



Maharashtra State Electricity Distribution Company Limited

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SPEC. NO. STORES: MSC-II/DT/Conventional 63,100 CSP with metering /2011

TECHNICAL SPECIFICATION

FOR

**63, 100 kVA, 11/0.433 kV, 22/0.433 kV THREE PHASE (Conventional)  
DISTRIBUTION TRANSFORMERS WITH CSP FEATURE & DTC METERING  
UNIT.**

FOR

DISTRIBUTION SYSTEM

IN

MSEDCL

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# MAHARASHTRA STATE ELECTRICITY DISTRIBUTION COMPANY

## TECHNICAL SPECIFICATION FOR 63 kVA & 100 kVA, 11/0.433 & 22/0.433 KV THREE PHASE DISTRIBUTION TRANSFORMERS (Conventional) WITH CSP FEATURE & DTC metering Unit

SPEC. NO. STORES: MSC-II/DT/Conventional 63,100 CSP with metering /2011

### 1 Scope:-

This specification covers design, manufacturing, testing and delivery of **63 kVA & 100 kVA, 11/0.433 & 22/0.433 KV , Oil immersed Oil Natural (ONAN), Outdoor type Distribution Transformers (Conventional) with CSP feature & DTC metering unit suitable for 11 & 22 kV, 50 Hz Distribution System.**

- 1.1 The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.
- 1.2 It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements.
- 1.3 The design and constructional aspects of materials shall not withstanding any anomalies, discrepancies, omissions, in-completeness, etc. in these specifications and will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E. Act and other statutory provisions.
- 1.4 The Bidder/supplier shall bind himself to abide by these considerations to the entire satisfaction of the purchaser and will be required to adjust such details at no extra cost to the purchaser over and above the tendered rates and prices.
- 1.5 Tolerances:  
The tolerance of guaranteed performance figures shall be as specified in the (Part-I) table 7 of latest issue of IS 2026 or relevant International Standard except wherever specified otherwise in this specification.

### 2 System Particulars:-

The transformers shall be suitable for outdoor installation with following system particulars and they should be suitable for service under fluctuations in supply voltage as permissible under Indian Electricity Rules

- |     |                                      |   |                                |
|-----|--------------------------------------|---|--------------------------------|
| 2.1 | Nominal Voltage ratings              | : | 11 kV or 22 KV                 |
| 2.2 | Corresponding Highest System Voltage | : | 12 kV or 24 KV                 |
| 2.3 | Neutral earthing                     | : | Solidly earthed                |
| 2.4 | Frequency                            | : | 50 Hz with $\pm 3$ % tolerance |

2.5 Number of Phase : 3

### 3 SERVICE CONDITIONS:

3.1 Equipment supplied against the specification shall be suitable for satisfactory operation under the following tropical conditions:-

- i Max. ambient air temperature : 40 Deg. C
- ii Max. relative humidity : 100 %
- iii Max. annual rainfall : 1450 mm
- iv Max. wind pressure : 150 kg/sq.m.
- v Max. altitude above mean sea level : 1000 mtrs.
- vi Isoceraunic level : 50
- vii Seismic level(Horizontal acceleration) : 0.3 g.
- viii Climatic Condition Moderately hot and humid tropical climate conducive to rust and fungus growth.
- ix Reference Ambient Temperature for temperature rise : 40 Deg C

3.2 The climatic conditions are prone to wide variations in ambient conditions and hence the equipment shall be of suitable design to work satisfactorily under these conditions.

### 4 APPLICABLE STANDARDS:-

4.1 The design, manufacture and performance of the equipment shall comply with all currently applicable statutes, regulations and safety codes.

Nothing in this specification shall be construed to relieve the bidder off his responsibilities.

4.2 The Distribution Transformers shall conform to IS: 2026 as amended up to date or other International Standards for equal or better performance.

4.3 Unless otherwise specified, the equipment offered shall conform to latest applicable Indian, IEC, British or U.S.A. Standards and in particular, to the following:-

a.	IS 2026 (Part I,II,IV)/1997, (Part-III)/1981, (Part-V)/1994	Power Transformer
b.	IS:1180/1989 (Part-1)	Outdoor type, Three phase distribution transformers up to and including 100 kVA, 11KV
c.	IS:335/1993	New insulating oil- Specification (fourth revision)
d.	IS:2099/1986, IS: 7421-1988, IS:3347 (Part-I /Sec-2)-1979, IS:3347 (Part-I /Sec-1)-1982 amended up to date	Bushing

e.	IS 5	Colours for ready mixed paints and enamels.
f.	IS 13730 (Part-27)1996	Specification for particular types of winding wires.
g.	IS: 3073/1974, IS: 3070( Part-II)	Specifications for L.A's
h.	CBIP Publication No.295:2006	Manual on transformers
i.	I.S. 13947/I/1993	Specification for low voltage switchgear & control gear

4.4 In case of conflict arising out due to variations between the applicable standard and the standards specified herein the provisions of this specification should prevail.

## 5 Specific Technical requirement:

5.1 Standard kVA Ratings:-

The standard ratings for transformer shall be 63 kVA, 100 kVA.

5.2 Nominal voltage ratings

i Primary voltage : 11 KV/ 22 KV

ii Secondary voltage : 0.433 kV

5.2.1 Winding connections:-

i. H.V. Winding : Delta ( $\Delta$ )

ii. L.V. Winding : Star (Y)

The neutral of the L.V. winding shall be brought out to a separate insulated terminal. The voltage group shall be Dyn-11.

5.3 Temperature Rise:

i The temperature rise for top oil over an ambient temperature of 40° C should be 45° C maximum (measured by thermometer in accordance with IS 2026).

ii Temperature rise for winding over an ambient temperature of 40° C should be 50° C maximum (measured by resistance method in accordance with IS 2026).

5.4 No load voltage ratio:-

The no load voltage ratio shall be 11000/433 Volts or 22000/433 Volts.

## 6 Design & construction

### 6.1 Core

i The core shall be stacked/ wound type

a) **For Stack core** :- The core shall be of high grade cold rolled grain oriented (C.R.G.O) annealed steel lamination having low loss and good grain properties, coated with hot oil proof insulation, bolted together to the frames firmly to prevent vibration or noise. All core

clamping bolts shall be effectively insulated. The complete design of core must ensure permanency of the core losses with continuous working of the transformers.

**b) For Wound core :-**

The core shall be 'C' type construction of high grade cold rolled grain oriented (C.R.G.O.) annealed steel lamination having low loss and good grain properties, coated hot oil proof insulation or Amorphous core material. The complete design of core must ensure permanency of the core losses with continuous working of the transformers. The core material shall not be brittle in case of CRGO material.

Core clamping for C.R.G.O./Amorphous Wound core type transformers shall be as follows:

1. Core clamping shall be with top and bottom U- shaped core clamps made of sheet steel clamped.
  2. M.S. core clamps shall be painted with oil-resistant paint.
  3. Suitable provision shall be made in the bottom core clamp / bottom plate of the transformer to arrest movement of the active part.
  4. Core clamping shall be done with 12mm diameter MS Tie rods.
- ii. The grade of core laminations shall be M4 or better.

The successful bidder, shall be required to submit the manufacturer's test report showing the Watt Loss per kg and the thickness of the core lamination, to ascertain the quality of Core materials.

The purchaser reserves the right to get sample of the core material tested at any Government recognized laboratory.

- iii. The transformer core shall not be saturated for any value of V/f ratio to the extent of 112.5% of the rated value of V/f ratio (i.e. 11000/50) (due to combined effect of voltage and frequency) up to 12.5% without injurious heating at full load conditions and will not get saturated. The bidder shall furnish necessary design data in support of this situation.
- iv. Flux density:-

Flux density should not be more than 1.55 Tesla for CRGO transformers and 1.38 Tesla for Amorphous Metal Core transformers at the rated voltage and frequency. The value of the flux density allowed in the design shall be clearly stated in the offer along with graph.

- v. The No load current at rated voltage shall not exceed the percentage given in Table below.

Sr. No.	kVA Rating	At Rated Voltage	At 112.5 % Rated Voltage
1	63 (CRGO)	3% of the full load current in LT winding	6 % of the full load current
2	100 (CRGO)	2.5 % of the full load current in LT winding	5 % of the full load current

3	63 (AMDT )	1.25 % of full load current in LV winding	3.5% of full Load Current
4	100 (AMDT )	1.1 % of full load current in LV winding	3.0 % of full Load Current

i. Number of steps of core shall be minimum of

For 63 kVA	5 standard steps
For 100 kVA	5 standard steps

## 6.2. Winding:-

j. Materials:

Double paper covered Aluminium conductor shall be used for HV and LV winding for 11 kV class and Double paper covered copper conductor shall be used for HV and LV winding for 22 KV class.

ii Current Density:

Current density for HV and LV winding should not be more than **2.8 A / sq.mm** for copper and **1.6 A / sq.mm** for Aluminum conductor.

iii L.V. Neutral formation shall be at top.

## 6.3 Losses :

The No load losses and Load Losses of 63 kVA &100 kVA, 11 /0.433 kV and 22/ 0.433 kV transformers at rated voltage and rated frequency are specified as below:

TABLE – 1

KVA Rating	Voltage Ratio in kilovolts	No Load Losses (in Watts)	Load Losses at 75 ° C (in Watts)
63 ( CRGO)	11/0.433	180	1235
63 (CRGO)	22/0.433	230	1400
63 ( AMDT)	11/0.433	50	1235
100(CRGO)	11/0.433	260	1760
100 (CRGO)	22/0.433	300	1850
100(AMDT)	11/0.433	66	1760

The tolerances as per IS-2026 (Part-I) 1977 amended up to date is applicable to the Losses of 22/0.433 kV distribution transformers and no tolerance is applicable for the losses of 11/0.433 kV distribution transformers as per IS:1180 ( part 1) amended upto date. In case the actual losses exceed the guaranteed losses, the transformers shall be rejected at the



risk, cost and responsibility of the supplier.

The values guaranteed in G.T.P. for flux density, no load current at rated voltage, no load current at 112.5% of rated voltage and no load loss at rated voltage shall be individually met.

#### 6.4 Insulation material & clearances:

- i** Materials - Makes of Electrical grade insulating craft paper, Press Board, Perma wood/ Haldi wood insulation shall be declared in GTP by the bidder. The test reports for all properties as per relevant I.S. amended up to date shall be submitted during inspection.
- ii** The electrical clearance between the winding and body of the tank (between inside surface of the tank and outside edge of the windings) should not be less than 30 mm and 40 mm for 11 kV and 22 KV class respectively.

Minimum external clearances of bushing terminals

		<u>11 kV</u>	<u>22 kV</u>
HV	Ph to Ph	255 mm	330 mm
	Ph to E	140 mm	230 mm
LV	Ph-to-Ph	75 mm.	75 mm.
	Ph to E	40 mm.	40 mm.

