaves/ Kirlosker	
b	Application	Distribution	
c	Quantity	No. 1(One)	
d	IS specification to be complied with	IS 11171 AND IS 2026 (Part 1,2,3,4 & 5)	
e	Installation	Indoor	
f	Transformer Type (Oil filled / Cast Epoxy Resin Dry Type)	Cast Epoxy Resin Dry Type	
g	Type (Auto / 2 wdg/3 wdg)	2 WDG.	
h	Rating	kVA 2000	
i	Cooling (AN)	AN	
j	Colour (Epoxy/Stove Enamelled)	Epoxy, Shade No. 631, Light Grey	
2	Rating		
a	No load voltages	HV winding kV 33± 10% LV winding kV 0.433± 10%	
b	Frequency	Hz 50± 5%	
c	Combined Variation	± 10%	
d	Percentage Impedence	6.25%	
e	Impulse voltage withstand	HV kV 170 LV kV NA	
f	Power frequency withstand.	HV kV 70 LV kV 2.5	
3	System Data		
a	System voltages	HV Nominal/highest kV 33/36 LV Nominal/highest kV 0.433 / 0.5	

Sr. No.	Description		Specified	Vendor Data
b	Fault levels	HV System	kA	26.3 kA for 1 Sec
		LV System	kA	50 kA for 1 Sec.
c	System neutral earthing	HV		-
		LV		Solid Earthing
4	Transformer Neutral			
a	Type of earthing	H.V.		N.A
		L.V.		Solid Earthing
5	Neutral Current Transformer			
a	Location on primary/secondary side			Secondary
b	Ratio		Amps	3200/5A
c	Class			PS
d	Knee point voltage (vk)		Volts	Vk > 2If (RCT + 0.71) (See Note 7)
e	Quantity		Nos.	1 (One)
6	Temperature Rise			
a	Ambient temperature		°C	48.4°C
b	Temp. rise of winding by resistance ONAN cooling		°C	50°C
7	Tapping			
a	Tapping on winding Primary / Secondary			Primary
b	Type (Off Ckt / On Load)			OFF-CIRCUIT
c	Total tapping range		%	+ 10% to -10%
d	Step		%	2.5%, 9 Steps
8	Terminal Connections			
a	Primary wdg. line end.			Cable Box
b	Primary wdg. neutral end.			-
c	Secondary wdg. line end.			Bus Duct
d	Secondary wdg. neutral end			Extra Neutral Bushing for Earthing
e	Earthing Conductor for	Material		G.I

Sr. No.	Description		Specified	Vendor Data
	Transformer body.	Size mm.	75 x 10 mm	
9	Windings			
a	Material of winding		Electrolytic Copper	
b	Winding Connection Primary / Secondary		DELTA / STAR	
c	Vector Group		Dyn11	
10	Miscellaneous			
a	WTI, required with trip & alarm contact.		Required	
b	Housing Class		Min. IP 23	
c	Wheels	plain / flanged	Plain	
		Undirectional / Bidirectional	Bi-directional	
d	Transformer Accessories.		Required (See Notes 3)	
e	Cable box with disconnecting chamber. (Required / Not required).		Not required	
f	Magnetic flux density at rated voltage & frequency Tesla		1.72	
g	Constant power at all Taps		Yes	
h	Configuration of Primary /Secondary		90° Apart	
i	Extra Neutral Bushing		Required	
j	Thermal class of Winding		Class F	
k	Noise level at measuring distance of 1 Mt.		Within IS Tolerance	
l	Sheet steel thickness of enclosure		2 mm	
m	Temperature Scanner (Protection relay)		Similar to Pecon make TR-7570	
11	Losses			
a	Total losses at rated current & 75° C Winding Temp.	KW	21.5(Max)	
b	No load losses at 100% rated voltage & frequency.	KW	2.4 (Max)	
12	Weights And Shipping Section			
a	Core and winding	Kg.	Vendor to Furnish in this Data sheet.	
b	Enclosure	Kg.	Vendor to Furnish in this Data sheet.	
c	Total	Kg.	Vendor to Furnish in this Data sheet.	

