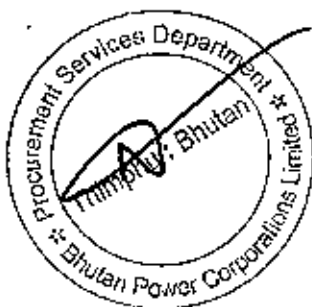




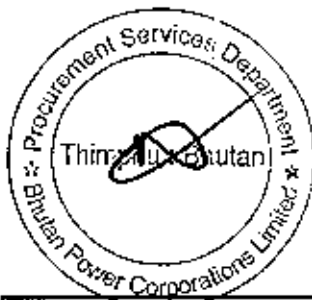
TECHNICAL SPECIFICATIONS





LOT 1

ENERGY METERS





SMART Commercial and Industrial Meters

Restricted Brand: ITRON/Actaris

- i. Type: SL700 SL761W071;
- ii. Firmware Version: 7.14 or Higher;
- iii. Voltage: 3x57.7/100V up to 3x277/480 auto-ranging;
- iv. Current: (1-10) A;
- v. Accuracy Class: 0.2 for Active Energy and 1 or 2 for Reactive Energy;
- vi. APS Specification: Compatible with 48VDC to 145VDC and 48VAC to 288VAC.

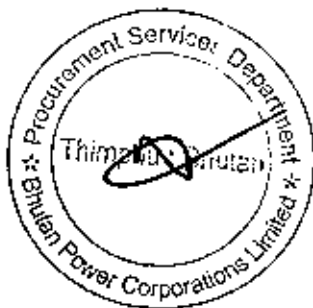
Complete set along with all necessary accessories.





LOT 2

ARCB (AUTO RECLOSER)



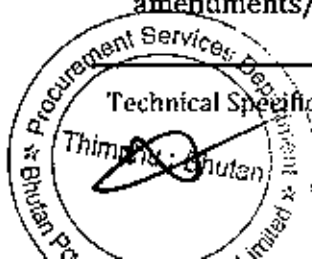


1. Scope

- The specification covers the design, manufacturing, testing, supply and delivery of SCADA compatible Auto Recloser Circuit Breaker (ARCB also called as Auto Recloser) suitable for 3-phase 11kV and 33kV with bidirectional communication facility.
- For Local Communication/configuration via craft terminal or Hand-Held-Unit (HHU), the ARCBs shall have serial/TCP-IP port for communication. For remote communication the ARCBs shall have TCP/IP (Ethernet) port(s) in congruent with IEC 60870-5-104 to facilitate communication with Control Centre / Data Concentrator Unit (DCU) / MDAS.
- Each Auto Recloser shall include programmable protection features and integrated remote operation capability that are intended for installation on 11kV and 33kV feeders to facilitate complete distribution automation.
- The Auto Recloser shall be along with appropriate lightning arrester at upstream as well as downstream terminals.
- The Auto Recloser shall either have its own power supply supplied or an auxiliary power supply by single phase dry type resin cast transformer. A rechargeable battery and battery charger should also be provided to provide stable power source to the controller and other communication equipment. The battery must be easily available in the market and specially designed or vendor specific battery will not be accepted.
- Auto Recloser shall be connected to its controller using suitable connector by means of umbilical cable or equivalent cable. The bidder should provide hardware and clamping structures, conductors and lightning arrestors wherever required.
- The vacuum interrupter shall be versatile to trip or close based on capability of interruption and it should be fully sealed in solid dielectric housing for lifetime of the recloser. Recloser shall be provided with magnetic actuator with all accessories in order to facilitate operation of the reclosers.

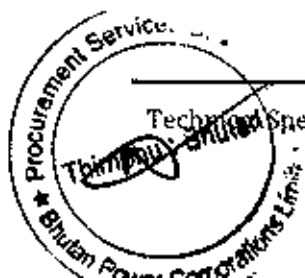
2. Standards applicable for ARCB

Unless otherwise specified elsewhere in this specification, the performance and testing of the Auto Reclosers shall conform to the following International Standards and all related International standards to be read with up-to-date and latest amendments/revisions, thereof:





Sl. #	Standard No.	Title
1	IEC 62271 - 111	Overhead, pad mounted, dry vault and submersible automatic circuit reclosers and fault interrupters for alternating current systems up to 38kV
2	IEC 62271 - 200	AC Metal-enclosed switchgear and control gear for rated voltages above 1kV and up to and including 52kV
3	IEC 60255	Electrical Relay standards
4	IEC 60529	Degree of protection provided by enclosures
5	IEC 61000-4-2	Electrostatic Discharge standard
6	IEC 61000-4-3	Radiated electromagnetic field
7	IEC 61000-4-4	Electrical fast transient/burst immunity test
8	IEC 61000-4-5	Surge immunity
9	IEC 61000-4-6	Immunity to Conduced Disturbances
10	IEC 61000-4-8	Power Frequency Magnetic Field
11	IEC 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests
12	IEC 61000-4-16	Conducted common mode disturbances
13	IEC 61000-4-18	Damped oscillatory wave
14	IEC 68-2-6	Vibration in three axes
15	ANSI/IEEE C37.60-2012	Standards Requirements for overhead, pad-mounted, dry vault, and submersible automatic circuit reclosers and fault interrupters for alternating current systems up to 38kV.





3. Environmental conditions

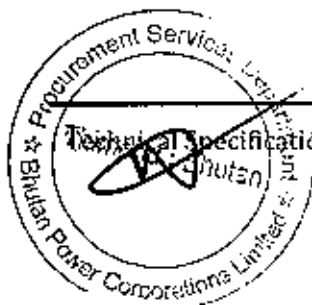
All materials supplied shall be capable of operating under following environmental conditions.

Sl No.	Particulars	Unit	Value
1	Minimum ambient temperature	°C	-20
2	Maximum ambient temperature	°C	+50
3	Relative humidity	%	0 to 100
4	Maximum Altitude	meters above sea level	3500
5	Minimum Altitude	Meters above sea level	300

1. General operating parameters

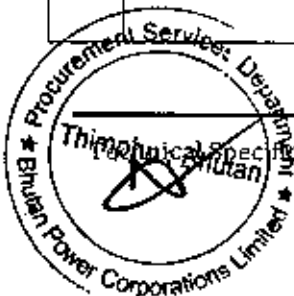
General operating parameters required for the Auto Reclosers are as shown in the table below:

Sl #	Particulars	33kV	11kV
1	Rated Voltage	33kV	11kV
2	Maximum system voltage	36kV	12kV
3	Applicable Standard	IEC 62271 - 111	
4	Type	Outdoor, pole mounted	
5	Frequency	50 Hz	



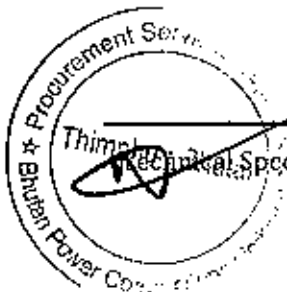


6	Rated Power Frequency withstand Voltage (kV)	70	28
7	Rated Lightning impulse withstand Voltage (kV)	170	75
8	Rated continuous current(Amps)	300A and above	301A and above
9	Fault make capacity (RMS)-kA	Minimum of 12.5	Minimum of 12.5
10	Fault make capacity (Peak)-kA	Minimum of 31.5	Minimum of 31.5
11	Fault breaking capacity (kA)	Minimum of 12.5	Minimum of 12.5
12	Protection Features	Overcurrent	Overcurrent
		Earth fault	Earth fault
		Sensitive Earth Fault	Sensitive Earth Fault
		Negative phase sequence	Negative phase sequence
		Over/Under frequency	Over/Under frequency
		Over/Under Voltage	Over/Under Voltage
		Live load blocking	Live load blocking
		Cold load pick up	Cold load pick up
		Inrush restraints	Inrush restraints





13	Metering/Measurement features	Voltage	Voltage
		Current	Current
		Frequency	Frequency
		Kilowatt (kW)	Kilowatt (kW)
		Apparent Power (kVA)	Apparent Power (kVA)
		Reactive power (kVAR)	Reactive power (kVAR)
		Power Factor	Power Factor
		Energy (kwh)	Energy (kwh)
		Outage Measurement	Outage Measurement
14	Communication features	Local: Serial/TCP/IP and USB port	Local: Serial/TCP/IP and USB port
		Remote: TCP/IP	Remote: TCP/IP
15	Interrupting medium	Vacuum	Vacuum
16	Insulation	Solid Di-electric material	Solid Di-electric material
17	Mechanical operating life	Minimum of 10,000 operations	





Above values are the standard values at 1000 meters ASL. For installing at an altitude higher than 1000 m, the insulation withstand level of external insulation and the clearances shall be defined by the bidder considering altitude correction factor in accordance with an altitude as given in Clause no. 3 (Environmental Conditions) above.

2. Testing

2.1 Type Tests & Test Certificates

ARCBs or Auto Reclosers shall be type tested for all the type tests as per applicable international standard in an accredited lab within last 10 years from the date of bid opening.

Bidder shall submit, along with tender, all Type Test Certificates as per international standards including **immunity to magnetic field** as per international standards with relevant amendments.

2.2 Routine & Acceptance Tests

The Factory Acceptance and Routine tests shall be carried out as per applicable international standards in presence of purchaser or her representatives. Apart from above test Auto Recloser shall also be tested for all functional requirement through communication as part of acceptance test.

4. Mounting features of Auto Reclosers

The Auto Recloser shall be suitable for mounting on existing poles of the distribution network and suitable mounting bracket shall be provided with appropriate lifting lug provided at appropriate position. There should be suitable mounting brackets for surge arrester as well and all associated nut and bolts shall be galvanized. The terminals or bushings of Auto Recloser shall have laser cut markings indicating incomer side and load side. Means shall be provided to permit manual operation of the Auto Recloser through operating rod or built in extensible lever system from the ground level.

5. Bushing terminals

The material for bushing shall be outdoor Cycloaliphatic epoxy resin / hydrophobic Cycloaliphatic epoxy / HECF and preferred arrangement for connection to overhead conductor is using crimp lugs with holes. There shall be encapsulated CVTs for voltage measurement on bushings required for auto-reconfiguration of the network and CT for current measurement and protection. All components of the equipment shall be de-rated as per applicable international standards.





6. Finish

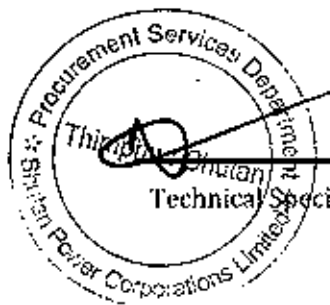
All interior and exterior ferrous surfaces of Auto Recloser and control cabinets shall be manufactured from 304 or better grade stainless steel.