#### 6.5 Impedance Value-

The percentage impedance at 75 ° C. shall be 4.5% for 11 kV and 5.0% for 22 kV (IS tolerance of ± 10 % is applicable).

#### 6.6 Tank

- 6.6.1 The transformer tank shall be made up of prime quality M.S. sheets of **rectangular** shape. No other shape will be accepted. The transformer tank shall be of robust construction. All joints of tank and fittings should be oil tight and no bulging shall occur during service. The tank design shall be such that the core and windings can be lifted freely. The tank plates shall be of such strength that the complete transformer when filled with oil may be lifted bodily by means of the lifting lugs provided. Tank inside shall be painted by varnish. Top cover plate shall be slightly sloping; approximately 5 to 10 deg. towards HV bushing and edges of cover plate should be bent downwards so as to avoid entry of water through the cover plate gasket. The width of bend plate shall be 25 mm min. The top cover shall have no cut at point of lifting lug. The rectangular tank shall be fabricated by welding at corners.
- 6.6.2 The transformer tank of corrugation is also acceptable, however shape of tank shall be rectangular only. The corrugation sheets thickness shall be of minimum 1.6mm. Corrugation panel shall be used for cooling. The transformer shall be capable of giving continuous rated output without exceeding the specified temperature rise. Bidder shall submit the detailed calculation sheet alongwith offer. The safe guard angle frame 50X50X5 mm shall be welded for corrugated side to the tank.

6.6.3 In rectangular shape tanks, horizontal or vertical joints in tank side walls and its bottom or top cover will be not allowed. In addition the cover of the main tank shall be provided with an air release plug.

Side wall thickness : 3.15 mm. (min.)

Top and bottom plate thickness : 5 mm. (min.)

6.6.4 Reinforced by welded angle 50X50X5 MM on all the outside walls on the edge of tank to form two equal compartments. The permanent deflection is not more than 5mm up to 750 mm length and 6mm up to 1250 mm length when transformer tank without oil is subject to air pressure of 35 KPa above atmospheric pressure for 30 min. Pressure test shall be performed carefully at the time of 1<sup>st</sup> stage inspection only to confirm the adequacy of reinforcement angle and gauge of the tank and certified by E.E. (IW).

6.6.5 All welding operations to be carried out by MIG process.

6.6.6 Lifting lugs: 2 nos. welded heavy duty lifting lugs of MS plate of 8mm thickness suitably reinforced by vertical supporting flat of same thickness as of lug welded edgewise below the lug on the side wall, up to reinforcing angle. They shall be so extended that cutting of bend plate is not required. 2 nos welded heavy duty lifting lugs of MS Plate of 8 mm thickness should be on the top plate of transformer.

6.6.7 Pulling lugs: 4 nos. of welded heavy duty pulling lugs of MS plate of 8mm thickness shall be provided to pull the transformer horizontally.

6.6.8 Top cover fixing bolts: GI nut bolts of 3/8" dia. with one plain washer shall be used for top cover fixing, spaced at 4" apart. 6mm neoprene bonded cork oil resistance gaskets conforming to type B/C IS 4253 Part-II amended up to date will be placed between tank and cover plate.

6.6.9 Vertical clearance: - The height of the tank shall be such that minimum vertical clearance up to the top cover plate of 120 mm is achieved from top yoke.

## 7.0 CSP Protection:

For distribution transformers with CSP Feature following additional fittings as their integral part shall be provided. The transformer shall have the following CSP features:

### a) INTERNAL HV FUSES ON THE HV SIDE OF TRANSFORMER:

Specifications for the HV Fuses: Expulsion / any other suitable fuse placed in series with primary winding. This fuse is mounted normally inside of the primary bushing and is connected to the high voltage winding through a terminal block. This has to protect that part of electrical distribution system which is ahead of distribution transformers i.e. either the windings or the other part of the transformer. It shall be ensured that this fuse dose not blow for faults on the secondary side (LT side) of the transformer i.e. the blowing characteristic of the fuse and LT breaker shall be so coordinated that the fuse shall not blow for any faults on the secondary side of the transformer beyond LT breaker and these faults shall be cleared by the LT breaker only.

### b) INTERNALLY MOUNTED OIL OMMERESD LT BREAKER ON THE LV SIDE OF THE TRANSFORMER:

**LT Circuit Breaker:** All LT Faults after the breaker shall be cleared by this breaker. As such, it shall be designed for perfect coordination with the HT fuse link. The supplier shall furnish the time/ current characteristics of LT circuit breaker and 11 KV fuses for various current multiples.

The two characteristics shall be drawn on the same sheet to indicate coordination between the circuit breaker and fuse. This shall be based on the type test carried out on one of the transformers. In addition, the supplier shall carry out coordination test as indicated above, and this forms one of the tests for acceptance.

The breaker is to be mounted on the secondary side of the transformer under oil to minimize premature operations from primary surges as would be with undersized line fuses. Three single pole elements are preferred. The breaker shall be coordinated thermally with the transformers rating to follow closely the variations of coil temperature due to fluctuations in loads and ambient temperatures.

This is to be accomplished by connecting the breaker in series between the secondary winding and the load current. The breaker shall be located in the same oil as the core and coil assembly so that the bimetals are sensitive to the temperature of oil as well as the load current. (Offers with LV breakers of MCCB type are not acceptable).

The circuit breaker may be an electro-mechanical device with three main elements viz. (a) temperature sensing (b) latching and tripping and (c) current interrupting. The temperature sensing function might be accomplished through the use of bimetallic strips which would be built into the breaker, such that load current of the transformer flows through them. In addition to this, a magnetic tripping device is to be provided for all ratings of transformers for increasing the opening speed be mounted inside of the transformers so that these bimetallic strips are within the top oil layer of the transformer. The current carrying parts of the breakers shall be copper plus a set of copper tungsten current interrupting contacts. The cross section of a current density not more than 2.8 A/sq.mm. (For additional mechanical strength, the area should be more).

The magnetic element shall increase the opening speed of the circuit breaker to the thermal activity shall remain unchanged by the addition of the magnetic trip element.

Beside a signal light controlled by a bimetal in the breaker shall switch on when the transformer load reaches a predetermined level indicating that the transformer has been over-loaded and the change out shall have to be scheduled without causing an un-planned service interruption.

The Type tests shall be carried out on Circuit breaker as per IS: 13947 (Part-2)/1993 amended upto date at any NABL Laboratory and shall be submitted alongwith the offer.

**Note: Mechanical operation test on LV Circuit Breaker shall be carried out in OIL medium as per IS: 13947 (Part-2)/1993 amended upto date.**

c) LOAD MANAGEMENT SIGNAL LIGHT:

The load management signal light shall perform two functions. It shall show visually when the particular transformer has been operating in an overload condition and shall provide knowledge that for good system management, the economical change out point for the transformer is fast approaching. The signal light need not indicate temporary overloads and shall turn on only when the overload condition has existed at a given level for a certain length of time.

The LT CSP Circuit breaker shall have a set of auxiliary contacts built –in for signal light operation. This normally open contact shall form part of the signal light contact circuit. The signal light circuit shall consist of an auxiliary transformer winding (one or two turns) which generates about 4 V , for the signal light contact set within the circuit breaker and the signal light is to be mounted on the transformer tank. The signal light contact set is mechanically connected to the main circuit breaker latching and bimetal system. The signal light mechanism is adjusted so that the signal light contacts will close at a pre-set thermal condition which occurs before the main latching system opens the main contact. The net result is a visual external

indication that a pre-set load condition has been reached by the transformer. The signal light mechanism does not reset itself when the load drops off, the signal light remains lighted once the signal light contacts close and can only be turned off by manually operating the external circuit breaker handle.

## **8.0 Tamper proof DTC METERING UNIT :**

Tamper Proof DTC Metering Unit shall be manufactured in accordance with the following Standards (as per drawing enclosed) **Annexure –IV**.

The Metering unit shall comply with the requirement of **IS:2147/1962** for Degree of Protection **I.P. 54**.

### **General Technical Particulars:**

This outdoor type Metering Unit shall be designed and fixed on the LV bushing side of the main transformer tank. General arrangement of Metering Unit shall be kept as per drawing covering the above aspect is enclosed at Annexure –IV. The overall dimensions of enclosure shall be such that it should accommodate the LV Bushings, Three Ring Type CTs of rating 200/5 A, for 100kVA & 150/5 A for 63 kVA transformers, one LT CT operated Static TOD meter.

#### **1. In First chamber-**

The first chamber shall be provided as an enclosure to transformer L.V. bushings and CTs as shown in diagram. The required minimum electrical clearances as per relevant IS, shall be maintained while providing / fixing the box. The suitable rubber gasket shall be provided between transformer body and enclosure so as rain water shall not enter in the chamber.

Three CTs of 5VA burden & class of accuracy 0.5 shall be mounted on fixed arrangement inside the chamber for each phase as shown in the drawing. The inner diameter of CTs shall be suitable to cover the cable size. CTs should be magnetically shielded and fixed inside the enclosure with suitable nut bolts & washers.

Minimum 2.5 sq. mm. copper multistranded (flexible) wire shall be used for connections from CT secondary terminals to Meter & P.T connections.

The Enclosure shall be fabricated by using CRCA sheet steel of 14 SWG (2mm) thickness & shall comply with the requirement of I.P.-54 as per **IS:2147/1962**.

#### **2. Second Chamber:**

The energy meter shall be fixed on suitable arrangement keeping minimum clearance of 50 mm from the tank surface. The clearances from Meter front side to enclosure shall be minimum 50 mm.

The Meter fixing arrangement shall be such that front and back as well as up and down with tilting adjustment can be done to accommodate various type & make of meter (s). Also suitable space shall be provided to install GSM MODEM alongwith the Antenna for future communication with the meter.

**Note :** MSEDCL shall install any **reputed** make 3 phase, 4 wire static LT CT operated TOD energy meters in the metering box.

