BSES

Technical Specification of
Dry Type Distribution Transformer
Specification no – BSES-TS-13-CRDT-R0

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Record of Revision

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1.0 Scope of supply

For scope of supply, refer annexure – A

2.0 Codes & standards

The Dry Type distribution transformers shall be designed, manufactured & tested in accordance with the following IEC & Indian standards

IS 2026- part 11/IEC 60076-11	Dry type Transformer
IS 11171	Dry Type Power Transformer
IS 2026	Power Transformers
IS 1271/IEC60085	Thermal Evaluation & Classification Of Electrical Insulation
IS/ IEC 60137	Bushing for Alternating voltage above 1000V
IS 10028	Code Of Practice For Installation And Maintenance of Transformers
IS 5	Ready Mixed Paint, Air Drying, Red-Oxide Zinc Chrome, Priming
IS 2932	Enamel, Synthetic, Exterior : A)Undercoating B) Finishing
IS 3347	Dimensions For Porcelain Transformer Bushings (For Use In Very Heavily Polluted Atmosphere)
IS 2026 part 12/IEC 60076-12	Loading Guide for dry type Power Transformers
IEC 60076	Power Transformers
IEC 60616	Terminal and Tapping Markings for Power Transformers
IEC 60726	Dry-Type Power Transformers.
IS/IECIEC 60529	Degrees of Protection Provided by Enclosures (IP Code).
Publication no. 317	CBIP Manual – Manual on transformers
	ECBC guideline-Energy conservation building guidelines

In the event of direct conflict between various order documents, the precedence of authority of documents shall be as follows:

i. Guaranteed Technical Particulars (GTP)

ii. This Specification

iii Referenced Standards

iv Approved Vendor drawings

v. Other documents

3.0 Major Design Criteria & Parameters of the Transformer

3.1	Location of equipment	Generally Outdoor but may be located indoor also with poor ventilation
3.2	Reference design ambient temperature	50 deg C
3.3	Type	Dry, core type, step down
3.4	Type of cooling	AN
3.5	Reference Standard	IS: 2026 part -11, 11171
3.6	No. of phases	3

3.7	No. of windings per phase	2
3.8	Rated frequency (Hz)	50 Hz
3.9	Highest system voltage HV side	12 KV
3.10	Highest system voltage LV side	460 V
3.11	Lightning Impulse withstand voltage	
3.11.1	For nominal system voltage of 11 kV	75 kV peak
3.12	Power Frequency Withstand Voltage	
3.12.1	For nominal system voltage of 11 kV	28 kV rms
3.12.2	For nominal system voltage of 415 V	3 kV rms
3.13	Major Design criteria	
3.13.1	Voltage variation on supply side	+ / - 10 %
3.13.2	Frequency variation on supply side	+/ - 5 %
3.13.3	Transient condition	- 20 % or + 10 % combined variation of voltage and frequency
3.13.4	Service Condition	The transformer enclosure is to be designed for outdoor location with service condition as specified, but its full rating shall be available if located indoor in poorly ventilated atmosphere
3.13.5	Insulation level	
3.13.6	Short Circuit withstand level	As per rating & impedance of transformer.
3.13.7	Overload capability	As per IS 2026-12/IEC 60076 Part 12
3.13.8	Noise level	Shall not exceed limits as per NEMA TR-1 with all accessories running measured as per IEC 551 / NEMA standard
3.13.9	Radio Influence Voltage	Maximum 250 microvolt
3.13.10	Harmonic currents	Transformer to be designed for suppression of 3^{rd}, 5^{th}, 7^{th} harmonic voltages and high frequency disturbances.
3.13.11	Partial Discharges	10 Pico C (max)
3.13.12	Parallel operation	Shall be designed to operate in parallel with existing transformer. Details of existing transformers shall be forwarded to the bidder on request.
3.14	Major Parameters	
3.14.1	Rating in KVA	250/400/630/750/1000/1600/2000/2500
3.14.2	Voltage Ratio	11000/415 Volts
3.14.3	Vector Group	Dyn11
3.14.4	Percentage Impedance at **130 deg C**	
3.14.4.1	250 KVA	5 % with IS tolerance

3.14.4.2	400 KVA	5 % with IS tolerance
3.14.4.3	630 KVA	5 % with IS tolerance
3.14.4.4	750 KVA	5 % with IS tolerance
3.14.4.5	1000 KVA	5 % with IS tolerance
3.14.4.6	1600 KVA	6 % with IS tolerance
3.14.4.7	2000 KVA	6 % with IS tolerance
3.14.4.8	2500 KVA	6 % with IS tolerance
3.14.5	No Load Losses, KW	
3.14.5.1	250 KVA	0.7 KW
3.14.5.2	400 KVA	0.9 KW
3.14.5.3	630 KVA	1.2 KW
3.14.5.4	750 KVA	1.4 KW
3.14.5.5	1000 KVA	1.78 KW
3.14.5.6	1600 KVA	3.2 KW
3.14.5.7	2000 KVA	3.56 KW
3.14.5.8	2500 KVA	4.05 KW
3.14.6	Max. full load losses at **130 deg. C**, kW	
3.14.6.1	250 KVA	2.2 KW
3.14.6.2	400 KVA	3.4 KW
3.14.6.3	630 KVA	5.4 KW
3.14.6.4	750 KVA	6.0 KW
3.14.6.5	1000 KVA	7.5 KW
3.14.6.6	1600 KVA	12 KW
3.14.6.7	2000 KVA	15.25 KW
3.14.6.8	2500 KVA	17.0 KW
3.14.7	Winding Temperature Rise above ambient deg C	**90 deg C**
3.14.8	Flux Density	1.73 T max at 110% rated voltage
3.14.9	Tapping on HV winding	Off Circuit taps on HV winding , + / - 10% in steps of 2.5% , change of taps by link
3.14.10	Design Clearance phase to phase (between bare conductor of bushings)	
3.14.10.1	For nominal system voltage of 11KV	180 mm min.
3.14.10.2	For nominal system voltage of 415 V	25 mm min.
3.14.11	Design clearance phase to earth	
3.14.11.1	For nominal system voltage of 11KV	120 mm min.
3.14.11.2	For nominal system voltage of 415 V	25 mm min.
3.14.12	System Fault Level , HV side	350 MVA
3.14.13	System Fault Level , LV side	35 MVA
3.15	System Earthing	
3.15.1	HV	Not Required

3.15.2	LV	Solidly earthed
3.16	Fire Protection Class	Class F1 shall be required
3.17	Climate Class	C2 shall be required
3.18	Environment Class	E2 shall be required
3.19	IP class requirement	IP 34
3.20	Warranty Period	66 months from date of supply & 60 months from date of commissioning whichever is earlier.