7. Switching Equipment

- 7.1 The pole mounted outdoor type ARCB shall have Current Transformer, Capacitive Voltage Transformer and vacuum interrupter contained in the outdoor circuit switching unit.
- 7.2 The current transformer shall be as per applicable international standards with appropriate ratio of 300/1A for 11kV and 150/1 for 33kV with 5P protection accuracy class. This shall be able to detect and record the lowest line current in a rural feeder at any instant of time. A capacitive voltage transformer meeting service requirements as per international standard shall be available to measure the voltage.
- 7.3 There shall be manual trip / close or lock options provided externally in the events of faults or line maintenance. The supplier or manufacturer shall also supply properly insulated hotstick or any items required for manual operation.
- 7.4 The ARCB shall be provided with position indicator, or other suitable means, which will clearly indicate the position OFF and ON and the indicator shall be visible from the ground.
- 7.5 All accessories required for switching components shall be supplied

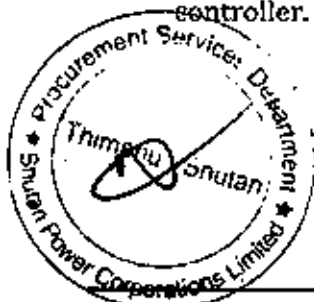
8. Control Equipment

1. The pole mounted weather proof outdoor control cabinet for Auto Recloser shall be manufactured from 304 or better grade stainless steel and it should house battery, battery charger, switches, relay and other required communication equipment.
2. The control cabinet shall be connected to the Auto Recloser with multi-pin weatherproof connector using 5 meters long umbilical cable or equivalent or ultraviolet-resistant cable. It should be possible to disconnect the cable when recloser is connected to power system, without causing damage or malfunction.
3. Control cabinet shall be adequately sealed with ingress protection rating of IP55 or better.





4. The supplier shall ensure that the equipment housed in the control cabinet can withstand the heating effect of direct solar radiation without causing failure and/or malfunction.
5. Cabinet shall be with additional provision for bottom entry of three cables and all holes shall be pre-punched and suitably blanked off. There should be another provision of bottom entry for the cable connect to Auto Recloser.
6. The cabinet shall have ventilation holes to avoid hydrogen build-up inside the cabinet.
7. The door of the cabinet shall be fitted with a secure and robust locking arrangement and there should be minimum of two latching points. The door shall be removable for replacement at site and door stay shall be fitted to keep door open while operators are attending the unit.
8. There shall not have any sharp edges and there shall not be any danger of pinching or guillotining an operator's fingers or hands inside the cabinet.
9. All connections that could potentially expose the operator to dangerous voltages will be shielded as per applicable standards. These connections shall include the terminals used for current transformers, primary power supply and voltage measurement inputs.
10. The controller, upon opening of panel's door, shall also have separate push button for manual trip and close of the Auto Recloser from control panel.
11. The controller shall be equipped with standard size Liquid Crystal Display to access
 - Close/open operation log
 - View configuration or setting
 - View event log and messages
 - View, modify and change configuration or setting
12. There shall be toggle buttons available to select, move up, move down, move left and move right. There shall also be local/remote selector button available with the controller.



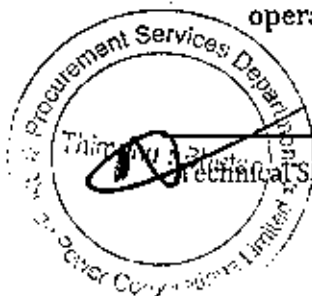


9. Protection characteristics

1. Protection element shall be provided with at least 4 independent protection group settings. Protection should at least include following features.

Sl. No.	Protection type
1	Phase Instantaneous overcurrent
2	Earth Instantaneous overcurrent
3	Phase time overcurrent
4	Earth time overcurrent
5	Sensitive Earth Fault
6	Negative phase sequence(Broken conductor)
7	Over/Under frequency
8	Over/Under Voltage
9	Live load blocking
10	Cold load pick up
11	Inrush restraints
12	Loss of supply
13	Directional blocking
14	Loop automation

- 2 The ratio of drop-off current to pick-up current shall be at least 95 % for all protection functions.
- 3 The E/F and SEF functions shall be equipped with harmonic filtering to prevent operation when harmonics are present in the primary residual earth currents





- 4 All protection functions, i.e. over-current (O/C), earth fault (E/F) and sensitive earth fault (SEF) shall have elements with characteristics that comply with IEC 255.
- 5 All the basic protection parameters shall be provided with Standard inverse (SI), very inverse (VI) or extremely inverse (EI), definite time curve.
- 6 In addition to above, provision for at least four customer programmable curves shall be provided.
- 7 Loss of supply (LOP) on all three phases shall not generate the protection trip. There shall be facility to turn LOP ON or OFF without affecting other protection functions of the device.
- 8 SEF a primary earth fault current of 4A to 20A in steps not exceeding 1A shall be detectable. Delayed protection operation shall be possible by selecting a definite time protection element with time delay from 0s to 25s, in 1s steps.
- 9 The AR shall have minimum 4 independent protection groups. The Protection Groups shall have clear indication and shall be marked as "I, II, III, IV" or "A, B, C, D" or "1, 2, 3, 4".
- 10 Each protection group shall have the facility to configure O/C, E/F and SEF trip current and specify the number of the protection trips independently from others.
- 11 Changes to any of the protection parameter to any of the not active protection group shall not affect the protection functionality of the active protection group.
- 12 Information about activation of any of the protection group shall be recorded in history and shall be easily assessable. Information about protection trip shall clearly indicate the protection group, active at the time of fault.
- 13 Automatic Protection Group Selection shall have the facility to be turned ON or OFF with password protection or other form of access control.

10. Auto Recloser Operation parameter

1. The number of sequential trips to reach lockout shall be selectable to be either 1, 2, 3 or 4.
2. Reset times shall ideally be separately selectable for SEF and the combination of over-current and earth fault functions. The reset time shall be selectable from 5s to 120s in 1s steps.





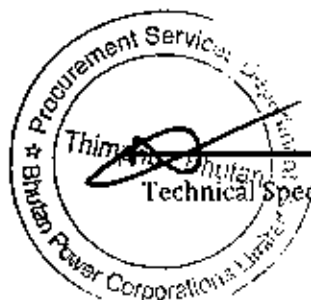
3. The dead time between each successive recloser shall be independently selectable from instantaneous to 5s for the first recloser and from a minimum of 2s up to a maximum of 120s for subsequent reclosers.
4. A close instruction initiated locally or remotely during a dead time shall result in lockout if the fault is still present upon closure.
5. Software required for any components shall be provided without any additional cost.

11. Auto Recloser Measurement characteristics

- 1 Measurement of following parameters shall be done either by three phase 3 wire method or three phase 4 wire method.

Sl. No.	Measurement values
1	Phase Voltage
2	Line Voltage
3	Phase Current
4	Frequency
5	Active power (kW)
6	Apparent Power (kVA)
7	Reactive power (kVAR)
8	Power Factor
9	Energy (kwh)
10	Daily Peak Load

- 2 The number and duration of outages shall be recorded and should be accessible locally or remotely using SCADA system.





12. Local Engineering

1. The Auto Recloser controller shall have a real time clock with leap year taken into account and the clock should be settable both locally and remotely.
2. A facility for selecting all the protection, operating and communications characteristics shall be locally available in the control cabinet. Optional password protection against unauthorized changes shall be available.
3. The controller shall be provided with non-volatile memory storage that shall have capacity to store at least 3000 logs. The log shall be including, but not limited to, all operating, protection and communication parameters, event recording of at least 3000 events, all changes in setting and measurement values
4. A pointer shall be provided to indicate up to where the data was last read. This will enable regular uploading or downloading of the data without re-loading of previously read data.
5. All events shall be time and date stamped with a resolution of at least 10 ms relative to the onboard real time clock.
6. The Auto Recloser shall be provided with position indicator, or other suitable means, which will clearly indicate the position OFF and ON and the indicator shall be visible from the ground.

15. Tele control and communication

- 1 The AR controller shall detect and report disconnection of the control cable between the controller and AR.
- 2 It shall be possible to operate AR, change the active protection group, turn Auto-Recloser capabilities ON/OFF and turn E/F and SEF ON/OFF remotely using the protocol specified.
- 3 As a minimum, one serial communication port & one Ethernet communication ports that allow for simultaneous operation shall be provided.
- 4 A USB port shall be provided for upgradation of firmware.
- 5 The protocol to be supported by the AR controller for remote communications shall be IEC 60870-5-104.
- 6 The software required for any equipment shall be provided without additional cost





16. Power supply

- 1 Power supply to the electronics, controller operation, operation of Auto Recloser and communication equipment shall be from auxiliary power source by use of dry type resin cast single phase 11000/230V or 33000/230V transformer.
- 2 Rechargeable Li-ion Battery/Lithium iron phosphate battery and constant voltage charger with current limiting shall be provided with Auto Recloser. The battery should be easily available in the market and specially designed battery or vendor specific battery will not be accepted. Battery standby time shall not be less than 24 hours and shall allow for a minimum of five (5) sequences of LRC trip-close operations. The battery shall recharge to 80 % of its capacity in a maximum of 15 hours. Battery low indication shall be available locally and remotely and minimum life expectancy of the battery shall be 5 years.

17. Maintenance and commissioning

- 1 All the communications equipment shall be easily accessible in the control cabinet. It shall be possible to perform secondary injection testing while the Auto Recloser is communicating with the center.
- 2 The AR shall not malfunction while the modem is transmitting via an antenna in close proximity and the control cabinet door is open
- 3 Provision shall be made in the control cabinet for individually isolating the power supply to/from the battery, Battery charger, Communication equipment and primary supply source to control cabinet

18. Rating plate

ARCBs shall bear a name plate clearly visible, effectively secured against removal and indelibly and distinctly marked in accordance with international standard. In addition, the words 'Property of BPC' along with the Purchase Order No. and year/month of manufacture, "Guarantee Years" shall either be punched or marked indelibly on the name plate.

19. Training

The supplier/manufacturer should arrange week long workshop or short course on setting, configuration, demonstration on setting up communication, installation and commissioning of ARCBs and all components before inspection. Only after the workshop or the course, inspection shall be carried out and the workshop or short course shall be free of cost to





purchaser. The supplier or manufacturer shall propose appropriate solution to facilitate the workshop or short course in events of natural and unavoidable global catastrophe.

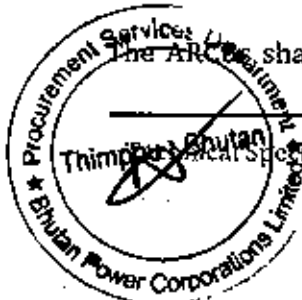
20. Inspection

- 20.1 The materials shall be subjected to all its routine inspections and tests as per relevant international standards. The supplier shall give the purchaser two weeks written notice of the materials being ready for testing. Unless the test is waived off, the purchaser shall attain such test on the scheduled date for which purchaser has been so notified or on a mutually agreed alternative date. If the purchaser fails to attain the testing on the mutually agreed date, supplier may proceed with the test which shall be deemed to have been made in the presence of purchaser and supplier shall forthwith forward to the purchaser duly certified copies of the test results.
- 20.2 The employer shall carry out inspection only upon completion of workshop or short course mentioned in Training section of this document.
- 20.3 The inspecting Officer of the Employer will inspect the ARCBs as per sampling plan for acceptance test according to international standard. Apart from above test, the ARCBs shall also be tested for all functional requirement through communication as part of acceptance test. After testing, these sample shall be additionally sealed by the inspecting officer and one copy of the inspection report will be handed over to the manufacturer.
- 20.4 The supplier or manufacturer shall propose appropriate solution to facilitate the inspection in events of natural and unavoidable global catastrophe.