**Constructional main features of the Metering Unit are as under:**

1. The single door panel shall be provided with 5 mm thick triplex glass window of size 150 mm x 115 mm – 1 nos for second chamber to facilitate meter reading.
2. One 6 mm isolated Earth Terminal in second chamber at side of the box.
3. Each LT Bushing provided with 2 nos. washer for lugs tightening.
4. Cam lock shall be provided to each chamber door with separate keys. The Two keys set shall be supplied with each unit. e.g. Godrej cam lock.
5. 2 nos. earthing bolt size 25x10 mm each with 2 nos washer and one nut to be provided
6. 3 nos earth sticker with earth symbol to be provided
7. 4 nos suitable size lugs for 70/ 120 sq.mm, 31/2 core PVC Al.Cable shall be provided
8. Danger marking 125 x 38 mm with Marathi language with 433 V AC.
9. Flat gasket of size 20 x 2 mm to be fixed with adhesive (fevibond) inside door
10. Inside hinges to be MIG welded strictly ( NO SPOT WELDING).
11. CT secondary & PT wires with proper lugs shall be connected to meter terminals.
12. Single panel doors for chamber 1 & 2.
13. Arrangement to be provided for holding the panel door manually
14. The sizes of each compartment & overall size shown are minimum and may be more to suit the size of Transformer Tank and LT bushings.
15. The complete metering unit shall be as per Drawing enclosed so fitted with the transformer that a gap of minimum 50 mm is maintained from the transformer tank & the unit for free circulation of air & fitted towards the ground so that it is possible to take readings from a distance of 2 to 3 meters.
16. The suitable cable glands shall be provided in first chamber for 3/12 cables.
17. Cable holding clamp shall be provided as shown in diagram. The cable holding clamp support shall be welded on transformer tank.

Note: 1) All dimensions are in mm.

2) Chamber no.1& 2 Door - front open back

3) Sheet steel thickness: 2 mm (min)

4) Paint shade : Exterior & interior – Aircraft Blue at shade No 108 of IS 5.

5) Degree of enclosure protection IP : 54.

**9.0 A) Heat Dissipation:**

- a. Heat dissipation by tank walls excluding top and bottom should be **500 W/ sq.m.**

- b. Heat dissipation by fin type radiator 1.25 mm thick will be worked out on the basis of manufacturers data sheet. The tenderer shall submit the calculation sheet with the offer or the offer shall stand rejected.
- c. Two nos. radiators shall be provided only on HV side and shall be of fin type. They should be fixed at right angle to the sides and not diagonally. The size of the radiator shall be such that it covers at least 50% of the bottom yoke, full core and complete top yoke.

**B) Total Minimum Oil Volume :**

Sr.No.	KVA rating	Voltage Ratio in Volts	Oil in liters (exclusive of oil absorbed in core & coil assembly)
1	63 kVA	11000/433	155
2	100 kVA	11000/433	190
3	63 kVA	22000/433	165
4	100 kVA	22000/433	200

Note: The firm should maintain the oil volume in all supplied transformers as mentioned above.

**10.0 Conservator:**

- a) The total volume of conservator shall be such as to contain 10% of total quantity of oil. Normally 3% quantity of the total oil will be contained in the conservator. Dimension of the conservator shall be indicated on the General Arrangement Drawing.
- b) Oil level indicator shall be provided on the side which will be with fully covered detachable flange with single gasket and tightened with MS nut-bolt.
- c) The inside diameter of the pipe connecting the conservator to the main tank shall be within 20 to 50 mm and it should be project into the conservator in such way that its end is approximately 20mm above the totem of the conservator so as to create a sump for collection of impurities. The minimum oil level (corresponding to (-) 5 deg.) should be above the sump level.
- d) The pipe from conservator tank connecting to main tank shall be of 30 mm (min.) dia and shall have a slopping flap so that the oil falling from the pipe shall not fall directly on the active job and shall fall on the side walls only.
- e) The conservator shall be provided with the drain plug and a filling hole (30mm dia) with cover.

**11.0 Breather:**

Breather joints will be screwed type. It shall have die-cast aluminum body or of Poly propylene materials and inside container for silica gel shall be of tin sheet, in case of aluminum die cast breather. Makes of the breather shall be subject to purchaser's approval. Volume of breathers shall be suitable for 250 gm. of silica gel. The make and design of breather shall be subject to approval of C.E. (Stores).

**12.0 Terminals:**

- a. **Brass rods 12 mm. diameter for HT** with necessary nuts, check-nuts and plain thick tinned washer.
- b. **Tinned Copper Rods of 12 mm diameter** for 63/100 kVA distribution transformers for LT extension with suitable cable lugs, necessary nuts, check-nuts and plain thick tinned washer.

### **13.0. Bushings & Connections:**

- 13.1 For 11 kV class 12 kV bushing, for 22 kV class 24 kV bushing shall be used and for 433 volts 1.0 kV bushing shall be used. Bushings of the same voltage class shall be interchangeable. Bushings with plain shed shall be as per relevant IS:3347 amended up to date. HV bushings shall be mounted on the top of the transformer tank & LV bushings shall be mounted on side of the transformer tank.
- 13.2 HV bushings shall be mounted on curvature shaped embossed plate, in such a way that all H.V. Bushings shall remain parallel and at equi-distance throughout. Bushings having type tested, as per relevant IS amended up to date shall only be acceptable.
- 13.3 The minimum creepage distance for both HV & LV Bushings shall not be less than 25 mm per kV.

### **14.0 Internal connections:**

- 14.1 H.V. Winding :
  - i. In case of H.V. winding all jumpers from winding to bushing shall have cross section larger than winding conductor.
  - ii. Inter coil connection shall be by crimping and brazing.
  - iii. In case of Copper Winding Delta joints shall be with crimping and Brazing only.
  - iv. Lead from delta joint shall be connected to bushing rod by brazing only.
- 14.2 L.V. Winding :
  - i. L.T. Star point shall be formed of Aluminium/Copper flat of sufficient length. Lead from winding shall be connected to the flat by crimping and brazing.
  - ii. Firm connections of L.T. winding to bushing shall be made of adequate size of 'L' shaped flat. Connection of L.T. Coil lead to 'L' shape flat shall be by crimping and brazing. Alternatively 'L' shape lug of adequate capacity effectively crimped shall be acceptable.
  - iii. 'L' shape flat/lug shall be clamped to L.V. Bushing metal part by using nut, lock-nut and washers.
  - iv. For Aluminum windings, L&T Alkapee aluminum brazing rods with suitable flux shall be used. For copper winding crimping and silver brazing alloy shall be used.

### **15.0 Tank base channel :**

It should be of two numbers of 75 mm x 40 mm channel for 63 kVA and 100 kVA transformers.

### **16.0 Terminal Marking Plates and Rating Plates :**

Terminals shall be provided with terminal marking plates. The transformer shall be provided with riveted rating plate of minimum 18 SWG aluminum anodized material sheet in a visible position. The entries of the rating plate shall be indelibly marked (i.e. by etching, engraving or stamping).

Marking as 'M.S.E.D.C.L'S and 'Sr. No.' of transformer shall be engraved on transformer main tank below L.T. bushings.

The name of the company, order No., capacity, month and year of manufacturing shall be engraved on separate plate which shall be firmly welded to main tank and shall form integral part of the tank.

## 17.0 Fittings:

The fittings on the transformers shall be as under:

1	Rating and diagram plate	1 no.
2	Earthing terminals with lugs.	2 no.
3	Lifting lugs	4 no. ( 2 nos to top plate of transformer and 2 nos of transformer tank
4	Oil filling hole with cap(on conservator)	1 no
5	Drain valve - 20mm for all T/Fs	1 no
6	Conservator with drain plug.	1 no
7	Thermometer pocket	1 no
8	Explosion vent (Only for 22 kV T/F)	1 no
9	Silica gel breather	1 no
10	Platform mounting channel	2 no
11	Oil level gauge indicating 3 positions of oil marked as below :	1no
	Minimum (-) 5 deg.C.	
	Normal 30 deg.C	
	Maximum 98 deg.C.	
12	HT & LT bushing	3 nos. of HT bushing and 4 nos. of LT bushing shall be provided. Each bushing (HV & LV) should be provided with 3 nos. of brass nuts and 2 plain brass washers.
13	Radiators	As per Cl. No. 8 (C)
14	Lightening Arrestors for HV Bushings	3 nos
15	Pulling lugs	4 nos
16	Metallic cover spot welded to tank for drain valve shall be provided.	-
17	CSP feature operating handle	1 No
18	DTC metering Unit	1 No.



## 18.0 Lightning Arrestors:

The Lightning Arrestors (Disconnecter type) of high surge capacity of 9 kV( Vrms), 5 kA( 8/20 micro wave shape) for 11 kV class transformers and 18 kV( Vrms), 5 kA ( 8/20 micro wave shape) for 22 kV class transformers conforming to IS: 3070/1974 shall be mounted on the HV bushings of transformer, clamped securely to the tank, to protect the transformer and associated line equipment from the occasional high voltage surges resulting from lighting or switching operations. The earthing terminal of the lightning arresters shall be grounded separately.

## 19.0 Transformer Oil

Transformer oil to be used in all the Distribution transformers shall comply with the requirements of latest IS 335/1983 amended up to date thereof. In addition the oil should conform to 'Ageing Characteristics' specified below for New Oil and Oil in Transformers. Type test certificates of oil being used shall be produced to EE (IW) at the time of stage inspection.

New oil - Ageing characteristics after accelerated ageing test 96 hrs at 115° C (open beaker method with copper catalyst):

- i. Specific Resistance (Resistivity)
  - a) at 20 ° C :-  $2.5 \times 10^{12}$  Ohm-Cm (Min)
  - b) at 90 ° C :-  $0.2 \times 10^{12}$  Ohm-Cm (Min)
- ii. Dielectric dissipation factor - 0.20 (Max.tan delta) at 90 ° C.
- iii. Total acidity mg/KOH/gm - 0.05 (Max)
- iv. Total sludge value (%) by weight - 0.05 (Max.)
- v. The method of testing these aging characteristics is given in Appendix - C of IS 335 amended up to date.
- vi. Oil filled in Transformers:

The important characteristics of the transformer oil after it is filled in the transformer (within 3 months of filling) shall be as follows: -

Sr.No.	Characteristics	Specifications
1.	Electric Strength (Breakdown voltage)	30 kV (Min)
2.	Dielectric dissipation factor (Tan Delta) at 90 deg.C.)	0.01 (Max)
3.	Specific Resistance (Resistivity) at 27 deg. C (ohm-cm)	$10 \times 10^{12}$
4.	Flash Point, P.M. (closed)	140 ° C (Min)
5.	Inter facial tension at 27 ° C.	0.03N/M (Min)
6.	Neutralization value (total acidity)	0.05Mg.KOH/gm (Max.)
7	Water content PPM	35 (Max)

## **20.0 Test and Inspection:-**

### **20.1 Routine Tests:-**

- i. All transformers shall be subjected to the following routine tests at the manufacturer's works. The tests are to be carried out in accordance with the details specified in IS 2026 or as agreed upon between the purchaser and the manufacturer.
  1. Measurement of winding resistance.
  2. Ratio, polarity and phase relationship.
  3. Impedance voltage.
  4. Load losses.
  5. No-load losses and No-load current.
  6. Insulation resistance.
  7. Induced over voltage withstand.
  8. Separate source voltages withstand.
- ii. All the routine tests shall be conducted in the suppliers' laboratory at their cost.
- iii. Heat run test shall be arranged free of cost on the unit selected from the 1<sup>st</sup> lot by Executive Engineer / Authorized Representative.
- iv. The calculations to confirm the thermal ability as per Clause no. 9.1 of latest IS: 2026 Part-I or equivalent International Standard shall be submitted to Executive Engineer (IW).