Sr. No.	Description	Specified	Vendor Data
d	Weight of largest package	Kg.	Vendor to Furnish in this Data sheet.
e	Overall dimension (when view from primary side) (L x B x H)	mm.	Vendor to Furnish in this Data sheet.
13	Regulation		
a.1	At unity power factor at rated load		Vendor to Furnish in this Data sheet.
a.2	At unity power factor at 90% load		Vendor to Furnish in this Data sheet.
a.3	At unity power factor at 75% load		Vendor to Furnish in this Data sheet.
a.4	At unity power factor at 50% load		Vendor to Furnish in this Data sheet.
b.1	At 0.8 power factor at rated load		Vendor to Furnish in this Data sheet.
b.2	At 0.8 power factor at 90% load		Vendor to Furnish in this Data sheet.
b.3	At 0.8 power factor at 75% load		Vendor to Furnish in this Data sheet.
b.4	At 0.8 power factor at 50% load		Vendor to Furnish in this Data sheet.
14	Magnetisation Current		
a	Magnetisation current at rated voltage and frequency when excited from LV side.	A	Vendor to Furnish in this Data sheet.
b	When excited from LV side at 110% rated voltage	A	Vendor to Furnish in this Data sheet.
15	Current Density		
a	HV SIDE	A/Sq.mm	Vendor to Furnish in this Data sheet.
b	LV SIDE	A/Sq.mm	Vendor to Furnish in this Data sheet.
16	Efficiency		
a	100% load at unity power factor.		Vendor to Furnish in this Data sheet.
b	75% load at unity power factor.		Vendor to Furnish in this Data sheet.
c	50% Load at unity power factor.		Vendor to Furnish in this Data sheet.
d	100% Load at 0.8 power factor		Vendor to Furnish in this Data sheet.
e	75% Load at 0.8 power factor.		Vendor to Furnish in this Data sheet.

Sr. No.	Description	Specified	Vendor Data
f	50% Load at 0.8 power factor.	Vendor to Furnish in this Data sheet.	
17	Make Of Components		
a	WTI (Winding Temperature Indicator)	Perfect Control / Sukrut	
b	Limit switches	BCH/Siemens	
c	Bushings	WS/ Jayashree/ BHEL	
18	Resistance / Reactance		
a	% Resistance	Vendor to Furnish in this Data sheet.	
b	% Reactance	Vendor to Furnish in this Data sheet.	

Notes:-

1. All Data under 'Vendor Data' in this Data sheet to be filled up by vendor during Bidding stage.
2. Vendor shall quote for spares as per Clause No. 20.4 of specification: 322538-ETD-005.
3. All standard fittings and accessories for transformer, in addition to whatever is stated in this data sheet shall also be supplied.
4. HV cable box shall be suitable for the termination of 1#3Cx300 sq. mm (Al.), 33 KV (E), XLPE cable.
5. Transformer accessories shall be provided as specified in clause no.16 of Specification: 322538-ETD-005.
6. Knee point voltage shall be suitable for 3C - 2.5 YWY cable with length of 100 m (TO and FRO) Considering CAG14 Relay of AREVA Make. Knee point voltage $V_k > 2I_f (R_{ct} + 0.71)$ ($\geq 300V$) and $I_m < 30mA$ at $V_k / 4$, Where I_f =Secondary Fault current seen by CT, R_{ct} = CT Resistance.
7. The bushings of both Primary/Secondary windings shall be suitable to withstand the fault currents as mentioned in this Data sheet.
8. Transformer enclosure shall be provided with suitable door along with limit switch and it shall be wired up to the terminal block in marshalling box. In case someone tries to open the door with Transformer in energised condition then limit switch shall trip the incoming supply.