4.0 Construction & Design

4.1	Enclosure (Housing)	
4.1.1	Material	CRCA sheet steel
4.1.2	Sheet thickness	
4.1.2.1	Side, doors, covers	2 mm minimum
4.1.2.2	Top & Bottom sheet	3 mm minimum
4.1.2.3	Frames	3 mm minimum
4.1.3	Perforation on bottom sheet	As per manufacturers standard
4.1.4	Finish of perforated bottom sheet if Provided	Hot dipped Galvanized
4.1.5	Fixing of perforated bottom sheet if Provided	By nut bolt arrangement with the frame
4.1.6	Canopy at top	Required minimum 3 mm thick with slope to prevent water retention. Slope of canopy shall be kept away from cable termination side.
4.6.1	Essential provision for canopy	Canopy shall be fixed on load bearing member and shall be removable from inside of the enclosure only. Canopy shall be provided with lifting lugs.
4.1.7	Degree of protection	IP 34, Wire mesh (6 x 6 mm) shall have powder coated water blocking plates behind the wire mesh fixed on structure, plates behind wire mesh on top side of the enclosure shall have pipe routed suitably up to bottom of enclosure to drain the water accumulated in the plate, necessary slope to facilitate draining to be provided in both top and bottom water blocking plate
4.1.8	Design of door	
4.1.8.1	Minimum no of doors on HV/ LV side	Minimum 3 on each of HV / LV side
4.1.8.2	Hinges for doors of a) HV & LV side, b) for CT box c) for Winding temperature scanner box	i) Antitheft design (to make the door Non-removable type) ii) Minimum three hinges per door from top to bottom, Door suitable to be opened from outside iii) Door shall be earthed by flexible PVC insulated multi stranded copper wire of minimum 2.5 sqmm size.
4.1.8.3	Padlock Facility	Required at each HV /LV side door, CT box and WTI scanner box
4.1.8.4	Fixing of doors with the	By M6 size stainless steel Allen key screws.

	frame (applicable for CT box and Winding temperature scanner box too)	
4.1.8.5	Accessories	Welded Door handle , Danger plate on HV and LV side doors, caution plate for tap links for HT doors, Door limit switch on both HV and LV side doors to be wired up to WTI box terminal for tripping the transformer in case door is opened with the transformer energized, Phase marking plates on HV and LV doors
4.1.9	Design of covers on side other than HV /LV side	
4.1.9.1	Minimum no of covers on each side	Minimum 3 mm on each side
4.1.9.2	Hinges	None
4.1.9.3	Fixing of covers with the frame	With M6 size stainless steel Allen key screws and locking pin from inside so that the covers can be removed from inside only accessing the allen screw after opening door on HV or LV side only.
4.1.9.4	Accessories	Welded cover handle to be provided for handling while removing the cover minimum two nos per cover Covers shall be earthed by flexible PVC insulated multistranded copper wire of minimum 2.5 sqmm size.
4.2	Core	
4.2.1	Material	High grade , non ageing, low loss, high permeability, grain oriented, cold rolled silicon steel lamination. Core shall be low loss of 1Watt/kG (max)
4.2.2	Grade	Premium grade minimum M3 or better
4.2.3	Lamination Thickness with insulation	0.23 mm (max.)
4.2.4	Construction	The core shall be stack / wound-type annealed steel lamination having low loss and good grain properties, coated with high temperature insulation, bolted together and to the frames firmly to prevent vibration or noise. The core shall be properly stress relieved by annealing under inert atmosphere. The complete design of core must ensure permanency of the core losses with continuous working of the transformers. Vibration dampening pads provided to isolate the core and coil assembly from the base structure. The magnetic flux density is kept below the saturation point giving the better stability of the transformer in the long run.
4.2.5	Maximum Flux Density at 10 % over excitation / over fluxing	1.73 Tesla minimum allowed
4.2.6	Core Design Features	i) All steel sections used for supporting the core

		shall be thoroughly sand blasted after cutting , drilling, welding ii) Provision of lifting lugs for core coil assembly
4.3	Winding	
4.3.1	Material	Electrolytic Aluminium
4.3.1.1	Type	For HV shall be layer type & LV shall be with foil type.
4.3.2	Maximum current density allowed	1.5 Amp per sqmm (Max.)
4.3.3	Winding insulating material	Conductor insulation shall be class H where overall insulation class must be Class F (min), free from compounds liable to ooze out, shrink or collapse. Uniform insulation shall be applied to the windings and overall winding shall be cast resin.
4.3.4	Tappings	Off Circuit taps on HV winding , + / - 10 % in steps of 2.5 % , change of taps by link
4.3.4.1	Essential provisions for tap link	Shall be shrouded with cover made from insulating material. To prevent deposit of dust. Tap link inspection transparent window shall not be provided on the HV side door
4.3.5	Design Features	i) Stacks of winding to receive adequate shrinkage treatment ii) Connections braced to withstand shock during transport, switching, short circuit, or other transients. iii) Minimum out of balance force in the transformer winding at all voltage ratios. iv) Conductor width on edge exceeding six times its thickness v) The termination bus-bar coming out from winding shall be aluminium vi) Transposed at sufficient intervals. vii) Threaded connection with locking facility. viii) Winding leads rigidly supported , using guide tubes if practicable ix) Provision of taps as indicated in the technical particulars
4.3.6	Essential provision of HV and LV winding leads	Phase marking required near termination on both HV and LV side. Phase colour coding required on insulating sleeves on both HV and LV side. Phase sequence 1U, 1V, 1W from left to right looking inside from the HV side door. Phase sequence 2n, 2u, 2v, 2w from right to left looking inside from LV side door. Adequate HV termination clearance. Provision of check nut in all HV and LV winding lead connection.
4.4	Vibration Isolator	Vibration isolation pads shall be installed between core and coil assembly and enclosure base assembly to prevent the transmission of structure borne vibrations.
4.5	Bushing/Support Insulator/ Terminations	