### **21.0 Challenge Testing:**

The manufacturer can also request challenge testing for any test based on specification and losses. The challenger would request for testing with testing fees. The challenge test fees are proposed at least three times the cost of testing. This is likely to deter unnecessary challenges. The challenger would have the opportunity to select the sample from the store and any such challenge should be made within the guarantee period. The party challenged, challenger and the utility could witness the challenge testing.

The challenge testing would cover following tests:

1. Measurement of magnetizing current.
2. No load losses test.
3. Load losses test (at 50 % loading or as per acceptance test).
4. Temperature rise test.

The challenge test could be conducted at NABL Laboratory, like ERDA and CPRI. If the values are within the limits the products gets confirmed else not confirmed. No positive tolerances in losses is permitted. If the product is not confirmed the manufacturer would pay the challenge fee and challenger would get the fee refunded. However as a redressal system the challenger would be allowed to ask for fresh testing of two or more samples from the store and the same be tested in NABL Laboratory in presence of party challenge, challenger and the utility.

If any one of the above sample does not confirm the test, then the product is said to have failed the test. In such cases the manufacturer will be declared as unsuccessful manufacturer for the said

product with wide publicity and would not allow to complete in tenders of the MSEDCL for the period of three years and heavy penalty would be imposed.

## **22.0 Type Tests:-**

22.1 In addition to routine test as above Impulse voltage Withstand test and Dynamic Short Circuit Test as under shall be successfully carried out at laboratories accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with IS 2026/1977 as amended from time to time and technical specifications, within the last 5 (five) years prior to the date of offer. The bidder shall furnish the following type tests reports (along with General arrangement drawing, Core & Core details, Internal construction, HV& LV Bushing Assembly and Rating and Diagram Plate drawings ) along with the offer.

i. Impulse Voltage with stand Test shall be carried out as per Clause No. 13 of IS 2026 (Part-III)/81 on all three HV phases chopped on tail. Impulse Voltage shall be 75 kVp for 11 kV class transformers.

ii. Dynamic Short circuit Test

22.2 The following balance type test should be carried at the manufacturer's works invariably in the presence of MSEDCL's representative at the time of inspection from the first lot.

i. Temperature Rise Test

ii. Air pressure test as per clause no. 22.5 of IS:1180 (Part I)/1989

iii. Unbalanced current test – unbalanced current should not be more than 2% of full load current

22.3 The type test reports should be submitted and got approved from the Chief Engineer (Stores) before commencement of supply.

22.4 In case of any of the following, the offer may be considered for placement of order.

i. If above tests are carried out beyond 5 years

ii. Impulse Voltage Withstand test and Dynamic Short Circuit test carried out not from NABL approved Laboratory.

iii. If there is any change in the design/ type of old type tested transformers to be offered against this specification.

However, successful bidders have to carry out the type tests at the laboratories accredited by NABL before commencement of supply at their own expense on the sample drawn by the purchaser from the lot offered for first Stage Inspection.

22.5 In respect of the successful bidder, the purchaser reserves the right to demand repetition of some or all the type tests in presence of the purchaser's representative. In case the unit fails in the type tests, the complete supply shall be rejected. The bidders are therefore requested to quote unit rates for carrying out each type test, which however, will not be considered for evaluation of the offer.

## **23.0 Drawings:-**

23.1 A set of following drawings with all dimensions shall be submitted by the Bidder along with the offer:

i. General Dimensional.

ii. Core & Core Details (technical Details).

- iii. Internal Construction.
- iv. Rating & Diagram Plate.
- v. HV/LV Bushings Assembly indicating measurement of creepage distances.
- vi. Operation and Maintenance Manual.
- vii. Outline General Arrangement for kVA Dist. Transformer -MSEDCL/MMII/63-100DT/01
- viii.Meter Box & C.T. Mounting Box Arrangement for 63&100 kVA Dist. Transformer MSEDCL/MMII/63-100DT/02.
- ix. Meter Box & C.T. Mounting Box Arrangement for 63&100 kVA Dist. Transformer - MSEDCL/MMII/63-100DT/03.
- x. Meter Box with Meter for 63&100 kVA Dist.Transformer - MSEDCL/MMII/63-100DT/04.

- 23.2 The drawings shall be of A-3 (420 x 297 mm) size only. The bidder should also supply along with his offer the pamphlets/literatures etc. for fittings / accessories. Indicative Drawings are attached with the technical specifications for ready reference.
- 23.3 The bidder should not change design once offered as per A/T, Approved drawings and Type Test Reports.
- 23.4 The successful Bidders shall submit complete set of Drawings (as listed in Cl.No.23.1) of transformer in triplicate indicating dimensions to CE (Stores) for approval and get approved before commencement of supply.

#### **24.0 Rejection :-**

- 24.1 Apart from rejection due to failure of the transformer to meet the specified test requirements the transformer shall be liable for rejection on any one of the following reasons.
- i. At 50 % & 100% Loading condition, total losses exceeds the specified values mentioned in Cl. No.6.3 above.
  - ii. Impedance voltage value exceeds the Guaranteed value plus tolerances as mentioned at Cl..No.6.5 above.
  - iii Type test are not carried out as per clause no. 22.0 of the specification.
  - iv. Drawings are not submitted as per clause no. 23.0 of the specification.
  - v. GTP not submitted as per clause no. 26.0 of the specification.
  - vi Heat dissipation calculation sheet are not submitted as per clause no.8.0 of the specification.

#### **25.0 Cleaning and Painting.**

- i. The surface of the tank shall be properly pre-treated / phosphated in a seven tank process and shall be applied with a powder coating of 40 micron thickness. The powder coating shall be of **Aircraft Blue colour ( shade No. 108)** for transformers. Powder coating shall be suitable for outdoor use conforming IS: 13871/1993 – Powder coatings. The seven tank process facility shall be enhance to ensure proper quality for outdoor application.

- ii. The month and year of supply shall be painted in **Red bold Marathi** lettering at two places, one on conservator and other at sum conspicuous place on the transformer which shall be clearly visible from the ground.

## **26.0 Guaranteed & Technical Particulars:**

The bidder should fill up all the details in GTP parameter list, the statement such as “as per drawings enclosed”, “as per MSEDCL’s requirement” “as per IS” etc. shall be considered as details are not furnished and such offers shall liable for rejection.

## **27.0 Testing facility**

The bidder should have adequate testing facility for all routine and acceptance tests and also arrangement for measurement of losses, resistance, etc. details of which will be enumerated in the tender.

## **28.0 Submission Routine Test Certificate**

- a. The successful bidder shall submit the routine test certificate along with documentary evidence for having paid the Excise Duty for the following raw materials viz. Oil, Aluminum, copper for conductors, insulating materials, core materials, bushings at the time of routine testing of the fully assembled transformer
- b. The successful bidder shall be required to submit 5 copies of instruction and Operation manual for each lot of 100 Transformers (or part thereof) supplied. This instruction manual should give complete details about the pre-commissioning tests/checks and the details of preventive maintenance etc.

## **29.0 Stage Inspection :-**

- 29.1 Supplier shall give 15 days’ advance intimation to the Chief Engineer (Dist.) and S.E. (Store/Adm) to organize stage inspection in which assembly of core, windings and other core materials etc. would be inspected. In respect of raw materials such as core stamping, winding conductor, oil etc. successful bidder shall use these materials manufactured/supplied by the standard manufacturers and furnish the manufacturer's test certificates, as well as, proof of purchase from those manufacturers documentary evidence for having paid the excise duty for the information of the department.
- 29.2 Chief Engineer (Stores) will depute representatives from inspection wing and inspection wing at the time of stage inspection.
- 29.3 10 % of the transformers from the offered lot will be tested for acceptance tests at factory, in the presence of purchaser's representative before dispatch.
- 29.4 The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser's representatives at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specifications and shall not prevent subsequent rejection if the equipment is found to be defective.

29.5 The purchaser may at its option, open a transformer supplied to the Stores, in presence of supplier at site or at Stores. If any of the technical particulars are seen to be in variance than the guaranteed technical particulars, the whole lot of transformer will be rejected without any liability on purchaser.

29.6 In addition to the above, the purchaser may pick up any transformer and decide to get it type tested from any laboratory accredited by NABL at purchaser's cost. The Bidder will have to organize packing of the transformer at company's Stores for which they will be paid necessary charges. If the transformer fails to meet the requirement of type tests, the quantity of transformers ordered on them will be forthwith rejected and the purchaser may purchase these transformers at the risk and cost of the supplier.

**30.0 Testing for no load and full load losses of all Distribution Transformers:**

After inspection of new transformers at factory for acceptance of the lot, all distribution transformers from the lot will be tested for no load and full load losses at all stores. Tenderer has liberty to be present at the time of testing.

**31.0 Random Sample Testing (RST)**

The tenderer should intimate to C.E. (Stores), M.S.E.D.C.L of completion of dispatches of whole lot of Distribution Transformers to stores against this tender. C.E. (Stores), M.S.E.D.C.L for will select the stores for Random Sample Testing (RST) and depute E.E. (Testing) to carry out RST of the lot.

E.E. (Testing) will select a transformer from the lot of transformers already tested for No load & full load losses. 15 days advance intimation will be given to tenderer for joint inspection. The date of RST will not be altered to the convenience or request of supplier. If supplier's representative fails to attend on the date fixed for RST, the RST will be carried out in his absence and results of RST will be binding on supplier. In case the selected transformer fails in any of the tests, complete lot of transformers will be rejected.

**32.0 Inspection & Testing of Transformer Oil:**

The tenderer shall make arrangements for testing of transformer oil to be used in the transformers and testing will be done in presence of purchaser's representative.

To ascertain the quality of transformer oil, original manufacturer's test report should be furnished to EE (Testing) at the time of factory inspection for acceptance of the lot.

**33.0 Quality Assurance:**

33.1 The bidder shall invariably furnish following information along with the offer failing to which the offer will be rejected.