21. Packing and Transportation

The ARCBs shall be suitably packed for vertical/horizontal support to withstand handling during transport. The bidder shall be responsible for any damage during transit due to inadequate or improper packing. The ARCBs shall be packed appropriately to ensure safe transportation, handling, identification and storage. All packing materials shall be environment friendly and not in conflict with law in force. The primary packing shall ensure protection against humidity, dust, grease and safeguard its performance until its installation. The secondary packing shall provide protection during transport. The packing case shall indicate "Fragile in nature" and direction of placement of box. Each packing shall indicate marking details like Manufacturer's name, Serial. No. of material, quantity, address of destination, etc.

The ARCB shall not be exposed to undue shock and mishandling during transportation.





The stacking of box inside transport media shall be such as to avoid their free movement. The packing should also be protected from rain and dust by transport media. The Bidder shall be responsible for any damage during transit due to inadequate or improper packing.

22. Delivery

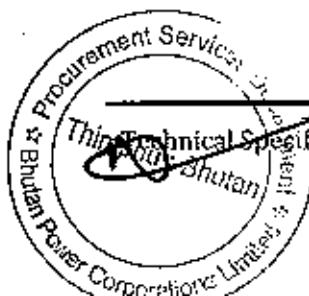
6.1 All components of the equipment shall be delivered to Regional Stores Division, Phuentshogling, BPC.

6.2 Bidder shall dispatch the material, only after the successful completion of Routine Tests witnessed by the purchaser and after receiving written material dispatch clearance from purchaser.

23. Submission of documents and diagrams

The following information shall be submitted in following stages

Sl. No	Particulars	Bid	Approval	Pre-Dispatch
1	Details of switching equipment	Required		
2	Wiring diagram (GA and Schematic diagram.)		Required	
3	General arrangement for installation on double pole		Required	
4	Procedures for maintenance and operation of all components			Required
5	Details of service history	Required		
6	Guaranteed Technical Particulars (GTP)	Required		
7	Deviation Sheet, if any	Required		





8	List of software and accessories required for installation/configuration/operation.	Required		
9	Manufacturer's certification for quality standards and performance certificate	Required		
10	Type Test reports	Required		
11	Routine test reports with procedures		Required	Required
12	Detailed manual for installation and commissioning instructions			Required
13	Details of lighting arrestor	Required		
14	Details of battery	Required		
15	Mounting details of control cabinet		Required	
16	Mounting details of switching equipment		Required	
17	Details of CT and CVT	Required		



ANNEXURE: Drawing of Existing Pole

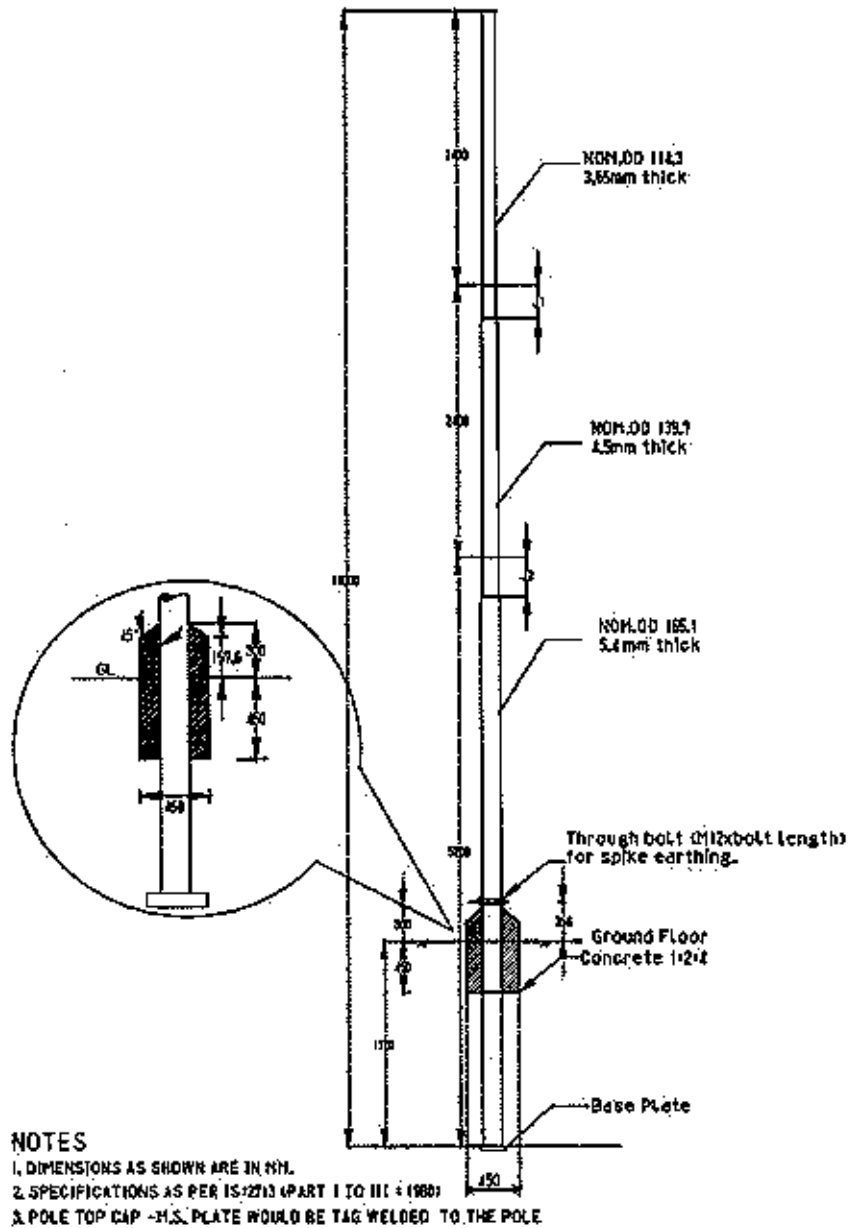
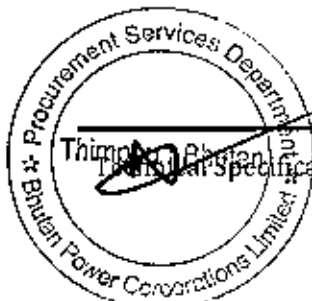
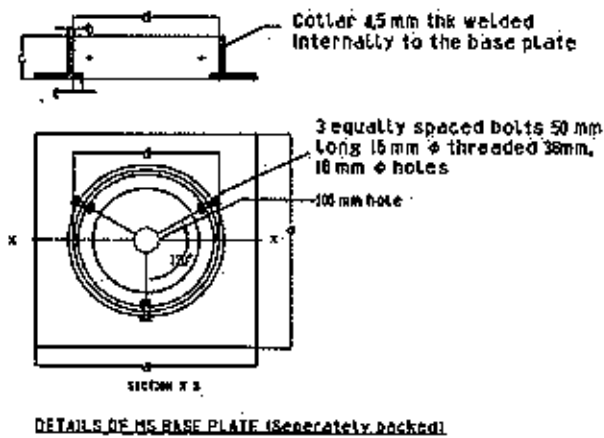
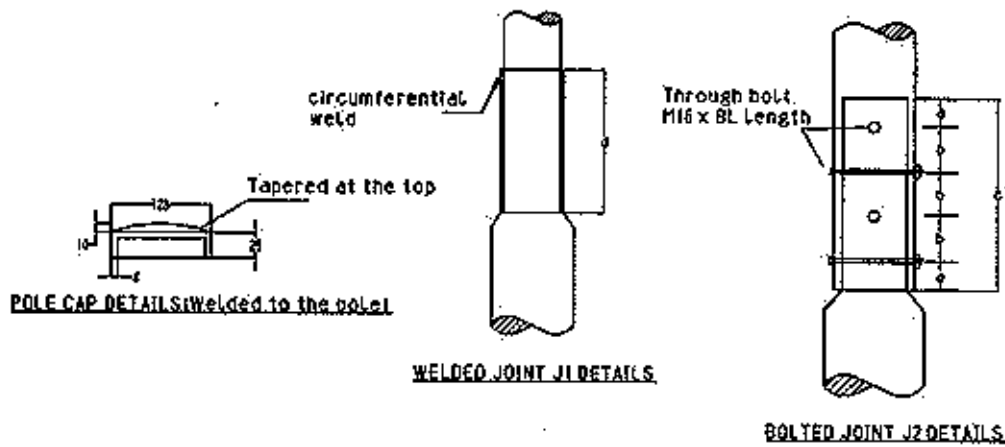


Figure 1: Dimension of Single Steel Tubular Poles





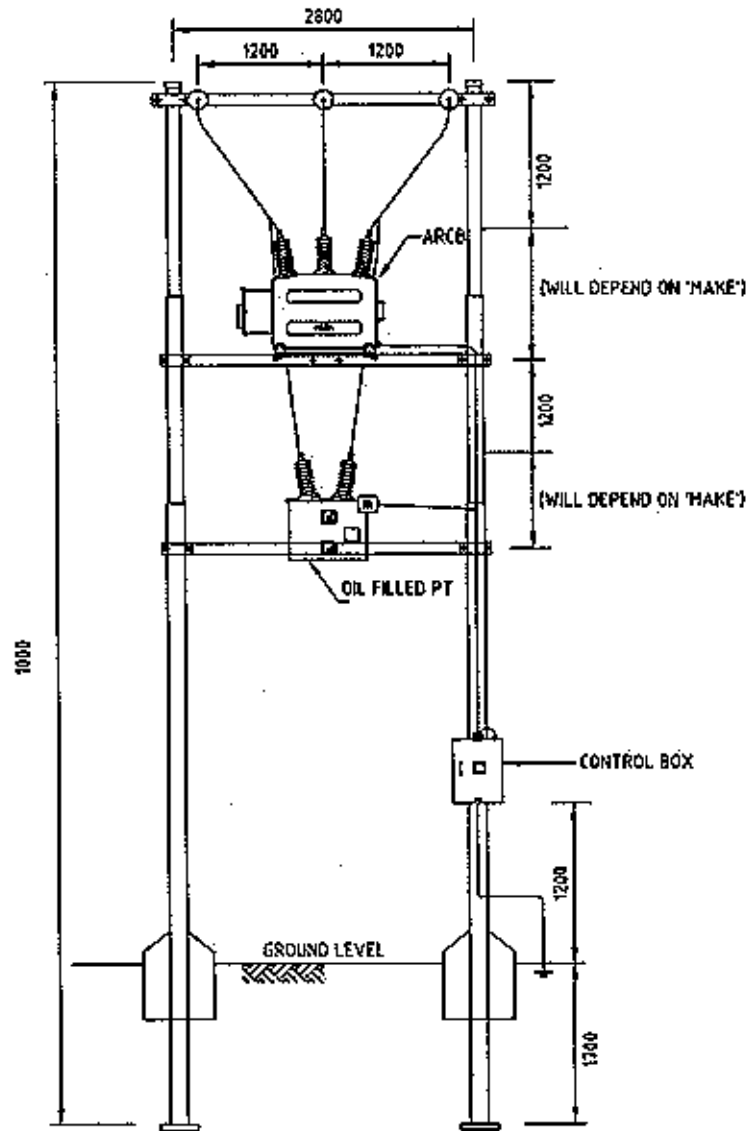
Pole Type		M.N. rate-SP-05
Length		mm
Top Segment	OD	mm
	Thickness	mm
	Length	mm
Middle Segment	OD	mm
	Thickness	mm
	Length	mm
Bottom Segment	OD	mm
	Thickness	mm
	Length	mm
Joint J1	Welded Joint	
	d	mm
Joint J2	a	mm
	b	mm
	c	mm
	BL	mm
	Flanging Depth	
Base plate details	a	mm
	b	mm
	c	mm
	d	mm
	e	mm