4.5.1	Type of HV and LV Bushings, support insulators	Epoxy Resin Cast
4.5.2	Minimum creepage of bushing & support insulators	31mm/KV
4.5.3	Arcing Horns	Not Required
4.5.4	Termination on HV side	By cable within main enclosure
4.5.4.1	HV side cable size	11KV(E) grade, A2XCEWY 3CX150 sqmm
4.5.4.2	HV side cable entry	At bottom of enclosure through detachable gland plate
4.5.4.3	Gland plate material	Hot dipped Galvanized Steel 3 mm thick
4.5.4.4	Gland	Nickel plated brass double compression weatherproof cable gland
4.5.4.5	Cable Lugs	
4.5.4.6	HV side cable terminating busbar	Aluminium with size of 50X10 mm
4.5.4.7	Support of HT cable with enclosure	By MS flat of minimum size 50X10 mm
4.5.5	Termination on LV side	By cable with main enclosure/ By Bus Duct as per enquiry. In case of bus duct termination, there shall be separate box on LV side. The same box shall be suitable for cable termination & for bus duct arrangement also i.e. bus duct flange on the top & gland plate at the bottom/ as per enquiry.
4.5.5.1	LV side cable size	LV cable size, 650/1100 V grade, A2XY cable single core 630 sqmm unarmoured (appx. cable dia. is 40 mm)
4.5.5.2	LV side cable entry	At bottom of enclosure through detachable gland plate.
4.5.5.3	No. of cables on LV side	
4.5.5.3.1	250 KVA	2 runs per phase + 1 run in Neutral
4.5.5.3.2	400 KVA	2 runs per phase + 2 runs in Neutral
4.5.5.3.3	630 KVA	3 runs per phase + 2 runs in Neutral
4.5.5.3.4	750 KVA	3 runs per phase + 2 runs in Neutral
4.5.5.3.5	1000 KVA	4 runs per phase + 2 runs in Neutral
4.5.5.3.6	1600 KVA	6 runs per phase + 3 runs in Neutral
4.5.5.3.7	2000 KVA	7 runs per phase + 4 runs in Neutral
4.5.5.3.8	2500 KVA	9 runs per phase + 5 runs in Neutral
4.5.5.3	Gland plate material & type	Aluminium of 5 mm thick and gland plate should be single piece with “Knock Out” holes of dia. 45 mm.
4.5.5.4	Gland	Nickel plated brass double compression weatherproof cable gland
4.5.5.5	Cable Lugs	Shall be double hole lug with lug dia. Of 31 mm
4.5.5.6	LV side cable terminating busbar	Aluminium of size as follows
4.5.5.6.1	250 KVA	
	Phase	2 nos 100 x 10 mm
	Neutral	2 nos 100 x 10 mm
4.5.5.6.2	400 KVA	
	Phase	2 nos 100 x 10 mm

	Neutral	2 nos 100 x 10 mm
4.5.5.6.3	630 KVA	
	Phase	2 nos 100 x 10 mm
	Neutral	2 nos 100 x 10 mm
4.5.5.6.4	750 KVA	
	Phase	2 nos 100 x 10 mm
	Neutral	2 nos 100 x 10 mm
4.5.5.6.5	1000 KVA	
	Phase	2 nos 100 x 10 mm
	Neutral	2 nos 100 x 10 mm
4.5.5.6.6	1600 KVA	
	Phase	2 nos 120 x 12 mm
	Neutral	2 nos 120 x 12 mm
4.5.5.6.7	2000 KVA	
	Phase	2 nos 130 x 12 mm
	Neutral	2 nos 130 x 12 mm
4.5.5.6.8	2500 KVA	
	Phase	2 nos 160 x 12 mm
	Neutral	2 nos 160 x 12 mm
4.5.5.7	Support of LV cable with enclosure	By Aluminium (non magnetic) clamp size 50 x 3 mm fixed on MS bracket of size 50 x 10 mm supported from enclosure wall inside
4.5.5.8	Maximum Overall Dimension Acceptable (length x width x height),mm x mm x mm	
	250 KVA	1600 x 1650 x 1850
	400 kVA	1700 x 1750 x 1850
	630 kVA	1900 x 1750 x 1850
	1000 kVA	2200 x 2100 x 2400
	1600 kVA	2460 x 2200 x 2600
	2000 KVA	2750 x 2250 x 2600
	2500 KVA	3000 x 2300 x 2650
4.5.5.9	Short Circuit withstand Capacity of the transformer	
4.5.5.9.1	Three phase dead short circuit at secondary terminal with rated voltage maintained on the other side	As per IEC 60076-5
4.5.6	Partial Discharge	Transformer to be free from partial discharge
4.5.7	Tappings	Off Circuit taps on HV winding , + / - 10 % in steps of 2.5 % , change of taps by link
4.5.8	Tap link current rating, Amp	
	250/400 kVA	60 A
	630/ 750 kVA	100 A
	1000/1500/2000 kVA	125 A
	2500 kVA	150 A
4.6	Current Transformer	

4.6.1	Mounting	On LV side terminal busbars on all three phases with the help of fibre glass mounting plate
4.6.2	Maintenance requirements	Replacement should be possible without dismantling LV side support insulators
4.6.3	Accuracy Class	0.5
4.6.4	Burden	15 VA
4.6.5	Type	Resin Cast Ring type suitable for outdoor use
4.6.6	CT Ratio	
4.6.6.1	250 KVA	
4.6.6.2	400 KVA	600/5
4.6.6.3	630 KVA	1000/5
4.6.6.4	750 KVA	1200/5
4.6.6.5	1000 KVA	1500/5
4.6.6.6	1600 KVA	2500/5
4.6.6.7	2000 KVA	3000/5
4.6.6.8	2500 KVA	3500/5
4.6.7	CT Terminal Box	
4.6.7.1	Size	650 mm height x 450 mm width x 275 mm depth.
4.6.7.2	Fixing of instruments/meters within box	On slotted channel 40 x 12 mm size, channel fixed on vertical slotted angle 40 x 40 mm size at two ends
4.6.7.3	No of horizontal channels to be provided	Four
4.6.7.4	Fixing of terminals within box	On horizontal slotted channel with the help of C channel available with the terminals
4.6.7.5	Location	Within enclosure frame such that box door comes in line with enclosure surface
4.6.7.6	Box Door design	
4.6.7.7	Terminal strip	Nylon 66 material, minimum 4 sq mm, screw type for control wiring and potential circuit.
4.6.7.8	Cables & Wires	PVC insulated, extruded PVC inner sheathed, armoured, extruded PVC outer sheathed 1100 V grade control cable as per latest edition of IS 1554 part 1 minimum 2.5 sqmm for signals and 4 sqmm for CT with multistrand copper conductor & PVC insulated multistrand flexible copper wires of minimum 2.5 sqmm size, 1100 V grade as per latest edition of relevant IS
4.6.7.9	Cable Glands	Nickel plated brass double compression weatherproof cable gland
4.6.7.10	Lugs on wires	Tinned copper preinsulated Pin, Ring, Fork type as applicable
4.6.7.11	Potential signal in CT box	Tapped from main LV busbars
4.6.7.12	Hinges of CT terminal Box & WTI scanner box	Shall be of Anti theft type & shall not be visible from outside.
4.6.7.13	Essential provision	i) Wiring diagram to be fixed on the back of door along with CT spec. ii) Wiring diagram, name plate / danger plate etc shall be made from Aluminium with black engraving & shall be fitted by riveting at