- 33.2 Certificates of following materials.
- i. Aluminium and copper conductor
  - ii. Transformer oil
  - iii. Core
  - iv. Insulating paper.
  - v. Porcelain Bushings
  - vi Steel Plate used for Tank

- 33.3 Names of the supplier for the raw material, list of standard accordingly to which the raw materials are tested, list of test normally carried out on raw materials in presence of bidder's representatives, copies of type test certificates.
- 33.4 Information and copies of test certificate as in (i) above respect of bought out accessories including terminal connectors.
- 33.5 List of manufacturing facilities available. In this list the bidder shall specifically mention whether lapping machine, vacuum drying plant, air conditioned dust free room with positive air pressure for provision of insulation and winding etc are available with him.
- 33.6 Level of automation achieved and list of areas where manual processing still exists.
- 33.7 List of areas in manufacturing process where stage inspection are normally carried out for quality control and details of such tests and inspections.
- 33.8 Special features provided in the equipments to make it maintenance free.
- 33.9 List of testing equipment available with the bidder for final testing of transformers and test plant limitation, if any, vis-à-vis the type, special acceptance and routine tests specified in the relevant standards and the present specification.
- 33.10 The successful bidder shall submit the Routine Test Certificate along with documentary evidence having paid for the excise duty for the following raw materials viz Oil, Aluminum for conductors, insulating materials, Core materials, Bushing at the time of routine Testing of the fully assembled transformer.

**34.0 Qualifying Requirement: AS PER Tender clause**

**35.0 Final Inspection:**

10 % of the transformers offered will be tested for all tests without opening the transformer. Heat Run Test will have to be carried out on the transformer having maximum no load and full load losses taken together. C.E. (Stores ) will depute his representative at the time of final inspection along with CPA's representative.

- 36.0** All transformers supplied against this specification shall be guaranteed for a period of 66 months from the date of receipt at the consignee's Stores Center or 60 months from the date of commissioning, whichever is earlier. However, any engineering error, omission, wrong provisions, etc. which do not have any effect on the time period, shall be attended to as and when observed/ pointed out without any price implication.

**37.0 COST DATA SHEET:-**

The bidders shall submit the cost data sheets indicating the break up prices and quantity of each raw material and components along with the unit rates required for manufacture the offered

transformers along with the offer. The cost data sheet format is enclosed herewith.. If the rates quoted are not justified with the cost data sheets, the offer shall not be considered for evaluation and placement of the order.

The cost data sheets shall be scrutinized by MM CELL section.

FORMAT FOR COST DATA					
ITEM ----- KVA , ----- KV DISTRIBUTION TRANSFORMER					
Sr. No.	PARTICULARS	UNIT	UNIT RATES Rs.	QTY	AMT (Rs.)
1	CORE (M4 or better )	KG			
2	ALUMINIUM/COPPER WITH DPC	KG			
3	INSULATION PAPER	Meter			
4	OIL	LTRS			
5	TANK	NO			
6	CHANNELS	KG			
7	INSULATORS/BUSHINGS	KG			
8	DTC METERING UNIT WITHOUT METER.	NO			
9	OTHERS	LUMP SUM			
				TOTAL	
	WASTAGE @ %				

### 38.0 Schedules:

38.1 The bidder shall fill in the following schedules which form part of the tender specification and offer. If the schedules are not submitted duly filled in with the offer, the offer shall be rejected.

Schedule `A' -Guaranteed Technical Particulars

Schedule `B' -Schedule of Tenderer's Experience.

38.2 The discrepancies between the specification and the catalogs, Literatures and indicative drawings which are subject to change, submitted as part of the offer, shall not be considered and representation in this regard will not be entertained.

38.3 The Bidder shall submit the list of orders for similar type of equipments, executed of under execution during the last three years, with full details in the schedule of Tenderer's experience (Schedule `B') to enable the purchaser to evaluate the tender.



# Schedule `A'

**GUARANTEED TECHNICAL PARTICULARS**

As indicated in E-Tendering GTP Parameter

SCHEDULE – 'B'  
SCHEDULE OF TENDERER'S EXPERIENCE

Tenderer shall furnish here a list of similar orders executed/under execution by him to whom a reference may be made by Purchaser in case he considers such a reference necessary.

---

Sr. No.	Name of client & Description.	Value Of Order (along with cap. of T/F)	Period of supply & commissioning	Name & Address to whom reference may be made.
1	2	3	4	5

---

NAME OF FIRM \_\_\_\_\_

NAME & SIGNATURE OF TENDERER \_\_\_\_\_

DESIGNATION \_\_\_\_\_

DATE \_\_\_\_\_

**Annexure I**

Air Pressure Test

Name of Supplier:

Order No.:

Capacity & Voltage Ratio of Distribution Transformer : \_\_\_\_\_ kVA, \_\_\_\_/0.433 kV

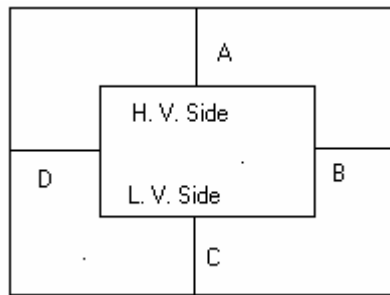
Vector Group Dyn11

Sr. No. of equipment Tested:

Date of Testing:

Reference Standard

All the opening of the transformer tank were closed with suitable gasket, bushing, valves and plugs. The compressor pipe connected at oil filling hole on conservator and a pressure guage was fitted at air vent plug. The parallel string were places around the tank, the distance between string and tank as shown in following diagram were recorded before applying the pressure and after releasing pressure.



Tank Thickness: Side \_\_\_\_\_ mm. Top & Bottom \_\_\_\_\_ mm

Test Pressure : \_\_\_\_\_ kg/cm<sup>2</sup> applied for 30 Minutes.

Test Point	Distance before Test In mm	Distance after release of Pressure in mm	Deflection In mm
A			
B			
C			
D			

Permanent Deflection : \_\_\_\_\_ mm

Permissible Limit of Permanent Deflection as per Specification : \_\_\_\_\_ mm.

Test witnessed by

Tested by

**Annexure II**

**Unbalance Current Test**

Name of Supplier:

Order No.:

Capacity & Voltage Ratio of Distribution Transformer : \_\_\_\_\_ kVA, \_\_\_\_/0.433 kV

Vector Group Dyn11

Sr. No. of equipment Tested:

Date of Testing:

Reference Standard

---

Transformer Secondary terminals 2U, 2V & 2W are shorted. The shorted 2U, 2V & 2W is connected to 2N through Ammeter. The primary terminals 1U, 1V & 1W are connected to supply. The rated current \_\_\_\_\_ A is fed to primary and unbalance current is noted on Ammeter.

Unbalance Current Measured in Ammeter : \_\_\_\_\_ A

Rated current in Secondary Side : \_\_\_\_\_ A

Permissible limits as per specification : 2% of the Rated current in Secondary Side

% of Unbalance current with reference to Rated current in Secondary Side

$$= \frac{\text{Unbalance Current} \times 100}{\text{Rated current in Secondary Side}}$$

=

=

Test witnessed by

Tested by



LV Winding : Since the resistance of LV winding is less than 0.005 ohm, Temperature Rise in LV Winding is taken as temperature rise of oil as per clause no. 4.3 of IS:2026 (Part II)/1977

Temperature Rise in LV Winding = \_\_\_\_\_ °C

HV Winding Resistance across 1U1V at \_\_\_\_\_ °C = \_\_\_\_\_ ohm

Measurement of Hot Resistance of HV Winding after Shut Down.

Time	Resistance

Hot winding Resistance at Ambient Temperature \_\_\_\_\_ °C (from graph) = \_\_\_\_\_ Ohm

Temperature Rise in H. V. Winding is

$$= \frac{\text{Hot Resistance} \times (235 + \text{Cold Ambient Temperature})}{\text{Cold Resistance}} - (235 + \text{Hot Ambient Temperature})$$

=

=

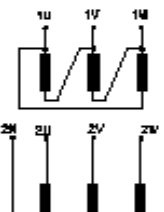
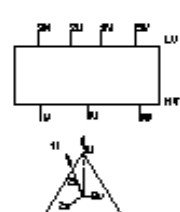
Results :

- 1) Temperature Rise in Oil = \_\_\_\_\_ °C
- 2) Temperature Rise in LV Winding = \_\_\_\_\_ °C
- 3) Temperature Rise in HV Winding = \_\_\_\_\_ °C

Test witnessed by

Tested by .

Annexure – IV

115			
REF. STANDARDS : IS 2024-1977 & IS 1380 3 STAR RATING, 3 PH. DISTRIBUTION TRANSFORMER			
TYPE	OUT DOOR	TYPE OF COOLING	ONAN
RATED KVAH	---	OIL TEMP. RISE	1/1 35
RATED HV V	11000	WDG TEMP RISE	2/2 40
VOLTAGE LV V	433	VOLUME OF OIL	l
RATED HV A	---	MASS OF OIL	kg
CURRENT LV A	---	WEIGHT OF CORE	kg
PHASES	3	WEIGHT OF WDGs	kg
FREQUENCY Hz	50	TOTAL MASS	kg
IMPEDANCE %	---	SERIAL NO	
GUARANTEED TOTAL LOSS	Wdg Loss at 75 deg C	--- IN WATTS	
INSULATION LEVEL	U75 AC 2B	CORE	DRG/AMDT
VECTOR GROUP	DYn-11	MONTH/YEAR OF MFG	--- & ---
OWNER	MSEDCL, MUMBAI.		
A/T.NO.			
 CONNECTION DIAGRAM		 VECTOR DIAGRAM	
4 HOLES Ø3			
145			

ASHTRA STATE

DISTRIBUTION CO.