NOTES

1. DIMENSIONS AS SHOWN ARE IN MM.
2. DRAWING NOT TO SCALE.
3. SPECIFICATIONS AS PER IS-2713 (PART I TO III) : (1989)
4. POLE TOP CAP - H.S. PLATE WOULD BE TAG WELDED TO THE POLE

Figure 2: Details of joints and other dimensions

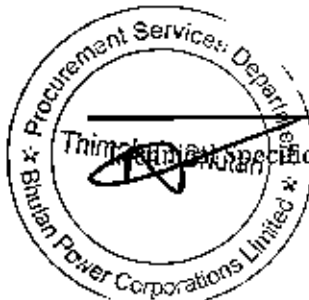




NOTES

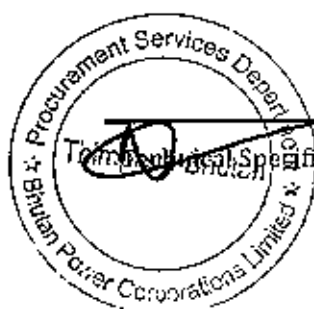
1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.

Figure 3: Two single steel tubular poles used as double pole for installation of ARCB





LOT 3 TRANSFORMERS



Technical Specifications of Lot 3: Transformers



A. Scope

This Specification covers the design, manufacture, testing and inspection, packing, shipping, delivery, and performance requirements of outdoor 33 kV and 11kV three phase and single phase (two wires) distribution transformers.

Any departure from the provisions of this Specification shall be disclosed in the Schedule of Non-Compliance of this document.

Transformer Weights and Special Bracing of Windings

Bidders, please note:

- a) Transformer winding shall be so braced / fitted internally to protect the windings against excessive movement and vibration during transportation and particularly during hand cartage to site.

Standards

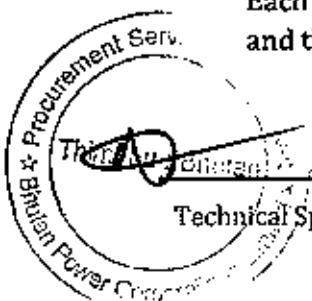
The transformers shall conform to the latest version of the following IEC Standards:

- IEC 60076 Power Transformers.
- IEC 60137 Insulating bushings for alternating voltages above 1000 V.
- IEC 60296 Specification for unused mineral insulating oils for transformers and switchgear.
- IEC 60354 Loading guide for oil-immersed power transformers.
- IEC 60529 Degrees of protection provided by enclosures (IP Code).
- IEC/TR 60616 Terminal and tapping markings for power transformers.

Packing

Transformers shall be crated at the manufacturer's works in a manner entirely suitable for international transport and delivery to the Purchaser's warehouse. Bushings and other parts liable to damage shall be additionally protected. The transformers shall be securely bolted to pallets suitable for handling by forklift. In addition the normal lifting eyes shall be accessible with the crating and pallet in place for handling by slings from a crane.

Each crate shall be clearly marked with the rating and voltage of the transformer, and the total transport weight.





Losses

The fixed (iron) and running (copper) losses shall be as low as possible, consistent with reliability and economical use of materials. The supplier shall provide the guaranteed values of losses in the Schedule of Technical Particulars enclosed with the Bid document.

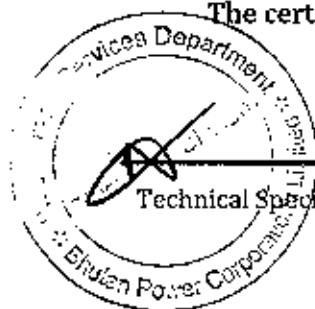
Maximum losses of the transformer should be as follows:

SL#	DESCRIPTION	Max losses	
		No Load Losses (kW)	Load Losses (kW)
(A) 11/0.415 kV System			
1	500 kVA Transformer	0.9	5
2	250 kVA Transformer	0.530	2.850
3	125 kVA Transformer	0.3	1.7
4	63 kVA Transformer	0.150	1.1
5	25 kVA Transformer	0.08	0.615
6	16 kVA Transformer	0.065	0.425
(B) 33/0.415 kV System			
1	500 kVA Transformer	1.1	7
2	250 kVA Transformer	0.55	3.50
3	125 kVA Transformer	0.30	1.70
4	63 kVA Transformer	0.175	1.3
5	25 kVA Transformer	0.125	0.425

Bidders are to design the transformer based on the above losses only and no tolerance will be permitted beyond the above values. Those bidders who do not meet the above losses will be rejected.

Quality Assurance

The manufacturer must operate a quality assurance system that complies with ISO Series 9000. The Supplier shall provide current certification showing the manufacturers' compliance with ISO Series 9000 or equivalent national standard. The certificate must be issued by an independent, accredited issuing authority.





B. TECHNICAL SPECIFICATIONS

i. General

This specification represents the minimum requirements for the works. The Supplier shall provide equipment, which meets or exceeds these minimum requirements. These items are being sought as additions to existing networks; it is essential to maintain compatibility with existing hardware and line design, as well as with established local work practices and methods.

ii. Tests and Test Certificates

All tests shall be carried out in accordance with IEC 76; routine tests, type tests, if certificates unavailable, as well as any agreed special tests. A satisfactory service history of approximately 5 years is preferred, for all plant items.

iii. Technical Parameters

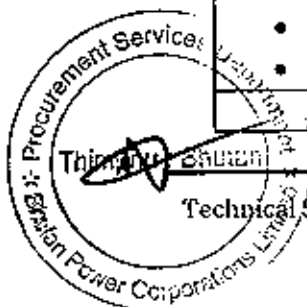
Ratings: The distribution transformers shall have the following ratings:

Three Phase: 11 kV - 25, 63, 125 & 250 kVA.
33 kV - 25, 63, 125, 250 & 500 kVA

iv. Operating Characteristics

In addition to the common technical requirements specified, the following minimum operating characteristics shall apply to all the distribution transformers covered in this Specification:

Parameter	Requirement
Applicable standard	IS 2026, IEC 60076
Type	Oil filled / two winding
Winding material	Copper
Core Material	CRGO silicon steel
Cooling	Oil natural air natural (ONAN)
Terminations	
• Primary	Outdoor Bushing or cable box ¹
• Secondary	Outdoor Bushing or Cable box
Rated no load voltage	

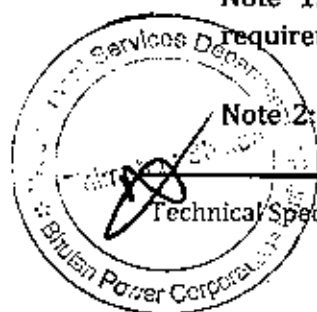




<ul style="list-style-type: none"> • Primary • Secondary 	33 kV or 11 kV 415 V
% Impedance 25 kVA-630 kVA	4%
Vector group	Dyn11
Tap changer <ul style="list-style-type: none"> • Type • Range • Step value 	Off load +5% to -5% 2.5%
Insulation Class (IEC-76)	A
Permissible Temperature rise <ul style="list-style-type: none"> • Maximum winding temperature • Max. Top oil temperature 	55°C 50°C
Insulation levels <ul style="list-style-type: none"> • Primary • Secondary 	170 kVp-70 kV/75 kVp-28 kV 7500 Vp-3000 V
Min. Clearances between Bushing (Outdoor) <ul style="list-style-type: none"> • HV phase to phase/phase to earth • LV phase to Phase/phase to earth 	350/320 mm (33 kV), 280/140 mm (11 kV) 25/20 mm
Min. Clearances between Bushing (Indoor) <ul style="list-style-type: none"> • HV phase to phase/phase to earth • LV phase to Phase/phase to earth 	351/222 mm (33 kV), 130/80 mm (11 kV) 25/20 mm
H.T Bushings <ul style="list-style-type: none"> • 12 kV bushings • 36 kV bushings 	Conforms to I.S: 3347 Part III(Sec 1&2) Conforms to I.S: 3347 Part V(sec 1&2)
Maximum allowable noise level	As per IEC 551

Note 1: Bushing for pole mount and cable for pad mount as per the specific requirement at site.

Note 2: Above values are standard values at 1000 meters ASL. For installing at an





altitude higher than 1000m, the insulation withstand level of external insulation and the clearances shall be defined by the bidder considering altitude correction factor.

v. Construction

The transformers shall be double-wound, oil immersed, naturally cooled (ONAN), oil types either hermetically sealed, or conventional type with tank breathers.

The core shall be constructed from M4 grade cold rolled, non-ageing, grain oriented silicon sheet steel having maximum of 1.11watt/kg. The primary and secondary windings shall be constructed from super enamelled insulated high conductivity copper. All turns of windings shall be adequately supported top and bottom, to prevent movement. In cases where turns are spaced out, a suitable inter-turn packing shall be provided. The insulation between core and bolts and core and clamps shall withstand 2,000V for one minute.

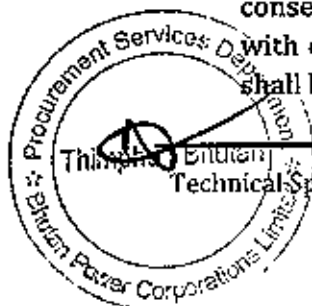
No material which can be deleteriously affected by the action of oil under the operating conditions of the transformers shall be used in the transformers or leads or bushings.

vi. Transformer Tank and Covers

The transformer tank and covers shall be fabricated from sheet steel and shall be of robust construction. All welds shall be made by the electric arc process. With the exception of radiator elements, all external joints shall be seam welded. Cooling radiators shall be of robust and simple construction.

All matching faces of joints to be made oil tight shall be finished with a smooth surface to ensure that the gasket material will make a satisfactory joint. Bolts shall be spaced at sufficiently close intervals to avoid buckling of either flange or covers and provide reasonably uniform compression of the gasket.

Each transformer shall be provided with a minimum of two closed lifting lugs. The minimum diameter of the hole or width of the slot shall be 25 mm. The two lifting lugs shall be so located that there will be a minimum clearance of 100 mm between the lifting chain and the nearest part of the bushings. Oil conservators are not mandatory, but the bidder must state whether his bid includes or excludes oil conservators. Transformers, other than hermetically sealed types, shall be fitted with oil draining and oil filling gate valves, plus a breather. An oil level sight glass shall be fitted marking the cold oil level.