		appropriate place
4.7	Hardware	
4.7.1	External	Stainless Steel only
4.7.2	Internal	Cadmium plated except special hardware for frame parts and core assembly as per manufacturer's design
4.8	Gasket	Nitrile Cork based gasket across all doors & covers
4.9	Control cable specification (to be used by the vendor)	PVC insulated, extruded PVC inner sheathed, armoured, extruded PVC outer sheathed 1100 V grade control cable as per latest edition of IS 1554 part 1 minimum 2.5 sqmm for signals and 4 sqmm for CT with multistrand copper conductor. Control cables shall be of FRLS only.
4.10	Specification of wires to be used inside CT box , WTI box etc.	PVC insulated multistrand flexible copper wires of minimum 2.5 sqmm size, 1100 V grade as per latest edition of relevant IS
4.11	Terminal Blocks to be used by the vendor	Nylon 66 material, minimum 4 sq mm,screw type for control wiring and potential circuit.
4.11.1	Essential provision for CT terminals	Sliding link type disconnecting terminal block screwdriver operated stud type with facility for CT terminal shorting material of housing melamine/ Nylon66
4.12	Cable glands to be used by the vendor	Nickel plated brass double compression weatherproof cable gland
4.13	Cable lugs to be used by the vendor	
4.13.1	For power cables	Long barrel medium duty Aluminium lug with knurling on inside surface
4.13.2	For control cables	Tinned copper pre insulated Pin, Ring, Fork type as applicable
4.14	Painting of transformer, CT box, WTI box	
4.14.1	Surface preparation	By 7 tank pretreatment process or shot blasting method
4.14.2	Finish on internal surfaces	Powder coated, Epoxy polyester base, grade A, shade – White, Uniform thickness of 80 microns minimum.
4.14.3	Finish on external surface	Powder coated, Epoxy polyester base, grade A, shade – 7032, Uniform thickness of 120 microns minimum with 01 coat of primer & 02 coats of paint.
4.14.4	Finish shade on external surfaces	RAL 7032 Siemens Grey
4.14.5	Painting on welding	All welding to be applied zinc rich paint before final painting
4.15	Labels & Name Plate	All name plate, wiring scheme plate, R&D plate, caution plate, danger plate, phase identification plate, identification plate shall be aluminium with black engraving Sticker of any form is not acceptable.
4.15.1	Fixing of name plate	By riveting only at appropriate location
4.16	Insulating support material	Backelite shall not be used as a base plate for

	for base plate for mounting components	mounting any components, insulating material non hygroscopic insulating material like FRP shall be used
4.17	Hazard sticker/plate	As per IS standard
4.18.0	Surge Arrester	Required, Connected on Transformer Primary side on all three phases
4.18.1	Type	Gapless Metal Oxide
4.18.2	Housing	Polymeric preferable, at bottom of HV winding
4.18.3	Surge Arrestor requirement for solidly grounded system	
4.18.4	System Voltage , kV rms	11
4.18.5	Rated Voltage of Arrestor, kV rms	9
4.18.6	Continuous operating voltage, kV rms	6.35
4.18.7	Maximum Continuous operating voltage, kV rms	7.65
4.18.8	Nominal Discharge Current, kA peak	10
4.18.9	Energy Absorption Capability, kJ/kV	Greater than 2.5
4.18.10	Creepage distance	31 mm /kV
4.18.11	Reference std	IS 3070 part 3 and IEC 99-4
4.19.0	Winding Temperature scanner	Required
4.19.1	No. of RTD inputs	Five (Three for windings, one for enclosure & one shall be spare) RTD for enclosure temperature monitoring shall be fixed at enclosure Top from inside to give max. Enclosure temp reading & shall be wired up to temp. Scanner to indicate the reading.
4.19.1.1	Location of winding RTD	At location of winding where maximum temperature is expected.
4.19.2	No of potential free trip contacts	Two
4.19.3	No of potential free Alarm contacts	Two
4.19.4	Auxiliary Supply	240 V AC, 1 phase, 50 Hz. Tapped from LV side busbar through a MCB located inside box.
4.19.5	Communication port	RS 485 port for interfacing with FRTU on Modbus protocol. Battery/Super capacitor for data transmission to SCADA in the event of Auxiliary supply fail
4.19.6	Winding Temperature Scanner terminal Box	Required
4.19.6.1	Size	As per manufacturers standard
4.19.6.2	Fixing of instrument within box	On side wall of enclosure
4.19.6.3	Fixing of terminals within the box	On C channel available with the terminals
4.19.6.4	Location	Within enclosure frame such that Marshalling Box &

		WTI on same side & free access to all LV side doors.
4.19.6.5	Terminal Strip	Nylon 66 material, minimum 4 sq mm, screw type for control wiring and potential circuit.
4.19.6.6	Cables & Wires	PVC insulated, extruded PVC inner sheathed, armoured, extruded PVC outer sheathed 1100 V grade control cable as per latest edition of IS 1554 part 1 minimum 2.5 sq mm for signals and 4 sq mm for CT with multi strand copper conductor & PVC insulated multi strand flexible copper wires of minimum 2.5 sq mm size, 1100 V grade as per latest edition of relevant IS
4.19.6.7	Cable Glands	Nickel plated brass double compression weatherproof cable gland
4.19.6.8	Lugs on wires	Tinned copper pre insulated Pin, Ring, Fork type as applicable
4.19.6.9	Auxiliary supply in box	Tapped from main LV busbars, taken via MCB for isolation and protection of scanner, MCB to be fixed on DIN rail with clamps on two sides.
4.19.6.10	Essential provision	Wiring diagram to be fixed on the back of door along with brief details of scanner, HV side , LV side door limit switches to be wired up-to Terminal Block, Service socket to be provided with switch, fuse and link.

5.0 Fittings and Accessories on Transformer

5.1	Rating & Diagram Plate	Required
5.1.1	Material	Anodized Aluminium 16 SWG
5.1.2	Background	Satin silver
5.1.3	Letters, diagram & border	Black
5.1.4	Process	Etching
5.1.5	Name Plate details	Following details shall be provided on rating and diagram plate as a minimum i) Type of transformer i.e cast resin with winding material ii) Standard to which it is manufactured iii) Manufacturer's name; iv) Transformer serial number; v) Month and year of manufacture. vi) Rated frequency in Hz. vii) Rated voltages in kV. viii) Number of phases. ix) Rated power in kVA. x) Type of cooling. xi) Rated currents in A. xii) Vector group symbol. xiii) 1.2/50ıs wave impulse voltage withstand level in kV. xiv) Power frequency withstand voltage in kV.