**NOTE:**

1. ACTUAL VALUES SHALL BE PUNCHED AT THE TIME OF DISPATCH.
2. RATING PLATE MATERIAL: ALUMINIUM ANODIZED
3. THICKNESS OF RATING PLATE: 18 SWG
4. WEIGHTS ARE SUBJECTED TO +10% TOLERANCE

**THIS IS AN INDICATIVE DRAWING**

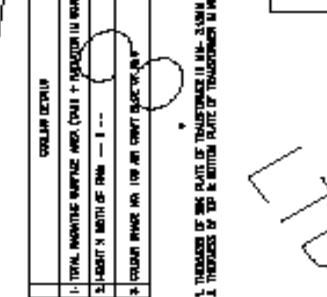
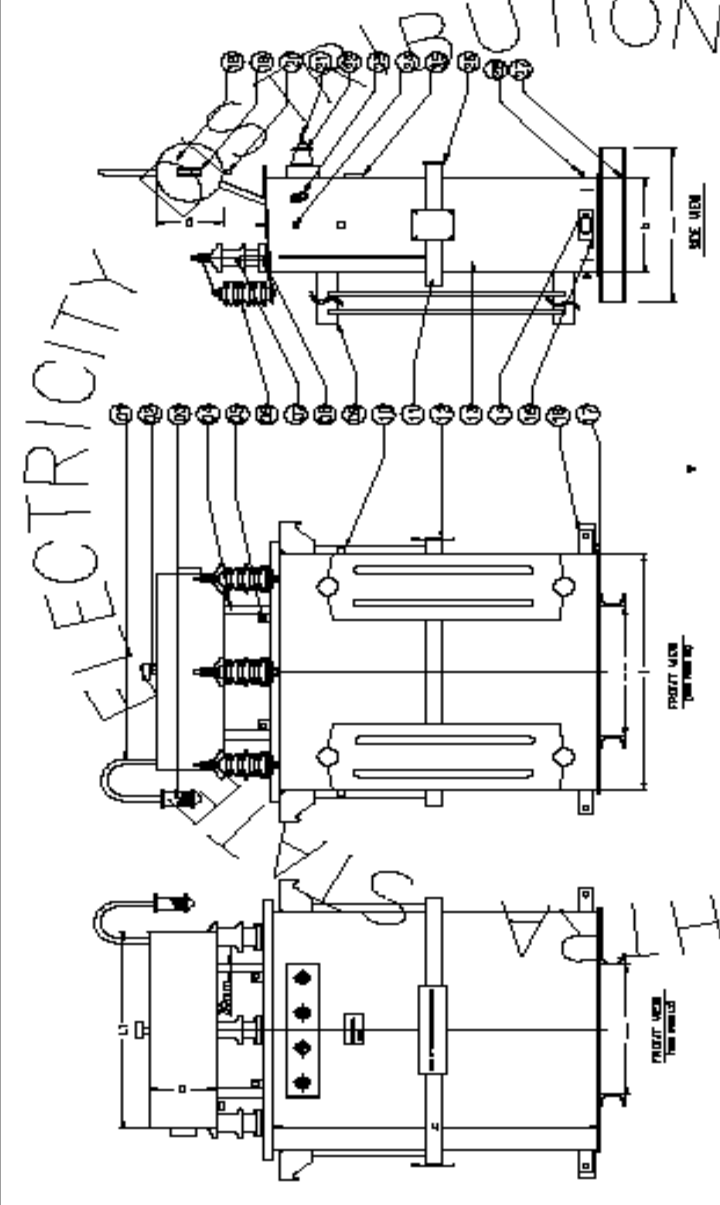
NAME OF THE CUSTOMER:	MSEDCL, MUMBAI-51
A/T. NO.	
QUANTITY	
DETAILS OF DISTRIBUTION TRANSFORMER:	---KVA, 11/0.433KV

NAME OF THE MANUFACTURE & SYMBOL	
DATE	<b>RATING &amp; TERMINAL MARKING PLATE</b> ---KVA, 11/0.433KV CRG/AMDT, DIST. TRANSFORMER
DRN	
CHD	SCALE
APPD	
	DRG. NO
--- KVA	NTS

SLM	DESCRIPTION	QTY
1	REGULATOR CONNECTING PIPE (SMA) (SMA)	
2	2X 1/2" PIPE TUBE (SMA) WITH GUN FOR PENETRATION	
3	RELIEF BREATHER 250 GPM	
4	CONNECTION PIPE (SMA)	
5	LETTER LUG FOR TOP COVER	
6	LETTERING (SMA) (SMA)	
7	4X 1/2" BUSHING (SMA) (SMA)	
8	4X 1/2" PIPE (SMA) (SMA)	
9	4X 1/2" PIPE (SMA) (SMA)	
10	4X 1/2" PIPE (SMA) (SMA)	
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19	4X 1/2" PIPE (SMA) (SMA)	
20	4X 1/2" PIPE (SMA) (SMA)	
21	4X 1/2" PIPE (SMA) (SMA)	
22	4X 1/2" PIPE (SMA) (SMA)	
23	4X 1/2" PIPE (SMA) (SMA)	
24	4X 1/2" PIPE (SMA) (SMA)	
25	4X 1/2" PIPE (SMA) (SMA)	
26	4X 1/2" PIPE (SMA) (SMA)	
27	4X 1/2" PIPE (SMA) (SMA)	
28	4X 1/2" PIPE (SMA) (SMA)	
29	4X 1/2" PIPE (SMA) (SMA)	
30	4X 1/2" PIPE (SMA) (SMA)	
31	4X 1/2" PIPE (SMA) (SMA)	
32	4X 1/2" PIPE (SMA) (SMA)	
33	4X 1/2" PIPE (SMA) (SMA)	
34	4X 1/2" PIPE (SMA) (SMA)	
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36	4X 1/2" PIPE (SMA) (SMA)	
37	4X 1/2" PIPE (SMA) (SMA)	
38	4X 1/2" PIPE (SMA) (SMA)	
39	4X 1/2" PIPE (SMA) (SMA)	
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100	4X 1/2" PIPE (SMA) (SMA)	

DIMENSIONS:		IN INCHES	
1	1.000	1	1.000
2	1.000	1	1.000
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96	1.000	1	1.000
97	1.000	1	1.000
98	1.000	1	1.000
99	1.000	1	1.000
100	1.000	1	1.000

NAME OF THE MANUFACTURE & SYMBOL	
A/THIG	
DATE	QUANTAL AMOUNTMENT DELIVERED
DRAWN	MANUFACTURE DELIVERED
CHECKED	SCALE
APPROVED	1/15
100 AWA	



ELECTRICITY

FRONT VIEW  
TOP VIEW

FRONT VIEW  
TOP VIEW

FRONT VIEW  
TOP VIEW

- NOTE:
1. WIDTH OF TOP COVER BEAD PLATE IN 1/8" DIA.
  2. POLAR OF JAW: AN OBTUSILE SHAPE WIDTH OF IN 1/8" DIA.
  3. CHAMFERED TOP CORNER WITH RADIUS AS PER IS 4534
  4. WEAR SURFACE TO BE HARDENED TO 50-55 HRC
  5. HARDENING TO 50-55 HRC
  6. POSITION AND TOLERANCE OF FITTINGS AND ACCESSORIES MAY VARY SLIGHTLY DURING MANUFACTURING
  7. NAME OF LIGHTING APPLIANCE
  8. NAME OF PRESS BLOWER
  9. ALL WELDING OPERATIONS TO BE CARRIED OUT BY AIR PROCESS.

THIS IS AN INDUSTRY DRAWING



CORE	DESCRIPTION	G CODE	K CODE
A	LEG CENTER		
B	WINDING HEIGHT		
C	CORE DIA		
D	EFFECTIVE CORE AREA		
HY COIL	CONDUCTOR MATERIAL NO. OF HY COILS PER PHASE	EC GRADE ALUMINUM	EC GRADE ALUMINUM
E	OUTER DIAMETER WITH INSU		
F	INNER DIAMETER WITH INSU		
G	AXIAL LENGTH		
	CONDUCTOR CROSS SECTION		
	CONDUCTOR DIA		
	CONDUCTOR INSULATION	DPC	DPC
	NO. OF TURNS		
LV COIL	CONDUCTOR MATERIAL	ALUMINUM	ALUMINUM
H	OUTER DIAMETER WITH INSU		
I	INNER DIAMETER WITH INSU		
J	AXIAL LENGTH		
	EFFECTIVE CONDUCTOR CROSS SECTION		
	CONDUCTOR SIZE		
	CONDUCTOR INSULATION	DPC	DPC
	NO. OF TURNS		
INSULATION			
K	WRAP ON CORE		
L	WEDGES BETWEEN HV & LV COILS		
N	CLEARANCE BETWEEN HV & LV COILS		
H	FRAME CHAZEL INSULATION		
O	PHASE BAND		
P	END INSULATOR BLOCK	25mm	25mm
Q	CLEARANCE TO TANKWALL FROM HV COIL	30mm(1/8")	30mm(1/8")
R	CORE RING CHAZEL SIZE	20x40mm	25x50mm
S	BASE CHAZEL SIZE	25x30mm	25x50mm
T	NO. OF SPACES B/W HV AXIAL COIL	10mm(3/8")	0
U	INTER PHASE CLEARANCE	10mm	10mm
V	THICKNESS OF SPACERS	Ø12mm & 4/16	Ø12mm & 4/16
W	THE ROD SIZE & NO	Ø12mm & 4/16	Ø12mm & 4/16
X	STUD SIZE & NO	LV	RY
	RESISTANCE		
	RESISTANCE AT 2000 C (PER PHASE) X 3		

NAME OF THE MANUFACTURE & SYMBOL

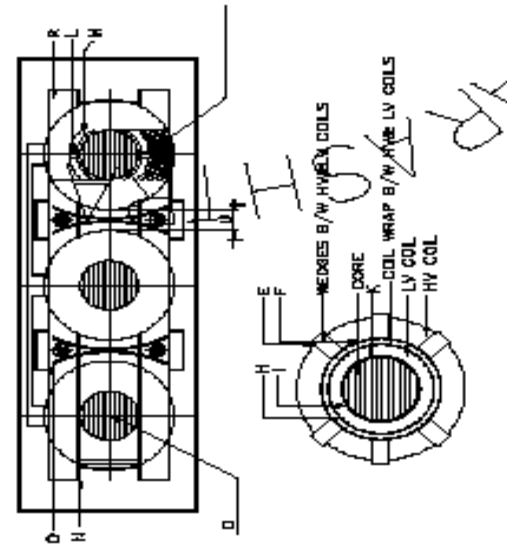
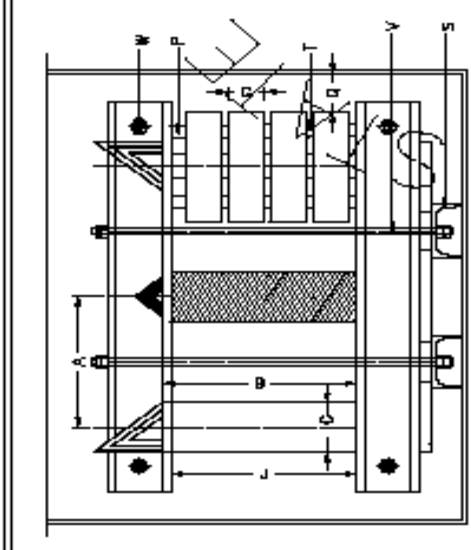
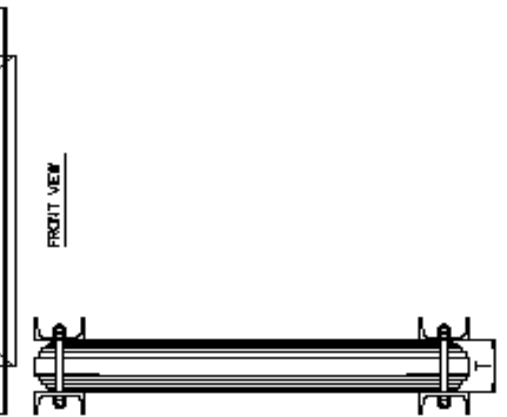
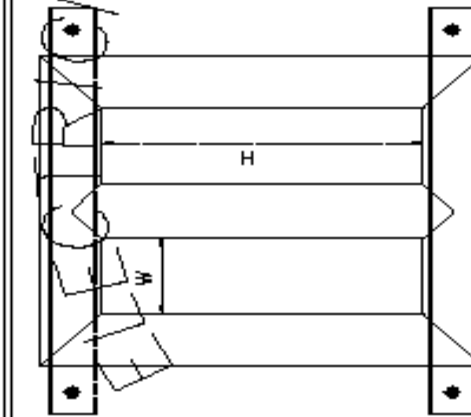
NAME OF THE CUSTOMER: NEELEC, MUMBAI-81

ART. NO.