Transformers 160kVA and below will be mounted on pole platform structures with four 12.5 mm dia bolts spaced 400 mm centre-centre for transformers up to and including 25kVA and spaced 500 mm centre- centre for transformers above 25kVA capacity.

The transformer tank base shall be provided with two steel channels having 14mm dia. holes to allow bolting to pole platforms. The 2 holes on the same channel should be spaced 227 mm centre-centre for transformers up to and including 25kVA and spaced 242 mm centre- centre for transformers above 25kVA capacity.

vii. Transformer Sealing

For sealed units, a satisfactory lid sealing gasket shall be provided on each of these transformers to maintain the seal at extremes of operating temperature. A cold oil level mark shall be provided inside each transformer marked C.O.L.

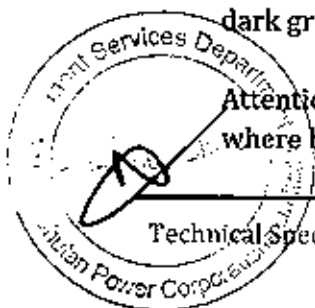
viii. Internal and External Finish

Internal and external tank and radiator surfaces shall be thoroughly cleaned by shot blasting or be given an acid and phosphate dip treatment to remove rust and scale and to provide an adherent, moisture resistant coating. Due care shall be given to avoid over pickling, resulting in pitting or unduly heavy deposit of phosphate. This resultant coating shall provide a surface, which shall offer good paint adhesion and a resistance to corrosion. The interior surfaces of the tank and cover, or conservator; above the lowest oil level shall be given one coat of oil and acid resisting paint, after cleaning.

The exterior surfaces of the complete transformer shall, where appropriate, be protected by a paint system which shall be applied strictly in accordance with the paint manufacturer's instructions. The system shall consist of not less than two priming coats and two finishing coats of oil and weather resisting paint.

The total thickness of the paint shall be not less than 0.120 mm with a minimum total thickness of priming and finishing paint of 0.06 mm each. Attention shall be paid to the need to achieve adequate coverage at metal edges, where breakdown of the paint film often begins. The paint system and the colour of the final coat shall be dark grey colour.

Attention shall be paid to the need to achieve adequate coverage at metal edges, where breakdown of the paint film often begins.





The paint system and the color of the final coat shall be subject to the approval of the Purchaser and preferably be a dark grey color.

i. Rating Plate

A stainless steel rating plate, of at least 1 mm thickness, shall be fitted to each transformer and shall carry all the information as specified in the Standards. The rating plate shall be fitted below the LV terminals.

ii. Terminal Markings

All transformers shall have the primary and secondary terminal markings plainly and indelibly marked on the transformer adjacent to the relevant terminal.

iii. Tank Marking

Each transformer shall have the kVA rating stencilled on the outside of the tank. The numerals shall be black, 75mm high, and positioned centrally below the HV bushings so as to be readily visible from the ground.

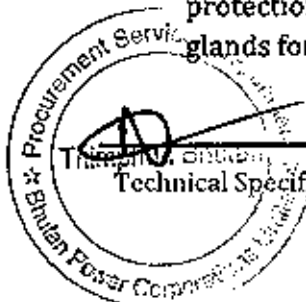
iv. Terminal Leads

Outgoing leads shall be brought out through bushings. The leads shall be such that the core and coils may be removed with the least possible interference with these leads, and they shall be specially supported inside the transformer, to withstand the effects of vibration and handling during transport, hand cartage and short circuits.

v. Bushings

All bushings shall be porcelain clad, and shall be sealed to prevent ingress of moisture and to facilitate removal. The neutral bushings and stems shall be identical to those provided for phase terminations. Bushing palms shall be made of brass and have one 14 mm dia. hole.

In case of outdoor bushings, the HV terminals shall be fitted with moulded heat shrinkable insulating covers suitable for 50 mm ACSR 'Rabbit' conductor to provide protection of the bushing palm. The LV bushings shall be in a cable box with suitable glands for cable sizes from 16-150 mm².





vi. Arching horns

All the transformers shall be equipped with arching horns on HT outdoor bushings.

ix. Earthing Connections

Two earthing connections shall be provided with connection facilities for 25 x 6 mm GI strip. The bolts shall be located on the lower side of the transformer and be of M12 size. Each connection shall be indicated clearly with an engraved 'earth' symbol.

x. Gaskets

Gaskets provided with the transformers shall be suitable for making oil tight joints, and there shall be no deleterious effects on either gaskets or oil when the gaskets are continuously in contact with hot oil. Exterior gaskets shall be weatherproof and shall not be affected by strong sunlight/UV. The material for gaskets shall be cork, neoprene or equivalent.

xi. Drying Out, Filling, Transformer Oil

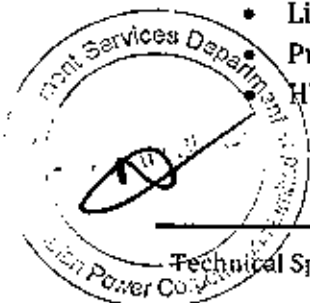
All transformers shall be thoroughly dried out at the manufacturer's works. Oil immersed type transformers shall be delivered filled with oil to normal level, ready for service, except that conservators may be removed for transport.

All transformers shall be filled to the required level with new, unused, clean, standard mineral oil in compliance with BS148/IEC-60296 and shall be free from all traces of polychlorinated biphenyl (PCB) compounds.

xii. Fittings

The following standard fittings shall be provided:

- Rating and terminal marking plates non-detachable of aluminium material
- Earthing terminals with lugs - 2 Nos.
- Lifting lugs for main tank & top cover
- Pulling lugs - 4 Nos
- HV bushings with arching horns





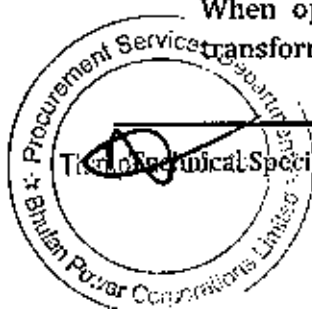
- LV bushings inside the cable box as per site requirement and neutral bushings (for high rating transformers).
- Metallic conservator tank (mandatory for 50 kVA and above for rated voltage 11 kV and below, and all ratings above 11 kV) with oil gauge
- Terminal connectors on the HV/LV bushings
- Thermometer pocket with cap.
- Air release device (bolted type) for all transformers fitted with conservator tank
- Radiators
- Prismatic oil level gauge
- Drain cum sampling valve
- Oil filling hole having M30 thread with plug and drain valve on the conservator
- Silica gel breather (25 kVA and above for rated voltage 11 kV and below and all ratings above 11 kV). Type of breather (Bolted type is preferred).
- Pressure relief device or explosion vent.
- Metallic off-load tap changer
- Base channel ISMC 75 x 40 mm with M16 bolts and nuts to fix on mounting platform (for pole mounted stations, spacing of the holes to be decided base on pole type (steel tubular / telescopic pole).
- MCCB at LT side inside a cable box for transformers rated 250 kVA and below.
- ACB at LT side inside a cable box for Transformer rated 500kVA.

Transformers 125 kVA and below will be mounted on pole platform structures with four 16 mm dia bolts. The bolts spacing shall be 400 mm centre-centre for transformers up to and including 25 kVA and 500 mm centre- centre for transformers above 25 kVA capacity. The transformer tank base shall be provided with two steel channels to allow bolting to pole platforms. The 2 holes on the same channel should be spaced 227 mm centre-centre for transformers up to and including 25 kVA and spaced 242 mm centre- centre for transformers above 25 kVA capacity.

Pad mounted transformers below 500 kVA shall have skid type under base channels having towing holes for pulling & mounting holes for foundation of transformer. For heavy transformers of 500kVA and above, the under base shall be equipped with rollers allowing the unit to be manoeuvred into final position and then anchored.

xiii. Radio Interference

When operated at voltages up to 10% in excess of the normal system rating, transformers shall be substantially free from partial discharges; i.e., corona





discharges in either internal or external insulation, which are likely to cause interference with radio or telephone communications.

xiv. Packing

Wooden pallets shall be provided for each transformers suitable for international transport and delivery to the Purchaser's warehouse. Bushings and other parts liable to damage shall be additionally protected. The transformers shall be securely bolted to pallets suitable for handling by forklift. In addition, the normal lifting eyes shall be accessible with handling by slings from a crane.

Providing of crate shall be at the discretion of the supplier. In case, if the crate is provided for protection, then each crate shall be clearly marked with the rating and voltage of the transformer, and the total transport weight.

C. TEST STANDARDS

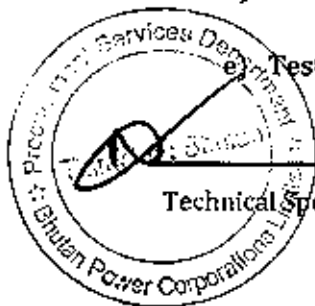
i. Inspection and Testing

The supplier shall carry out a comprehensive inspection and testing program during manufacture of the equipment. An indication of inspection envisaged by the purchaser is given under Clause 3.1.1. This is however not intended to form a comprehensive program as it is supplier's responsibility to draw up and carry out such a program in the form of detailed quality plan duly approved by purchaser for necessary implementation.

ii. Inspection

Tank and Conservator:

- a) Certification of chemical analysis and material tests of plates
- b) Check for flatness
- c) Electrical interconnection of top and bottom by braided tinned copper flexible
- d) Welder's qualification and weld procedure
- e) Testing of electrodes for quality of base materials and coatings

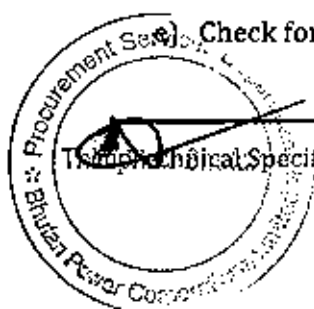




- f) Inspection of major weld preparation
- g) Crack detection of major strength weld seams by dye penetration test
- h) Measurement of film thickness of:
 - Oil insoluble varnish
 - Zinc chromate paint
 - Finished coat
- i) Check correct dimensions between wheels, demonstrate turning of wheels through 90°C and further dimensional check
- j) Check for physical properties of materials for lifting lugs, jacking pads, etc. All load bearing welds including lifting lug welds shall be subjected to NDT
- k) Leakage test of the conservator
- l) Certification of all test results

iii. Core

- a) Sample testing of core materials for checking specific loss, bend properties, magnetisation characteristics and thickness.
- b) Check on the quality of varnish if used on the stampings :
 - Measurement of thickness and hardness of varnish on stampings.
 - Solvent resistance test to check that varnish does not react in hot oil.
 - Check overall quality of varnish by sampling to ensure uniform shining colour, no bare spots, no over burnt varnish layer and no bubbles on varnished surface.
- c) Check on the amount of burrs.
- d) Bow check on stampings.
- e) Check for the overlapping of stampings. Corners of the sheet are to be part.