		xv) impedance voltage at rated current and frequency in percentage at principal, minimum and maximum tap at highest temperature. xvi) load loss at rated current at highest temperature. xvii) No-load loss at rated voltage and frequency. xviii) auxiliary loss xix) Continuous ambient temperature at which ratings apply in C. xx) winding connection diagram with taps and table of tapping voltage, current and power xxi) Transport weight of transformer xxii) Weight of Core xxiii) Weight of Winding xxiv) Weight of core coil assembly xxv) Weight of enclosure and fittings xxvi) Total weight xxvii) tapping details xxviii) Phase CT details xxix) Class of insulation xxx) IP protection rating of the enclosure xxxi) Name of the purchaser xxxii) PO no. & date xxxiii) Guarantee period xxxiv) Fire, Environment & Climate Class
5.2	Detachable Bi-directional flat Roller Assembly	Required
5.2.1	Roller center to center distance	Minimum 900 mm on the side of HV and LV termination Maximum 800 mm on the other side (perpendicular to HV, LV termination).
5.2.2	Essential provision	Roller dia. 150 mm min, roller to be fixed in such a way so that the lowermost part of the skid is above ground by at least 100 mm when the transformer is installed on roller.
5.3	Earthing pad on enclosure for transformer earthing complete with Stainless Steel nut, bolt, washers, spring washers etc.	Required with identification plate on outside of enclosure.
5.4	Core, frame to tank earthing	Required
5.5	Off circuit tapping links	Required. Shrouds to be provided on tap link
5.6	Tap link position plate	Required inside HV side door
5.7	Danger plate made of Anodized aluminum with white letters on red background on HV and LV side	Required
5.8	Skid with Haulage lugs	Required
5.9	Lifting lugs for complete	Required

	transformer as well as enclosure	
5.9.1	Essential provision for lifting lugs	Lifting lugs for core coil assembly shall be provided in such a way that the weight shall not come on canopy while lifting. Lifting lugs for canopy/ enclosure shall be provided in such a way that the weight shall not come on canopy while lifting , it shall be born by supporting members.
5.10	Caution plate for tap links	Required
5.11	Ventilation louvers with stainless steel wire mesh and rain water guard	Required as per Manufacturer's design, but it is to be provided minimum required to prevent ingress of excessive dust.
5.12	Surge arrester & its grounding bushings	Required. Shrouds to be provided on surge arrester terminations
5.12.1	Essential provision	Surge arrestor shall be erected vertically in such a way that the surge arrestor can be removed at site without removing HV cable lug. Surge arrestor shall not be used for any kind of support. Surge arrestor grounding strip to be routed to the surge arrester grounding bushing near bottom of enclosure with proper support. Surge arrestor grounding bushing shall be identified by identification plate on outside of enclosure. Surge arrestor grounding bushing shall be supplied with all hardware to readily connect purchaser's ground lead.
5.13	LV additional neutral earthing bushing	Required, separate & outside the enclosure.
5.13.1	Essential provision	Busbar connecting the neutral to additional neutral bushing shall be properly supported and additional neutral bushing shall be identified by identification plate on outside of enclosure. Additional neutral bushing shall be supplied with all hardware to readily connect purchaser's ground lead.
5.14	Extra earthing stud for cable armour earthing	Required
5.15	Winding temperature scanner	Required
5.16	RTD in Winding and near top of enclosure.	Required
5.17	Space heater inside enclosure	Required
5.17.1	Mounting of space heater	By suitable spacers so that heater does not come in contact with panel wall directly.
5.18	Copper earthing link	Across all gasketted joints in the enclosure body.

6.0 Approved make of components

6.1	Core	Nippon/JFE/Posco/Thyssen Krupp
6.2	Aluminium	Hindalco, Nalco, Sterlite, Birla
6.3	Steel	Essar/SAIL/Tata
6.4	Winding Temperature	Precimeasure / Pecon

	Indicator	
6.5	CT	Pragati/ECS/Kappa
6.6	Terminals	Elmex/Connectwell
6.7	Resin	Huntsmen
6.8	Lugs/Glands	Jainson/Dowells/Comet
6.9	Bushing/Support Insulator	Baroda Bushing/CJI/Jaipur Glass

*Vendor shall take prior approval of BSES before using any other make than approved make.

7.0 Quality Assurance

7.1	Quality Assurance program	To be submitted before contract award. Program shall contain following i) The structure of the organization ii) The duties and responsibilities assigned to staff ensuring quality of work. iii) The bidder should have qualified technical & dedicated QA personnel at various stages of manufacture & testing. iv) Factory inspection of bidder may be carried out to ascertain the quality system and process in place at manufacturing facility. The same is applicable to bidders not approved with BSES. v) The system for purchasing, taking delivery and verification of materials vi) The system for ensuring quality of workmanship vii) The system for control of documentation viii) The system for the retention of records ix) The arrangements for the Supplier's internal auditing x) A list of the administration and work procedures required to achieve and verify Contract's quality requirements. These procedures shall be made readily available to the Purchaser for inspection on request
7.2	Quality Plan	To be submitted by the successful bidder for approval. Plan shall contain following as a minimum i) An outline of the proposed work and programm sequence ii) The structure of the Supplier's organisation for the contract iii) The duties and responsibilities assigned to staff ensuring quality of work for the contract iv) Inspection Hold and notification points mutually agreed. v) Submission of engineering documents required

		by the specification vi) The inspection of materials and components on receipt vii) Reference to the Supplier's work procedures appropriate to each activity viii) Inspection during fabrication/ construction ix) Final inspection and test x) Successful bidder shall include submittal of Mills invoice, Bill of lading, Mill's test certificate for grade, physical tests, dimension, specific watt loss per kG for the core material to the purchaser for verification in the quality plan suitably

8.0 Progress Reporting

8.1	Outline document	To be submitted for purchaser approval for outline of production, inspection, testing, inspection , packing, dispatch, documentation programme
8.2	Detailed Progress report	To be submitted to Purchaser once a month containing i) Progress on material procurement ii) Progress on fabrication iii) Progress on assembly iv) Progress on internal stage inspection v) Reason for any delay in total programme vi) Details of test failures if any in manufacturing stages vii) Progress on final box up viii) Constraints/Forward path

9.0 Inspection an Testing

9.1	Inspection and Testing during manufacture	Only type tested equipment shall be acceptable
9.1.1	Enclosure	i) Check correct dimensions between wheels demonstrate turning of wheels through 90 deg and further dimensional check ii) Check for physical properties of materials for lifting lugs etc. All load bearing welds, including lifting lug welds shall be subjected to required load tests.
9.1.2	Core	
9.1.2.1	Mother Core coil	Verification & inspection of the mother coil at port & putting stamp & seal may be inspected by BSES.
9.1.2.2	Core sample type testing	Reconciliation of mother coil by checking stamp & seal at factory before slitting. One sample of CRGO to be sealed for testing at ERDA/CPRI. Following Tests shall be conducted on the sample per P.O.