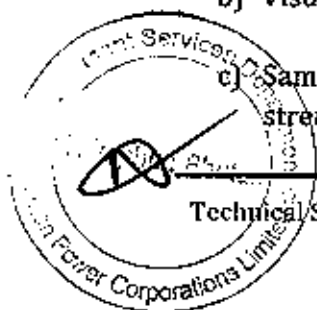
- f) Visual and dimensional check during assembly stage.
- g) Check for interlaminar insulation between core sectors before and after pressing.
- h) Check on completed core for measurement of iron loss and check for any hot spot by exciting the core so as to induce the designed value of flux density in the core.
- i) Visual and dimensional checks for straightness and roundness of core, thickness of limbs and suitability of clamps.
- j) High voltage test (2 kV for one minute) between core and clamps.
- k) Certification of all test results.

iv. Insulation Material

- a) Sample check for physical properties of materials.
- b) Check for dielectric strength.
- c) Visual and dimensional checks.
- d) Check for the reaction of hot oil on insulating materials.
- e) Dimension stability test at high temperature for insulating material.
- f) Tracking resistance test on insulating material.
- g) Certification of all test results.

v. Winding

- a) Sample check on winding conductor for mechanical properties and electrical conductivity.
- b) Visual and dimensional checks on conductor for scratches, dent marks etc.
- c) Sample check on insulating paper for pH value, bursting strength and electric strength.

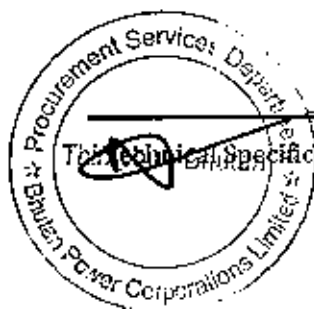




- d) Check for the reaction of hot oil on insulating paper.
- e) Check for the bonding of the insulating paper with conductor.
- f) Check and ensure that physical condition of all materials taken for windings is satisfactory and free of dust.
- g) Check for absence of short circuit between parallel strands.
- h) Check for brazed joints wherever applicable.
- i) Measurement of voltage ratio to be carried out when core/yoke is completely restacked and all connections are ready.
- j) Conductor enamel test for checking of cracks, leakage and pin holes.
- k) Conductor flexibility test.
- l) Heat shrink test for enamelled wire.
- m) Certification of all test results.

vi. Checks before Drying Process

- a) Check condition of insulation on the conductor and between the windings.
- b) Check insulation distance between high voltage connections, cables and earth and other live parts.
- c) Check insulating distances between low voltage connections and earth and other parts.
- d) Insulation of core shall be tested at 2 kV/minute between core to bolts and core to clamp plates.
- e) Check for proper cleanliness and absence of dust etc.
- f) Certification of all test results.





vii. Checks during Drying Process

- a) Measurement and recording of temperature, vacuum and drying time during vacuum treatment.
- b) Check for completeness of drying by periodic monitoring of IR and Tan delta.
- c) Certification of all test results.

viii. Assembled Transformer

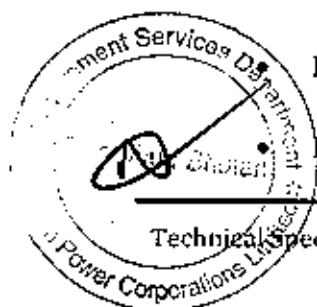
- a) Check completed transformer against approved outline drawings, provision for all fittings, finish level etc.
- b) Test to check effective shielding of the tank.
- c) Jacking test with oil on all the assembled transformers.
- d) Dye penetration test shall be carried out after the jacking test.

ix. Bought Out Items

- a) The makes of all major bought out items shall be subject to Purchaser's approval.
- b) The Contractor shall also prepare a comprehensive inspection and testing programme for all bought out/sub-contracted items and shall submit the same to the Employer for approval. Such programme shall include the following components:
 - Buchholz Relay.
 - Axles and wheels.
 - Winding temperature indicators for local and remote mounting.
 - Oil temperature indicators.

Bushings.

Bushing current transformers.





- Cooler control cabinet.
- Cooling equipment.
- Oil pumps.
- Fans/Air Blowers
- Tap change gear.
- Terminal connectors.

The above list is not exhaustive and the supplier shall also include other bought out items in his programme.

x. Factory Tests

Routine Tests

All standard routine tests in accordance with IS:2026 with dielectric tests corresponding to Method 2 shall be carried out on each transformer. Operation and dielectric testing of OLTC shall all be carried out as per IS:2026.

Following additional routine tests shall also be carried out on each transformer:

a) Magnetic Circuit Test

After assembly each core shall be tested for 1 minute at 2000 Volts between all bolts, side plates and structural steel work.

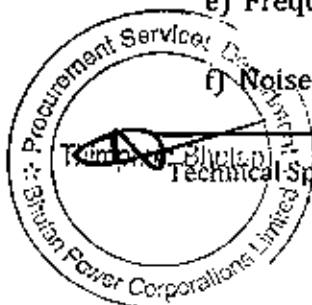
b) Oil leakage test on transformer tank

c) Magnetic balance test

d) Measurement of no-load current with 415V, 50 Hz AC supply on LV side.

e) Frequency response analysis (FRA)

f) Noise level test





g) Heat run test

h) Pressure test

xi. Type Tests

Following type tests shall be conducted on one Transformer of each rating:

a) Temp. Rise Test as per IS:2026 (Part-II)

Gas chromatographic analysis on oil shall also be conducted before and after this test and the values shall be recorded in the test report. The sampling shall be in accordance with IEC 567. For the evaluation of the gas analysis in temperature rise test the procedure shall be as per IS:9434 (based on IEC:567) and results will be interpreted as per IS:10593 (based on IEC -599).

The temperature rise test shall be conducted at a tap for the worst combination of loading on the three windings of the transformer. The supplier before carrying out such test shall submit detailed calculations showing alternatives possible, on various taps and for the three types of ratings of the transformer and shall recommend the combination that results in highest temperature rise for the test.

b) Tank vacuum Test

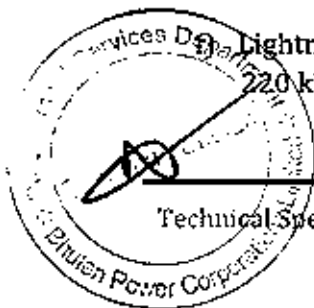
c) Tank pressure Test

d) Pressure Relief Device Test.

The pressure relief device of each size shall be subjected to increase in oil pressure. It shall operate before reaching the test pressure specified in transformer tank pressure test. The operating pressure shall be recorded. The device shall seal off after excess pressure has been released.

e) Measurement of capacitance and tan delta to determine capacitance between winding and earth.

f) Lightning Impulse withstand test in all phases as per IS: 2026 (As type test, only for 220 kV class & below)





xii. Additional type tests

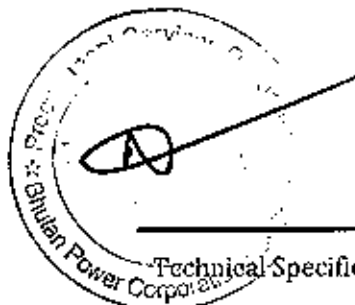
Following additional type tests other than type and routine tests shall also be carried out on one unit of each type:

- a) Measurement of zero Seq. reactance (As per IS:2026, for 3-phase transformer only.)
- b) Measurement of acoustic noise level.
- c) Measurement of power taken by fans and oil pumps.
- d) Measurement of harmonic level in no load current.
- e) One cooler control cabinet of each type shall be tested for IP:55 protection in accordance with IS:13947.
- f) Measurement of transferred surge on LV (tertiary) winding due to HV lightning impulse and IV lightning impulse.
- g) High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.

xiii. Routine tests on bushings

The following tests shall be conducted on bushings

- a) Test for leakage on internal fillings.
- b) Measurement of creepage distance, dielectric dissipation factor and capacitance.
- c) Dry power frequency test on terminal and tapping.
- d) Partial discharge test followed by dielectric dissipation factor and capacitance measurement.





xiv. Tank Tests

a) Routine Tests

Oil Leakage Test

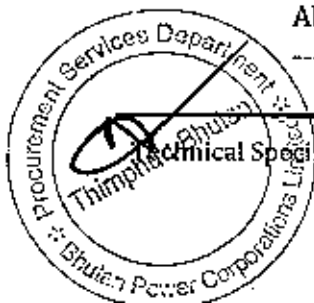
All tanks and oil filled compartments shall be tested for oil tightness by being completely filled with air or oil of a viscosity not greater than that of insulating oil conforming to IS:335 at the ambient temperature and applying a pressure equal to the normal pressure plus 35 KN/Sq.m (5 psi) measured at the base of the tank. The pressure shall be maintained for a period of not less than 12 hours for oil and one hour for air during which time no leak shall occur.

b) Type Tests

i. Vacuum Test

Where required by the purchaser one transformer tank of each size shall be subjected to the specified vacuum. The tank designed for full vacuum shall be tested at an internal pressure of 3.33 KN/Sq.m absolute (25 torr) for one hour. The permanent deflection of flat plate after the vacuum has been released shall not exceed the values specified below:

Horizontal Length of flat plate (in mm)	Permanent deflection (in mm)
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.5
2501 to 3000	16.0
Above 3000	19.0





ii. Pressure Test

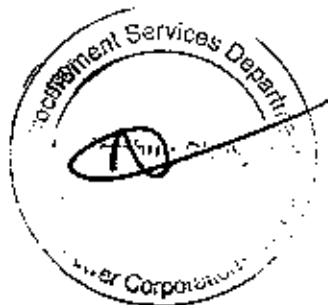
One transformer tank of each size, its radiator, conservator vessel and other fittings together or separately shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35 KN/m² whichever is lower measured at the base of the tank and maintained for one hour. The permanent deflection of flat plates after the excess pressure has been released shall not exceed the figure specified above for vacuum test.

xv. Pre-Shipment Checks at Manufacturer's Works

- a) Check for interchangeability of components of similar transformers for mounting dimensions.
- b) Check for proper packing and preservation of accessories like radiators, bushings, dehydrating breather, rollers, Buchholz relay, fans, control cubicle, connecting pipes, conservator etc.
- e) Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.
- f) Gas tightness test to confirm tightness.
- e) Derivation of leakage rate and ensure the adequate reserve gas capacity.

xvi. Note

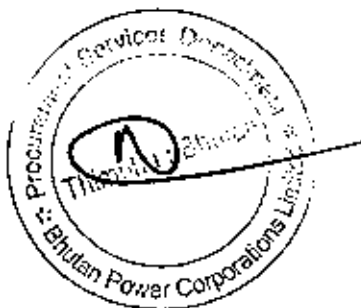
- a) Accuracy class PS as per IS:20705
- b) Class (for the relevant protection and duties) as per IEC 185.





LOT 3

TRANSFORMERS (ICT)





1 INTERCONNECTING TRANSFORMER

1.1 **Applicable standards** : IEC 60076, 60214, 60296
(Part I to IV) or IS 2026 (Part I to IV)

1.2 Parameters

Refer Table 1 for parameters of transformers.

1.3 Capitalisation of losses for bid evaluation

1.3.1 Transformer losses indicated by the Bidder will be capitalised considering tolerances as applicable for the purpose of bid evaluation at the following rates:

- | | | | |
|----|------------------|---|----------------|
| a) | No load losses | : | Nu. 132,000/kW |
| b) | Load Losses | : | Nu. 70,000/kW |
| c) | Auxiliary losses | : | Nu. 53,000/kW |

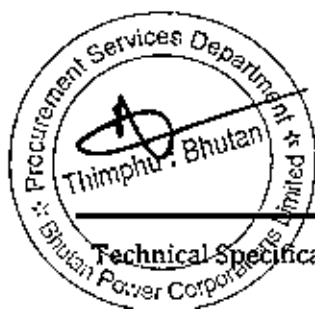
1.4 Penalty for Losses

1.4.1 If measured losses exceed the guaranteed figures; penalties will be levied on the Contractor at the rates given in Clause 1.1.3.1 above, within tolerable limits.

1.5 Accessories and Fittings

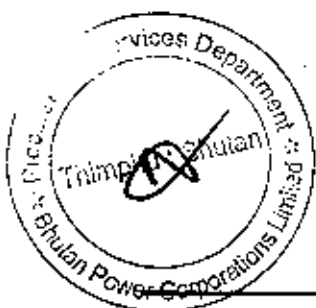
1.5.1 The transformer shall have the following fittings and accessories, including but not limited to:

- a) A conservator of sufficient volume with
 - i. separate compartment for OLTC
 - ii. oil level gauge with provision of potential free contacts for initiating alarm for low oil level
 - iii. weather-proof dehydrating breathers for both compartments
 - iv. shut off valves
 - v. filling plug and drain valves(Alternatively a separate conservator with all the accessories shall be provided for OLTC)
Conservator shall be designed to maintain an oil seal upto a temperature of 100° C.





- b) Gas and oil actuated Buchholz relay with
 - i. necessary shut off valves
 - ii. test cock with pipe connections for sampling
 - iii. potential free contacts for initiation of alarm in case of slow gas formation and trip in case of fast oil and gas surges
- c) Separate Buchholz relay as in b) above for OLTC chamber
- d) Dial type thermometer with
 - i. maximum temperature indicator and its resetting device
 - ii. potential free contacts for initiating alarm on high temperature and trip on very high temperature
 - iii. top oil temperature transducer and other necessary devices to provide two sets of 4-20mA signals for transmitting to remote control panel and SCADA.
- e) Winding temperature indicator with
 - i. necessary sensing, compensating and calibrating devices
 - ii. potential free contacts for initiating alarm on high temperature and trip on very high temperature
 - iii. WTI transmitter for remote indication
 - iv. winding temperature transducer and other necessary devices to provide two sets of 4-20mA signals for transmitting to remote control panel.
- f) Pressure relief devices and relays for transformer tank and OLTC chamber
- g) Weather-proof marshalling box mounted on transformer tank
- h) Name plate, rating and diagram plate and valve schedule plate
- i) All Valves with locking arrangement (covers) and plugs as below:
- j) Earthing pads of copper or non-corrodible material for transformer tank (2 places) and radiator banks
- k) Inspection manholes as required
- l) Lifting arrangement for lifting
 - i. fully assembled transformer
 - ii. core and coil
 - iii. tank





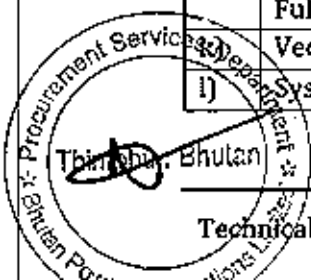
- m) Hauling eyes on each face of the transformer
- n) Bi-directional flanged wheels suitable for 1676 mm rail gauge
- o) Anti-earthquake clamping devices with locking arrangement
- p) Ladder with anticlimbing device
- q) Jacking pads
- r) All the wires and cables shall be securely fastned in the body through GI pipes and other places through flexible pipe.

1.6 Technical parameters

The Transformers shall be oil immersed type, and, shall be provided with ONAN cooling. These shall be suitable for outdoor installation under specified climatic conditions. The rating and other electrical parameters of the Transformers are given as under:

1.6.1 Table 1

a)	Designation of Transformer Rating	Interconnecting transformer	
		33 kV/11 kV	
		1.5 MVA	500 MVA
b)	Quantity	As per BOQ	As per BOQ
c)	Installation	Outdoor	Outdoor
d)	No. of phases	3	3
	And Frequency	50Hz	50Hz
e)	Type of cooling	ONAN	ONAN
f)	No. load Ratio	33kV/ 11 kV	33kV/ 11 kV
g)	Tap changer	On load circuit	On load circuit
	i. Range	±5%	±5%
	ii. Step	1.25%	1.25%
h)	Tap changing operations	Manual / Local	Manual / Local
i)	Impedance at principal tap	6.25%	5%
j)	Losses		
	No Load Losses	2.1kW	1.8kW
	Full Load Losses	14kW	8kW
k)	Vector group	YNyn0	YNyn0
	System earthing	Solidly earthed	Solidly earthed

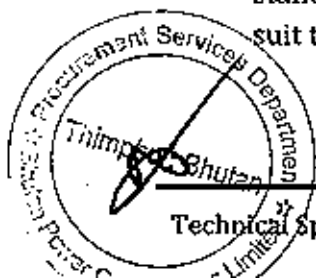




m)	Design ambient	40°C		40°C	
n)	Temp.Rise				
	i. Winding	55°C		55°C	
	ii. Top Oil	50°C		50°C	
o)	Insulation Type	Class A-Uniform		Class A-Uniform	
p)	Insulation Level	Primary	Secondary	Primary	Secondary
	i. 1min Power Frequency (kVrms)	70	28	70	28
	ii. 1.2/50 microsecond impulse (kVp)	170	75	170	75
	iii. Clearance	P-P=351mm & P-E= 320	P-P=280mm & P-E= 140	P-P=351mm & P-E= 320	P-P=280mm & P-E= 140
q)	Creepage Distance (mm)	25mm/kV	25mm/kV	25mm/kV	25mm/kV
r)	Terminations				
	i. HV	Outdoor Bushing type, The electrical and mechanical characteristics shall be accordance with IS 2099 & IS 3347. Bushing shall be solid porcelain.		Outdoor Bushing type, The electrical and mechanical characteristics shall be accordance with IS 2099 & IS 3347. Bushing shall be solid porcelain.	
	ii. LV				
s)	Current Transformer	As per requirements		As per requirements	
	i. HV & LV side	To be decided during detail engineering.		To be decided during detail engineering.	
t)	Paint shade	RAL 7032		RAL 7032	
u)	Altitude correction	The transformer shall be designed taking into altitude consideration for different places as given in the bid.		The transformer shall be designed taking into altitude consideration for different places as given in the bid.	
v)	Maximum loss limit				
w)	Maximum Noise level at 1 m	As per NEMA -TR-1		As per NEMA -TR-1	

1.7 General Design and Operating Considerations

1.7.1 The Transformers shall be of three-phase core or shell type, and shall be suitable for bidirectional flow of rated power. The Transformers shall be rated for standard ambient conditions as per IS and de-rating factors as per IS applied to suit the ambient conditions at the site.





1.7.2 The Transformer shall be capable of being operated without danger on any tapping at the rated MVA with voltage variation of $\pm 5\%$ corresponding to the voltage of that tapping.

1.7.3 The Transformers and all its accessories like CTs etc. shall be designed to withstand without injury, the thermal and mechanical effects of any external short circuit to earth and of short circuits at the terminals of any winding for a period of 2 seconds as per IS:2026.

1.7.4 The Transformer shall be capable of being loaded in accordance with IS:6600/IEC-60076 (Part-7) up to 150% of rated load. There shall be no limitation for overloading imposed by bushing, tap changer etc. or any other associated equipment.

1.8 Windings

1.8.1 The windings shall be of electrical grade copper.

1.8.2 Materials used in insulation and assembly shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil and shall not soften or otherwise be affected under operating conditions.

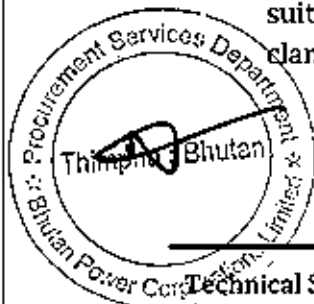
1.8.3 Leads from winding to the terminal board and bushings shall be rigidly supported to prevent injury from vibration.

1.8.4 HV windings shall be suitably braced to withstand short circuit stresses.

1.9 Core

1.9.1 The magnetic circuit shall be constructed from high grade, cold rolled, non-ageing, grain oriented silicon steel laminations. Each sheet shall have an insulating coating resistant to the action of hot oil.

1.9.2 The insulation structure for the core to bolts and core to clamp plates shall be such as to withstand a voltage of 2000 V for one minute. The framework and clamping arrangements of core and coil shall be securely earthed inside the tank by a copper strap connected to the tank. The core clamping structure shall be designed to minimise eddy current loss. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The framework and clamping arrangements shall be securely earthed.





1.10 Tank

1.10.1 The transformer tank shall be made from high-grade sheet steel, suitably reinforced by stiffeners made of structural steel sections. All seams, flanges, lifting lugs, braces, and other parts attached to the tank shall be welded. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant, oil insoluble paint. Adequately sized manholes shall be provided for ease of inspection and maintenance. Steel bolts and nuts exposed to atmosphere, shall be galvanised.

1.10.2 Tank together with radiators, conservator, bushings and other fittings shall be designed to withstand without permanent distortion the following conditions:

- a) Full vacuum of 760 mm of Hg for filling with oil under vacuum.
- b) Internal gas pressure of 0.35 kg/cm² with oil at operating level.

1.10.3 Tank shall be provided with a pressure release device, which shall operate at a pressure below the test pressure for the tank and radiators. The device shall be rainproof after blowing and shall be provided with a device visible from ground to indicate operation. An equaliser pipe connecting the pressure relief device to the conservator shall be supplied. The device shall be provided with potential free contacts for alarm and tripping. Alternatively, a separate pressure relay shall be provided for this purpose.

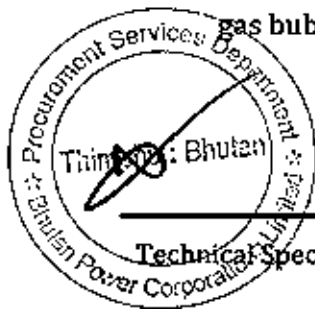
1.10.4 The tank cover shall be bolted type and not welded, sealed type. The tank cover shall be removable and shall be suitably sloped so that it does not retain rainwater.

1.11 Bushings

1.11.1 Bushings shall be of porcelain. Stresses due to expansion and contraction in any part of the bushing shall not lead to deterioration.

1.11.2 The angle of inclination of oil filled bushing to vertical shall not exceed 30°.

1.11.3 Bushings rated 36 kV and above shall be of the oil-filled condenser type with a central tube and draw-in conductor, which shall be connected to the connector, housed in the helmet of the bushings. The pull through lead shall be fitted with a gas bubble deflector.





1.11.4 Bushings shall be equipped with oil level indicators and means for sampling and draining the oil. Condenser type bushings shall be equipped with the following additional features:

- a) Provision for power factor testing without disconnecting main leads; and
- b) Bushing turrets with vent pipes so connected as to route any gas collection through the Buchholz relay

1.11.5 All applicable routine and type tests as stated and specified in the applicable standards shall be carried out.

1.12 Radiators

1.12.1 Radiators shall be designed to withstand the vacuum pressure conditions specified for the tank. They shall be so designed as to completely drain oil into the soak pit and to prevent formation of gas pockets when the tank is being filled.