		i) Specific core loss measurement ii) Magnetic polarization iii) Magnetic permeability iv) Specific core loss measurement after accelerated ageing test v) Surface insulation resistivity vi) Electrical resistivity measurement vii) Stacking factor viii) Ductility(Bend test) ix) Lamination thickness x) Magnetization characteristics (B-H curve)
9.1.2.3	Core cutting	Bidder should have in house core cutting facility for proper monitoring & control on quality. In case it is done outside cutting shall be done in presence of BSES.
9.1.2.4	Core physical verification	i) Check on the quality of varnish if used on the stampings. a) Measurement of thickness and hardness of varnish on stampings. b) Solvent resistance test to check that varnish does not react in hot oil. c) Check over all quality of varnish by sampling to ensure uniform hipping colour, no bare spots. No ever burnt varnish layer and no bubbles on varnished surface. ii) Check on the amount of burns. iii) Bow check on stampings. iv) Check for the overlapping of stampings. Corners of the sheet are to be apart. v) Visual and dimensional check during assembly stage. vi) Check on complete core for measurements of iron-loss and check for any hot spot by exciting the core so as to induce the designed value of flux density in the core. vii) Check for inter laminar insulation between core sectors before and after pressing. viii) Visual and dimensional checks for straightness and roundness of core, thickness of limbs and suitability of clamps. ix) High voltage test (2 KV for one minute) between core and clamps. Certification of all test results.
9.1.2.5	Documents verification	Following documents to be submitted during the stage inspection i) Invoice of supplier ii) Mills test certificates iii) Packing list iv) Bill of lading

		v) Bill of entry certificates by customs
9.1.3	Insulating Materials	i) Sample check for physical properties of materials. ii) Check for dielectric strength. iii) Visual and dimensional checks. iv) Check for the reaction of hot oil on insulating materials. v) Certification of all test results.
9.1.4	Windings	i) Sample check on winding conductor for mechanical properties and electrical conductivity. ii) Visual and dimensional check on conductor for scratches, dept. mark etc. iii) Sample check on insulating paper for PE value, Bursting strength, Electric strength. iv) Check for the bending of the insulating paper on conductor. v) Check and ensure that physical condition of all materials taken for winding is satisfactory and free of dust. vi) Check for absence of short circuit between parallel strands. vii) Check for Brazed joints wherever applicable. viii) Measurement of voltage ratio to be carried out when core/ yoke is completely restocked and all connections are ready. ix) Weight of winding x) Certification of all test results.
9.1.4	Tests on fitting and Accessories	As per Manufacturer's Standards
9.2	Routine Tests	The sequence of routine testing shall be as follows i) Visual and dimension check for completely assembled transformer ii) Measurements of voltage ratio iii) Measurements of winding resistance at principal tap and two extreme taps. iv) Vector Group and polarity test v) Measurements of insulation resistance. vi) Separate sources voltage withstand test. vii) Measurement of iron losses and exciting current at rated frequency and 90%, 100% and 110% rated voltage. viii) Induced voltage withstand test. ix) Load losses measurement. x) Impedance measurement of principal tap (HV and LV) of the transformer. xi) Induced voltage withstand test (to be repeated if type tests are conducted). xii) Measurement of Iron loss (to be repeated if

		type test are conducted). xiii) Measurement of capacitance and Tan Delta for HV and LV bushings xiv) Partial discharge test xv) Ratio of LV CT xvi) Magnetic balance test xvii) Power frequency voltage withstand test on all auxiliary circuits xviii) Temperature rise test # xix) Certification of all test results. Note: a) #Temperature rise test may be necessary to be carried out on one unit/lot. Purchaser's engineer, will at its discretion, select transformer for temp.rise test from any lot offered for inspection at manufacturer's works and witness the same for comparison with CPRI/ERDA lab type test results b) BSES may appoint recognized testing authority like CPRI /ERDA lab with their instruments & engineer's team and measure no load loss, load loss and percentage impedance of the transformer at supplier's works at our own cost. Bidder shall agree and give them full co-operation during their stay & testing at shop floor. The losses & impedance values so obtained will be considered as final.
9.3	Acceptance test at NABL lab	Bidder should have in-house NABL accredited testing facility. In case of unavailability of same, one Transformer of each rating shall be randomly selected and sealed by BSES representative for complete acceptance test as per IS 2026-Part 11 (including temperature test) at third party NABL Lab. Tests shall be conducted once per Rate contract.
9.4	Type Tests	On one transformer of each rating and type at CPRI/ERDA. i) Impulse withstand test on all three HV limbs of the transformers for chopped wave as per standard ii) Temperature rise test as per IS Note – Purchaser may choose to carry out short circuit, impulse & temperature rise test on one unit from a lot offered for inspection at CPRI/ERDA lab **.** Cost of such tests shall be borne by the bidder**.**
9.5	Special Tests	On one transformer of each rating and type i) Dynamic & Thermal (3 sec) Short Circuit Test as per IS 2026 at CPRI/ERDA

		ii) Measure of zero seq. impedance (Cl. 16.10 IS 2026 Part I). iii) Measurement of acoustic noise level (Cl. 16.12 of IS 2026 Part I). iv) Measurement of harmonic level on no load current. v) Partial discharge test. vi) Enclosure Ingress protection at CPRI/ERDA vii) High voltage withstand test shall be performed on the auxiliary equipment and wiring after complete assembly. Cost of such tests, if extra, shall be quoted separately by the Bidder.
9.6	Notification to bidders	In case bidder had conducted type & special tests from CPRI/ERDA on BSES design and there is no design change in the transformer less than 10 years from the date of the bid opening, then bidder need not to conduct the type test from CPRI/ERDA lab. The bidder shall submit the under taking that there is no change in design with respect to type tested design.
		The product offered must be of type tested quality. In case the product offered is never type & special tested the same (as per above clause 9.4.& 9.5), is to be conducted by bidder at his own cost at CPRI/ERDA
9.7	Customer Hold Point	i) GTP & Drawings approval ii) Core Inspection(See Cl No 9.1.2) Sample to be tested at CPRI/ERDA for each lot. iii) Core & Coil Stage inspection of each lot to be offered for final testing.

10.0 Packing, Shipping, Handling and Storage

10.1	Packing	
10.1.1	Packing protection	Against corrosion, dampness, heavy rains, breakage and vibration
10.1.2	Packing for accessories and spares	Robust wooden non returnable packing case with all the above protection
10.1.3	Packing details	On each packing case details required as follows i) Individual serial number; ii) Purchaser's name; iii) PO number (along with SAP item code, if any) & PO date iv) Equipment tag no. (if any) v) Destination vi) Manufacturer/Supplier's name; vii) Address of Manufacturer/supplier/it's agent viii) Description and quantity ix) Month & Year of Manufacturing

		x) Country of origin xi) Case measurements xii) Gross and net weights in kilograms xiii) All necessary slinging and stacking instructions. xiv) As built drawings & O&M manual. One copy with each transformer
10.2	Shipping	i) The bidder shall ascertain at an early date and definitely before the commencement of manufacture, any transport limitations such as weights, dimensions, road culverts, overhead lines, free access etc. from the manufacturing plant to the project site; and furnish to the Purchaser confirmation that the proposed packages can be safely transported, as normal or oversize packages, upto the plant site. ii) Any modifications required in the infrastructure and cost thereof in this connection shall be brought to the notice of the Purchaser
10.3	Handling and Storage	Manufacturer instruction shall be followed. Detail handling & storage instruction sheet / manual needs to be furnished before commencement of supply.