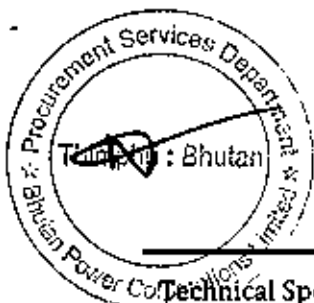
1.12.2 Radiators shall be of detachable with bolted and gasket flange connections.

- a) Shut-off valves and blanking plates on transformer tank at each point of connection of inlet and outlet header
- b) Top and bottom shut-off valves and blanking plate on each radiator
- c) Lifting lugs
- d) Top oil filling plug
- e) Air release plug at top
- f) Oil drain plug at bottom
- g) Earthing terminals.

1.13 Tap changing gear

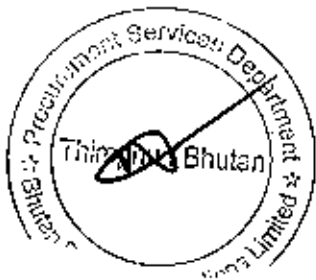
1.13.1 On-Load Tap Changer (OLTC) shall be provided for 1.5 MVA, 33/11 kV transformer and shall comply with the relevant standards. In addition, the following shall be followed:

- (a) OLTC gear shall have separate conservator connections and Buchholz relay so that the oil of OLTC does not mix with transformer oil. Alternately, OLTC shall have a separate conservator with accessories.





- (b) Provision shall be available for filling, draining of the oil, release of air, etc.
- (c) OLTC driving mechanism and its associated control equipment shall be mounted in a weatherproof cabinet having degree of protection of atleast IP55. It shall incorporate all the devices necessary for satisfactory design and O&M purpose.
- (d) Voltage sensing and regulating device for automatic control including a time delay relay for delaying the indication of tap changing shall be provided. Settings shall be adjustable at site.
- (e) A remote control panel shall be provided in control room including but not limited to following :
 - i. Automatic Voltage regulator (solid state)
 - ii. Control switches for raise/ lower
 - iii. Auto/ manual selector switch
 - iv. Tap position indicator
 - v. Facia alarm annunciator with 'Acknowledge', 'Sound Cancel', 'Reset' and 'Lamp test' push buttons,
 - vi. Audio signal for 'Tap Change in progress'
 - vii. Remote digital WTI and OTI
 - viii. Indicating lamps for upper and lower limit of taps and for 'Tap Change in Progress'
 - ix. Out of step relay along with auxiliary relays as required for remote annunciation, control.
 - x. Auxiliaries such as terminals, fuses, space heaters, interior lighting, contactors and other equipment including a buzzer and a signal lamp to indicate the out of step indication when the transformers in one pair of group of rating in parallel are one tap out of step and also to trip the circuit breaker etc.
 - xi. Digital voltmeter – 2 nos for voltage indication on HV and LV side
 - xii. Control selector switch to enable to run transformer as master/follower or independent in a group.
 - xiii. Selection switches for individual/parallel operation.



1.14 Marshalling box

1.14.1 The marshalling box shall be tank mounted /free standing, weather proof, sheet steel (2.5 mm thick minimum), enclosed and with hinged door having padlocking



facility. Door and gland plate shall be fitted with neoprene gaskets. Bottom shall be atleast 600 mm from grade level. Top surface shall be sloped. The degree of protection shall be atleast IP55.

1.14.2 Contacts/terminals of electrical devices/relays, etc. mounted on the transformer shall be wired to the marshalling box. Interconnecting wires between the marshalling box and the accessories/devices shall be XLPE insulated armoured cables together with provision of compression type, brass cable glands at the marshalling box. The above mentioned cables as well as terminating the cables shall be the Contractor's responsibility.

1.14.3 All contacts for alarm, trip and indication circuits shall each be electrically free, designed for the auxiliary DC supply of 110/48 V (as available at the site) and brought out to separate terminals in the marshalling box. Terminals shall be rated for 10 A. Disconnecting/ shorting type terminal block shall be used for CT circuits.

1.14.4 Transformer digital outputs for remote annunciation/control shall be provided with two changeover contacts for alarm condition and two changeover contacts for trip condition for each of the following conditions including but not limited to: alarm and trip of Buchholz relay, oil and winding temperature high and very high, pressure relief device, oil level low in tank and conservator, auto changeover of control supply etc.

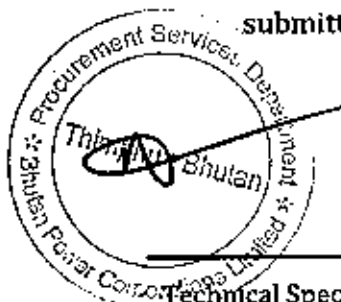
1.15 Tests

1.15.1 All routine and Acceptance tests as specified in the applicable standards shall be carried out on all the transformers and OLTC.

1.15.2 All auxiliaries and accessories such as bushing CTs, Temperature Indicators, Buchholz and pressure relays shall be tested as per the applicable standards and test certificates shall be furnished to the Engineer for approval.

1.15.3 Bends, pressure test for leakage, noise level and heatrun for 1 transformer of each rating shall be carried out without any additional cost implication and shall be included in the transformer cost.

1.15.4 Type test for each transformer rating carried out within 5 years shall be submitted during the bid submission.





1.16 Rejection

1.16.1 The Employer may reject the transformer if anyone of the following conditions arises:

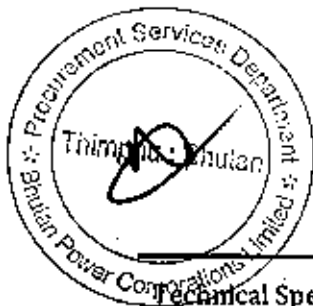
- a) Any of the quantities/parameters of transformers subject to tolerances are outside the tolerances given in the applicable standards or such tolerance guaranteed in the Contractor's bid.
- b) Winding and/or top oil temperature rise exceeds the specified/guaranteed value; and
- c) Transformer fails to withstand any of the dielectric tests.
- d) If the transformer losses are beyond the maximum losses specified in the specification.

1.16.2 Employer reserves the right to have the transformer replaced or repaired by the Contractor within reasonable period to Employer's satisfaction at no extra cost to the Employer. The Contractor shall also bear the costs, including but not limited to, incurred by the Employer in re-inspection/re-testing such as travel and incidental expense, etc. The Contractor shall note that any delay in completion time due to such repair/replacement shall be subject to liquidated damages as specified in the Conditions of Contract.

1.17 Inclusions

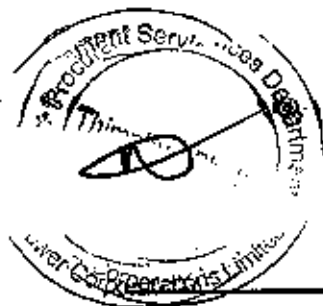
1.17.1 The following items shall also be included in the Contractor's scope:

- a) Supply, installation and commissioning of interconnecting cables between transformers mounted accessories, marshalling box, OLTC along with associated compression type brass cable glands, lugs, etc.
- b) Ten percent extra oil, in addition to that required for first filling of complete transformer, in non-returnable drums,
- c) A 10 liter can of paint for touching up the external surface after erection, and
- e) Terminal clamps/ connectors suitable for connecting to specified sizes of conductor/ tube/ cable.
- f) Tools and tackles as required for the normal operation shall be supplied with the transformer.



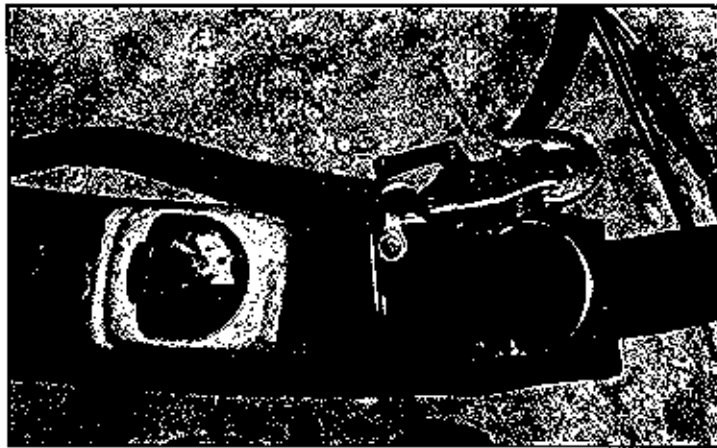
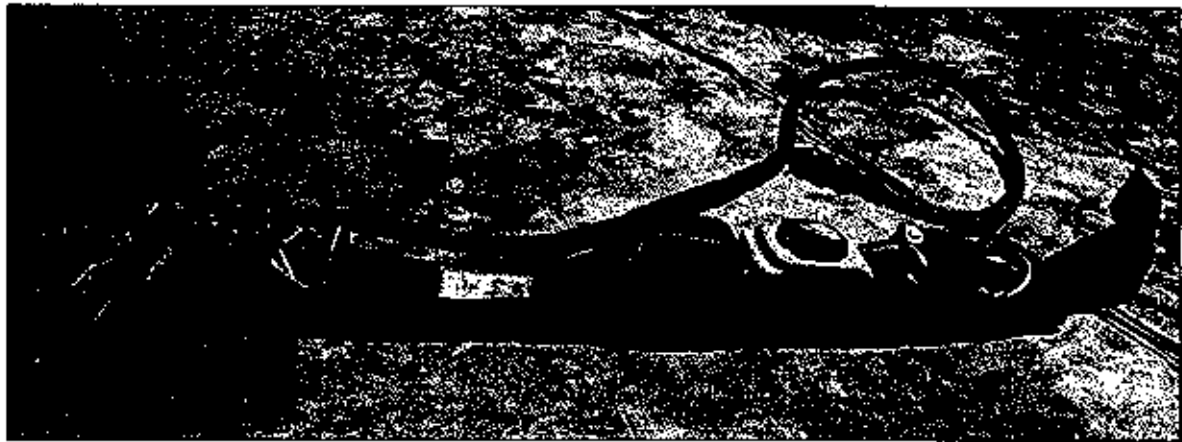


LOT 4 SAFETY BELTS



LINEMEN SAFETY BELT

- **Outer Belt:** 45 mm- 50 mm (W) x 1200 mm (L) (Curved),
- **Inner Belt:** 100 mm (W) x 700 mm (L) (Curved) with D-ring x 2pcs & V Square ring x 1pc
Lanyard: 3-strand Nylon Rope 14mm-16mm dia. x 2000 mm - 2500 mm (L) with snap hook and 8-Ring,
- **Additional unlocking type retractable lanyard:** 18 mm (W) x 1300 mm (L) with Snap Hook & Shock Absorber,
- **Weight:** 2 - 3 kg,
- **Application:** for both work Positioning Suspension & Single-Line Suspension.



Figures: Sample pictures of Linemen Safety Belt





Figures: Sample pictures of Linemen Safety Belt (color)