11.0 Deviations

Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, requirements of the Specification shall be met without exception.

12.0 Drawings & Data Submission Matrix

Drawing submission shall be as per the matrix given below. All documents/ drawing shall be provided on A3/A4 sheet in box file with separators for each section. PDF shall also be provided of all documents via USB. Deviation sheet and GTP shall be provided in excel sheet. Language of the documents shall be English only. Deficient/ improper document/ drawing submission may liable for rejection.

S.no	Documents to be submitted	With the bid	After Award	
			For Approval	Prior to dispatch
1	Copy of specification along with company seal & signature on each page.	✓	✓	
2	Guaranteed technical particulars	✓	✓	
3	Outline dimension drawing for each major component, general arrangement drawing showing component layout an general schematic diagrams.	✓	✓	

S.no	Documents to be submitted	With the bid	After Award	
			For Approval	Prior to dispatch
4	Type test certificates, where available, and sample routine test reports	✓	✓	
5	Detailed reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating	✓		
6	Details of manufacturers quality assurance standard and programme and ISO 9000 series or equivalent national certification.	✓		
7	Deviations from this specification. Only deviations approved in writing before award of contract shall be accepted.	✓		
8	Recommended spare parts and consumable items for the five years of operation with prices and spare parts catalogue with price list for future requirements.	✓		
9	Transport / shipping dimension and weights, space required for handling parts for maintenance	✓		
10	Quality assurance program.	✓	✓	
11	Programme for production and testing		✓	
12	General description of the equipment and all components, including brochures		✓	
13	Detailed dimension drawing for all components, general arrangement drawing showing detailed component layout		✓	
14	Rating and Diagram Plate		✓	
15	Wiring Diagram of Marshaling box		✓	
16	CT/VT termination box		✓	
17	Foundation details		✓	
18	Core coil Assembly		✓	
19	Wiring diagram Plate for CT Box		✓	
20	Tap Link position plate		✓	
21	Label plate for phase, Neutral, surge arrester & other essential parts		✓	

S.no	Documents to be submitted	With the bid	After Award	
			For Approval	Prior to dispatch
22	Surge Arrester Arrangement		✓	
23	HV &LV Cable support		✓	
24	22kV Support insulator		✓	
25	3.3kV support insulator		✓	
26	CT mounting details		✓	
27	Scanner box mounting details		✓	
28	HT termination detail		✓	
29	LT termination details		✓	
30	Enclosure assembly & door arrangement		✓	
31	Louver back plate arrangement		✓	
32	Calculations to substantiate choice of electrical, structural, mechanical component size, ratings		✓	
33	Detailed loading drawing to enable the purchaser to design and construct foundations for the transformer.		✓	
34	Transport /shipping dimension with weights ,wheel base details, untanking height etc.		✓	
35	Terminal arrangements and cable box details		✓	
36	Lists of makes of all fittings and accessories		✓	
37	Statement drawing attention to all exposed points in the equipment at which contact with or in close proximity to other metals and stating clearly what protection is employed to prevent corrosion at each point		✓	
38	Complete casting process		✓	
39	Resin Data sheet		✓	
40	Detailed installation and commissioning instructions			✓
41	Inspection and test reports carried out in manufacturers works			✓
42	Test certificates of all bought out items. and catalogues			✓
43	Operation and maintenance instructions as well as trouble shooting charts.			✓

Annexure A Scope of supply

Sr. No	Description	Scope of Supply
1.0	Scope	Design, manufacture, assembly, testing at stages of manufacture as per this specification, final testing at manufacturer works on completely assembled transformer before dispatch, packing, transportation, delivery and submission of all documentation for the Distribution transformer with all accessories as below and Cl. 4 & 5 of this specification (Above is typical, It has to be validated on a case to case basis
1.1	Nickel Plated brass double compression glands for HV and LV, LVN cables (in case of termination by cable)	YES
1.2	Long barrel medium duty Aluminium lugs for power cables (in case of termination by cable)	YES
1.3	Nickel Plated brass double compression glands and tinned copper lugs for control cable termination in Marshalling box and CT/VT box for vendor's	YES
1.4	Cables and wires for transformer accessories, CTs etc. and internal wiring of CT	YES
1.5	Touch up paint	YES
1.6	Routine testing as per Cl. Of this specification	YES
1.7	Type testing as per Cl. of this specification	YES
1.8	Special testing as per Cl. of this specification	YES
1.9	Supervision of testing & commissioning of transformer	YES

Annexure B Service Condition

1.0	Delhi Atmospheric conditions	
1.2	Average grade atmosphere	Heavily polluted , dry
1.3	Maximum altitude above sea level	1000 M
1.4	Ambient Air temperature	Highest 50 deg C, Average 40 deg C
1.5	Design ambient air temperature	50 deg C
1.6	Relative Humidity	90 % Max
1.7	Seismic Zone	4
1.8	Rainfall	750 mm concentrated in four months

Annexure C Guaranteed Technical Particulars (Data by Seller)

Sr. No.	Particulars	Specified / Required	Offered
1.0	General		
1.2	Make		
1.2	Type	core type , outdoor, step down	
1.3	Full rating available for installation of the same transformer in indoor poorly ventilated condition (YES/ NO)		
1.4	IP Class		
1.5	Fire Protection Class		
1.6	Environment Class		
2.0	Nominal Continuous Rating, KVA		
2.1	HV Winding	250/400/630/750/1000/1600/2000/2500	
2.2	LV Winding	250/400/630/750/1000/1600/2000/2500	
3.0	Rated Voltage (kV)		
3.1	HV winding	11 KV	
3.2	LV winding	415 Volts	
4.0	Rated current (Amps)		
4.1	HV winding		
4.2	LV winding		
5.0	Connections		
5.1	HV winding	Delta	
5.2	LV winding	Star with additional neutral	
5.3	Vector Group Reference	Dyn11	
6.0	Impedance at principal tap rated current and frequency at 130 deg C		
6.1	Impedance	5/5/5/5/5/6/6/6 %	
6.2	Reactance		
6.3	Resistance		
6.4	Impedance at lowest tap rated current and frequency		
6.5	Impedance at highest tap rated current and frequency, %		
7.0	Resistance of the winding at 130 deg C ,at principal tap, ohm		

7.1	a) HV		
7.2	b) LV		
8.0	Zero sequence impedance, ohm		
8.1	a) HV		
8.2	b) LV		
9.0	Guaranteed maximum losses principal tap full load and 130°C without any positive tolerance kW		
9.1	No load losses (max)	As per Spec Cl.	
9.2	Load Losses (max)	As per Spec Cl.	
9.3	Total stray loses @ 130 deg C		
10.0	Temperature rise over reference design ambient		
10.1	Winding by resistance 0 C		
10.2	Maximum hot spot temperature, deg. C		
11.0	Efficiency		
11.1	Efficiency at 130 degC and unity power factor %		
11.1.1	At 110% Load		
11.1.2	At 100% Load		
11.1.3	At 80% Load	Not less than 99.5 %	
11.1.4	At 60% Load		
11.1.5	At 40% Load		
11.1.6	At 20% Load		
11.2	Efficiency at 130 degC and 0.8 power factor lag %		
11.2.1	At 110% Load		
11.2.2	At 100% Load		
11.2.3	At 80% Load	Not Less than 99.5 %	
11.2.4	At 60% Load		
11.2.5	At 40% Load		
11.2.6	At 20% Load		
11.3	Maximum efficiency at 130 deg C, %		
11.4	Load and power factor at which it occurs		
12.0	Regulation , (%)		
12.1	Regulation at full load at		

	130 deg C		
12.1.1	at unity power factor		
12.1.2	at 0.8 power factor lagging		
12.2	Regulation at 110% load at 130 deg C		
12.2.1	at unity power factor		
12.2.2	at 0.8 power factor lagging		
13.0	Details of enclosure		
13.1	Material		
13.2	Thickness of sides mm		
13.3	Thickness of bottom mm		
13.4	Thickness of cover mm		
14	Core		
14.1	Type:	Core	
14.2	Core material grade	Premium grade minimum M3 or better	
14.3	Thickness of lamination		
14.4	Insulation of lamination	With insulation coating on both sides	
14.5	Design Flux Density at rated condition at principal tap, Tesla	1.6 T	
14.5.1	Maximum flux density at 10 % over excitation /over fluxing, Tesla	1.73 Tesla maximum allowed	
14.6	Equivalent cross section area mm^2		
14.7	Guaranteed No Load current At 100% rated voltage , Amps		
14.7.1	HV		
14.7.2	LV		
14.8	Guaranteed No Load current At		
14.8.1	HV		
14.8.2	LV		
15	Type of Winding		
15.1	HV		
15.2	LV		
15.3	Conductor material	Electrolytic Aluminium	

15.4	Current density Amps/sqmm	Maximum allowed 1.5 A per sqmm.(max.)	
15.4.1	HV Winding		
15.4.2	LV Winding		
15.5	Gauge/area of cross section of conductor, sqmm		
15.5.1	HV		
15.5.2	LV		
15.6	Tappings provided as per Cl. 3.14.9 (YES / NO)		
15.7	Tap link Current rating , A		
16	Insulating Material		
16.1	HV Turn		
16.2	LV Turn		
16.3	LV Core		
16.4	HV - LV		
17	Insulating material thickness, mm		
17.1	HV Turn		
17.2	LV Turn		
17.3	LV to Core		
17.4	HV to LV		
18	Minimum design clearance, mm		
18.1	HV to earth in Air		
18.2	LV to earth in Air		
18.3	Between HV & LV in Air		
18.4	Top winding and yoke		
18.5	Bottom winding and yoke		
19	Bushing / Support Insulator		
19.1	Make		
19.2	Type		
19.3	Reference Standard		
19.4	Voltage class, kV		
19.4.1	HV side Bushing / Support insulator		
19.4.2	LV side line and neutral bushing / Support insulator		
19.5	Creepage factor for all bushing mm/KV		
19.6	Weight, Kg		
9.6.1	HV bushing / Support		

	insulator		
19.6.2	LV line and neutral bushing		
19.7	Free space required for bushing / Support insulator removal, mm		
19.7.1	HV bushing / Support		
19.7.2	LV line and neutral bushing / Support insulator		
20	Terminal connections		
20.1	HV		
20.2	LV		
20.3	Terminal Details		
20.3.1	HV side busbar size		
203.2	HV Termination suitable for cable size		
20.3.3	HV Termination height, mm		
20.3.4	HV side gland Plate dimension, mm x mm		
20.3.5	HV side gland Plate		
20.3.6	HV side Gland Plate Thickness, mm		
20.3.7	HV side Phase to clearance inside enclosure , mm		
20.3.8	HV side Phase to earth inside box, mm		
20.3.9	LV side busbar size		
20.3.10	LV Termination suitable for cable size		
20.3.11	LV Termination height, mm		
20.3.12	LV side gland Plate dimension, mm x mm		
20.3.13	LV side gland Plate material		
20.3.14	LV side Gland Plate Thickness, mm		
20.3.15	LV side Phase to phase clearance inside enclosure , mm		
20.3.16	LV side Phase to earth inside box, mm		

21	Current Transformer on LV phases		
21.1	Type		
21.2	Make		
21.3	Reference Standard		
21.4	CT Ratio		
21.5	Burden, VA		
21.6	Class of Accuracy		
22	CT terminal box size		
23	WT scanner terminal box size		
24	Alarm and Trip contact ratings of protective devices		
24.1	Rated / making/ breaking currents , Amp @ Voltage for		
24.1.1	Winding temperature		
25	Fittings and Accessories as per Cl. 5.0 provided (YES / NO)		
26	Painting as per clause 4.14 provided (Yes/No)		
27	Over all transformer dimensions		
27.1	Length, mm		
27.2	Width, mm		
27.3	Height, mm		
28	Weight data		
28.1	Core, kG		
28.2	Frame parts, kG		
28.3	Core and frame, kG		
28.4	Total Winding, kG		
28.5	Core , Frame, Winding, kG		
28.6	Enclosure, kG		
28.7	Total Transport weight of the transformer, kG		
28.8	Total weight of the transformer with all accessories		
29	Shipping Data		
29.1	Weight of heaviest package, kG		

29.2	Dimensions of the largest package (L x B x H) mm		
30	Surge Arrestor requirement		
30.1	Type		
30.2	System Voltage , kV rms		
30.3	Rated Voltage of Arrestor, kV rms		
30.4	Continuous operating voltage , kV rms		
30.5	Maximum Continuous operating voltage, kV rms		
30.6	Nominal Discharge Current, kA peak		
30.7	Energy Absorption Capability, kJ/kV		
30.8	Creepage factor		
30.9	Reference std		
31	WTI Scanner Details		
31.1	Make		
31.2	Model no.		
31.3	Manual submitted		
31.4	Modbus communication (Yes/No) port available		
32	Tests (As per Cl 9.0 of the spec)		
32.1	All in process tests confirmed (Yes/ No)		
32.2	All Type Tests confirmed (Yes / No)		
32.3	All Routine Tests confirmed (Yes/ No)		
32.4	All Special Tests confirmed (Yes/ No)		
33	Guarantee Period		