QUANTITY:

DETAILS OF DISTRIBUTION: TMS/FORMER: - POKA/1/CLASS/COMP

INTERNAL ASSIGNMENT DRWG	SCALE	DRG. NO
100 KVA	100 KVA	NTS



NOTE:

- ALL DIMENSIONS ARE IN MM.
- DIMENSIONS & WEIGHTS ARE SUBJECT TO +10% DATE TOLERANCE EXCEPT THOSE MENTIONED AS MIN. DRPT.

KVA	PHASES	RESISTANCE	CURRENT	VOLTAGE
				(HV) (LV) (HV) (LV)
100	3	50	453	5.25 133.3

THIS IS AN INDICATIVE DRAWING

Notes:

- CORE CLAMPS ARE PARTED WITH UNDRIGH
- SPACE OF PILES B/W CORE: MAIN/RESERVE/ALONG/WESTERN PILE
- HY COIL WRAP B/W HV & LV COILS
- CONDUCTORS ARE WELDED TO THE TANK WALL
- INSULATION IS TO BE AS PER SPECIFICATION
- THE FORMATION AND HV & LV WINDING LEAD CONNECTIONS TO BE DONE AS PER SPECIFICATION
- RODS SHALL BE WELDED TO THE TANK WALLS AND COILS (WHERE EVER IT IS APPLICABLE)







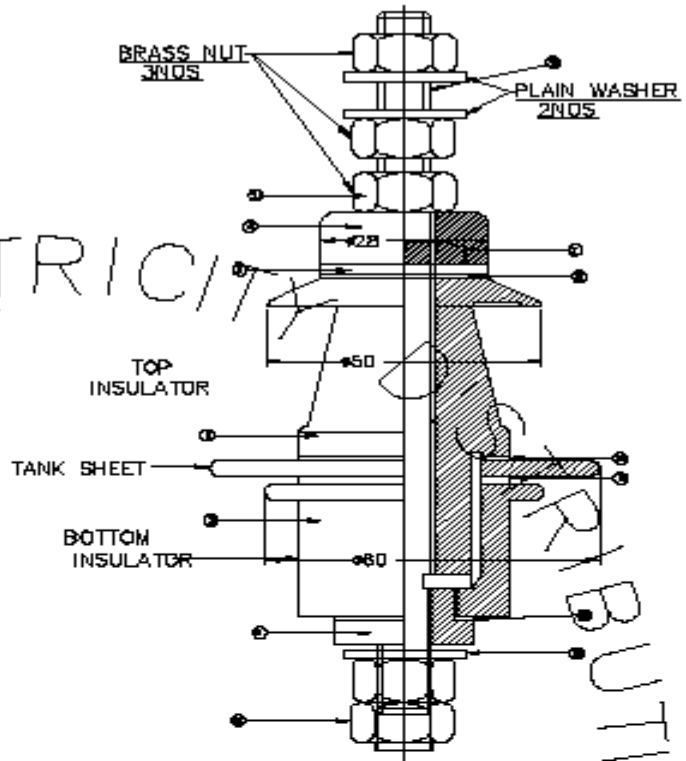
## TRANSFORMER BUSHING AS PER IS:3347

**ELECTRICAL CHARACTERISTICS:**

1. RATED VOLTAGE : 1 KV
2. RATED CURRENT : 250 Amp
3. POWER FREQUENCY WITHSTAND VOLTAGE : 3 KV
4. CREEPAGE DISTANCE : 25 MM. (MIN.)

**NOTE:**

PERFORMANCE REQUIREMENTS OF THE BUSHING SHALL CONFIRM TO IS: 3347



MAKE: / /

SER. No.	DESCRIPTION	QTY
1	INSULATOR UPPER	1
2	INSULATOR LOWER	1
3	BRASS NUT	1
4	TOP END WASHER	1
5	STEM WASHER	1
6	BOTTOM NUT	1
7	SEALING WASHER (TYPE M)	1
8	SEALING WASHER (TYPE M)	1
9	SEALING WASHER (TYPE M)	1
10	SEALING WASHER (TYPE M)	1
11	SEALING WASHER (TYPE M)	1
12	SEALING WASHER (TYPE M)	1
13	SEALING WASHER (TYPE M)	1
14	SEALING WASHER (TYPE M)	1

NAME OF THE CUSTOMER: MSEDCL, MUMBAI-51  
 A.T. NO. \_\_\_\_\_  
 QUANTITY: \_\_\_\_\_  
 DETAILS OF DISTRIBUTION TRANSFORMER: 100KVA, 11/0.433KV, CSP

NAME OF THE MANUFACTURE & SYMBOL	
A/T. NO. _____	
Note _____	
LV BUSHING ASSEMBLY DRAWING 100KVA, 11/0.433KV, 2500, CSP DIST. TRANSFORMER	
CHD _____	DRG. NO _____
APPD _____	_____

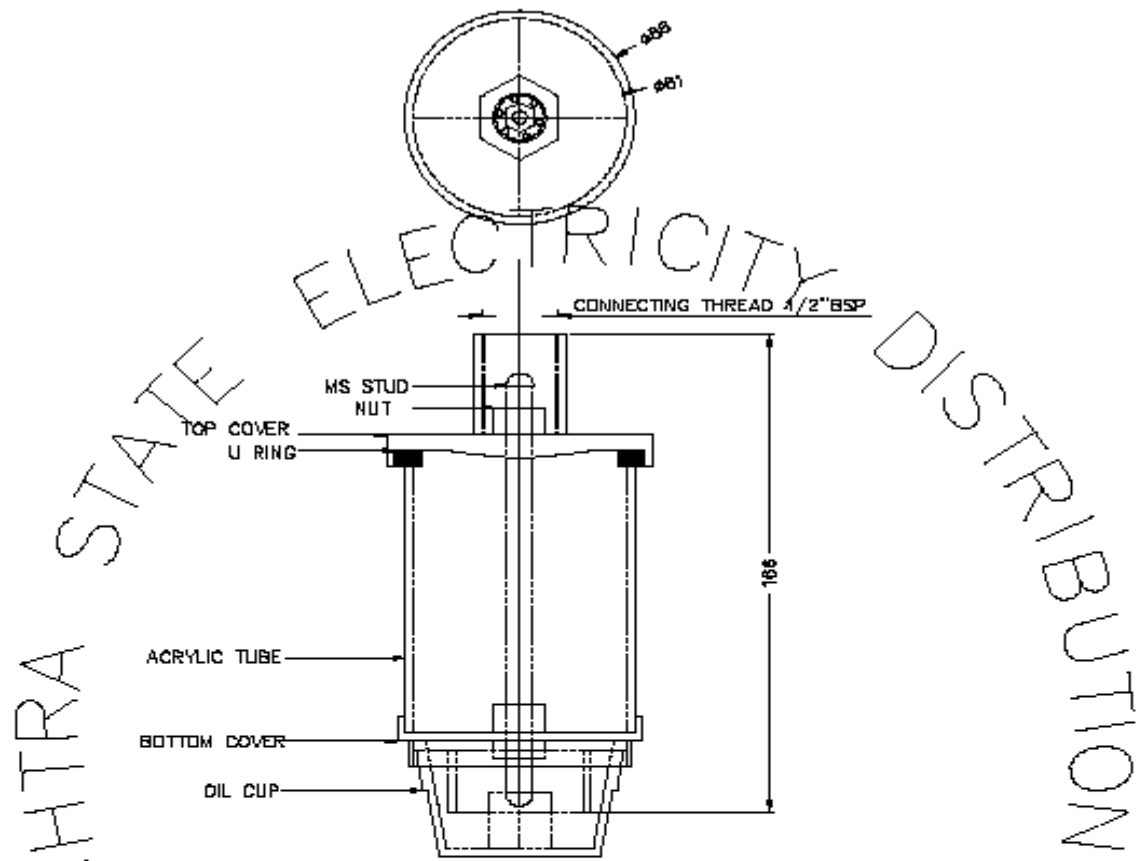
**THIS IS AN INDICATIVE DRAWING**

SHRUTI STATE ELECTRICITY DISTRIBUTION CO.

MUMBAI



# SILICAGEL BREATHER



**MAKE :**

**SPECIFICATION:**

PART NAME	MATERIAL USED
TOP COVER	NYLON
BOTTOM COVER	NYLON
OIL CUP	ACRYLIC

NAME OF THE CUSTOMER: MSEDCL MUMBAI-51  
 A/T. NO.  
 QUANTITY  
 DETAILS OF DISTRIBUTION TRANSFORMER: -- KVA, 11/0.433KV, DSP

NAME OF THE MANUFACTURE & SYMBOL

A/T.NO:

Make:

SILICA GEL BREATHER, 250gms

**THIS IS AN INDICATIVE DRAWING**

CHD  
APPD

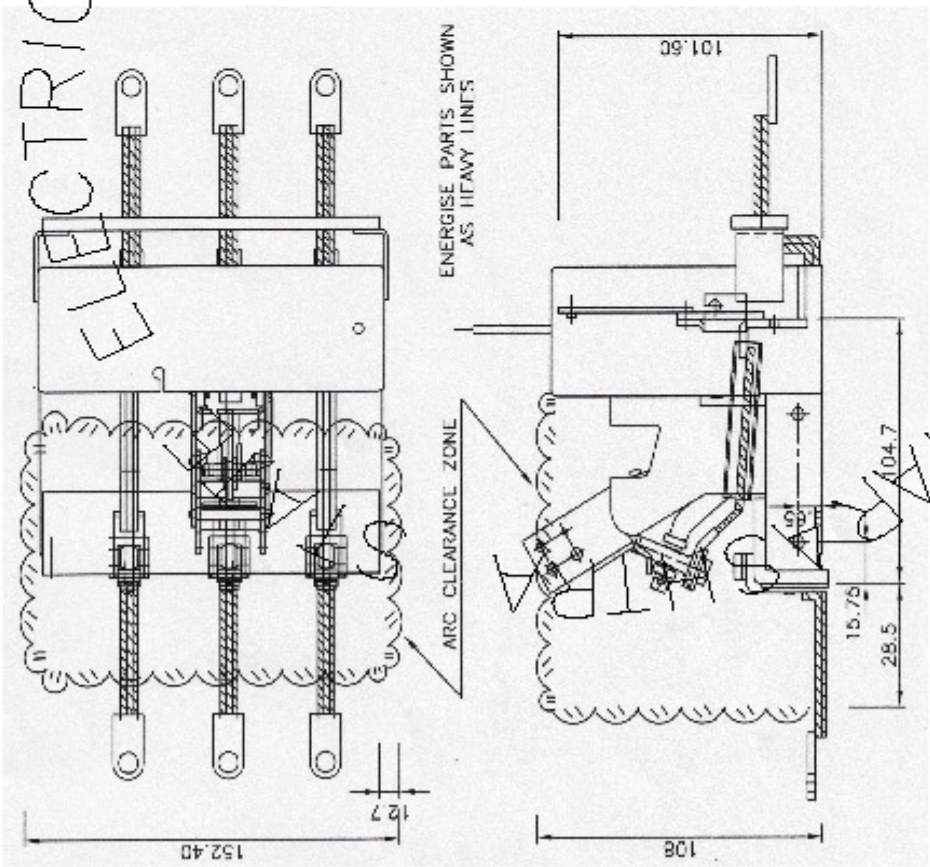
DRG.NO

# ELECTRICITY DISTRIBUTION

THIS IS AN INDICATIVE DRAWING

NAME OF THE CUSTOMER: MSEDCL, MUMBAI-51  
 A/T. NO.:  
 QUANTITY:  
 DETAILS OF DISTRIBUTION TRANSFORMER:--KVA,11/0.433KV,CSP

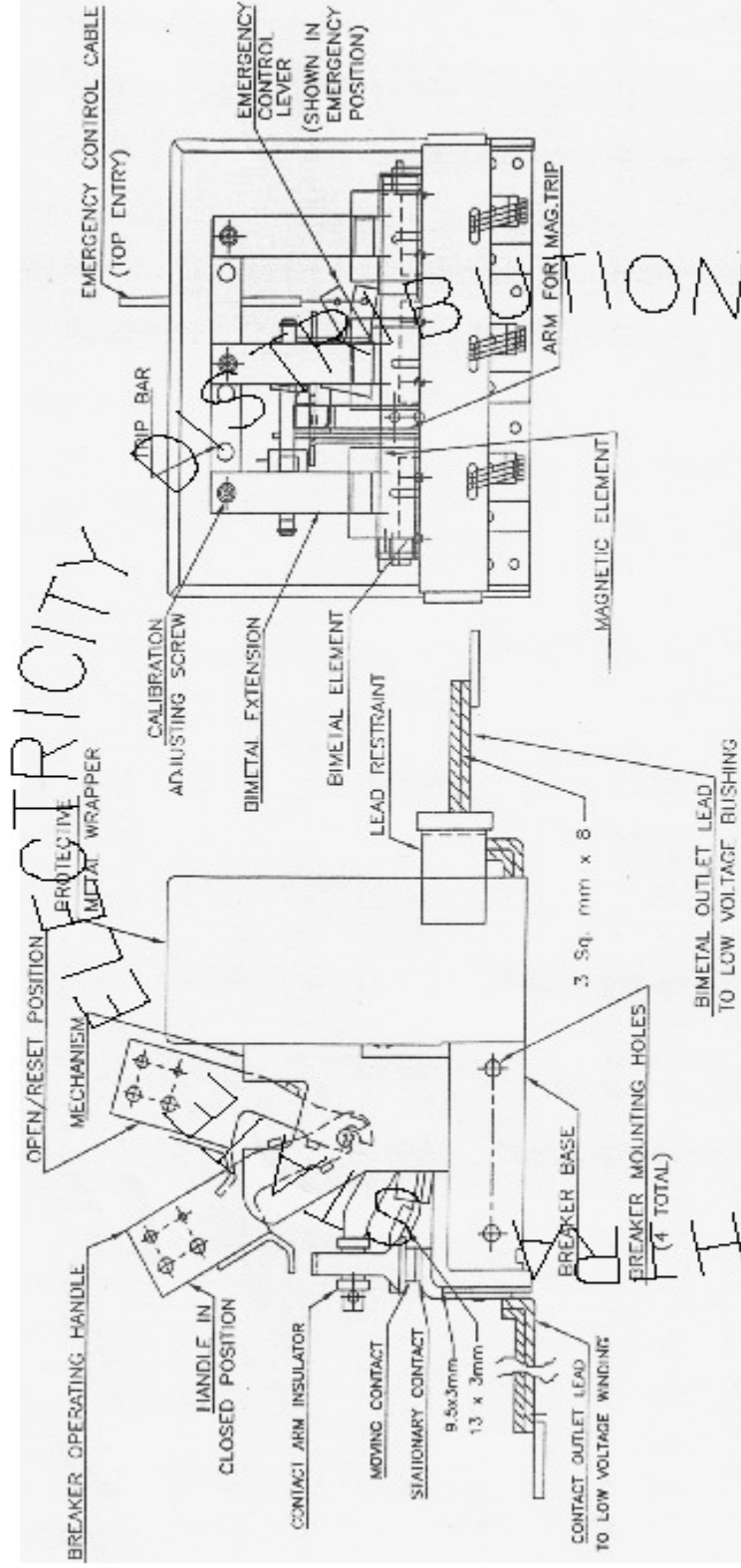
NAME OF THE MANUFACTURE & SYMBOL	
P.L. NO.:	
SARABHARA ELECTRICALS LTD. HYDRABAD, KURUPALLY, HYDRABAD, A.P.	
CQR BREAKER 3PHASE, 3POLE MAJOR PART IDENTIFICATION	
CHD	DRG.No.SEL-CQR-EL-005a
APPD	



Note: ALL DIMENSIONS ARE IN MM  
 CAPACITY: 480V, 1000Amp

MATHAN





THIS IS AN INDICATIVE DRAWING

NAME OF THE CUSTOMER: MSEDCL, MUMBAI - 51

A/T. NO.

QUANTITY:

DETAILS OF DISTRIBUTION TRANSFORMER: --KVA, 11/0.433KV, CSP

NAME OF THE MANUFACTURE & SYMBOL

A/T. NO.

CHD APPD

DRG. No. SEL - CCR - MI - 009

DRG. No. SEL - CCR - MI - 009

DRG. No. SEL - CCR - MI - 009

DRG. No. SEL - CCR - MI - 009

CAPACITY: 460V, 185Amp

MUMBAI.

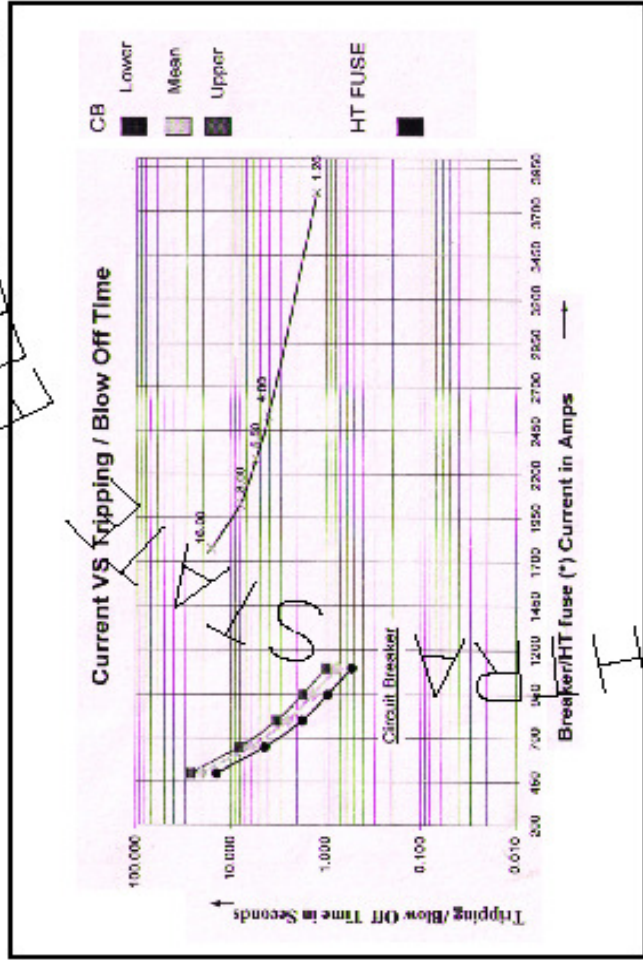
IS HAPS

STANDARD PROTECTION CO-ORDINATION GRAPH

100KVA 3-PHASE 3-POLE (11KV Class)

3 MR 551

ELECTRICITY



LOWER	UPPER		MEAN	
	Current Amps	Time Sec	Current Amps	Time Sec
500	500	26.00	500	20.0
650	650	8.060	650	6.20
800	800	3.250	800	2.50
950	950	1.750	950	1.350
1100	1100	0.875	1100	0.750

HT FUSE TYPE-7A

Current Amps	Time Sec
1778	18.0
2032	8.0
2286	5.50
2540	4.0
2800	1.28

Transformation Ratio: 25.4

THIS IS AN INDICATIVE DRAWING

NAME OF THE CUSTOMER: MSEDCL, MUMBAI-51

A/T. NO.

QUANTITY:

DETAILS OF DISTRIBUTION TRANSFORMER: ---KVA, 11/0.433KV, CSP

NAME OF THE MANUFACTURE & SYMBOL

A/T. NO. **100KVA/3PH/3P/3W/11KV/0.433KV**

HTA: SHANTHINATH ELECTRICALS LTD.  
HYDRABAD, KARNATAKA, HYDRABAD, A.P.

STANDARD PROTECTION CO-ORDINATION GRAPH

CHD

APPD

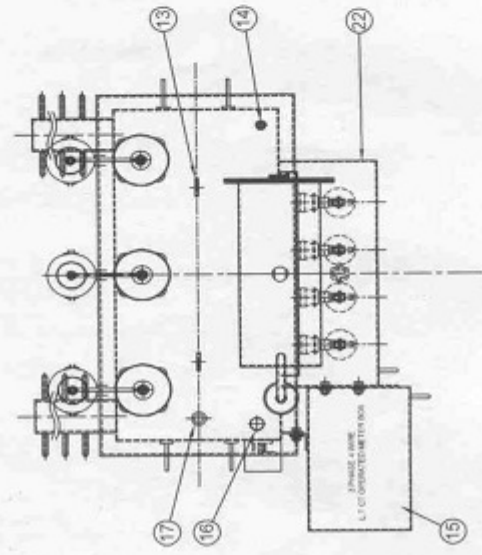
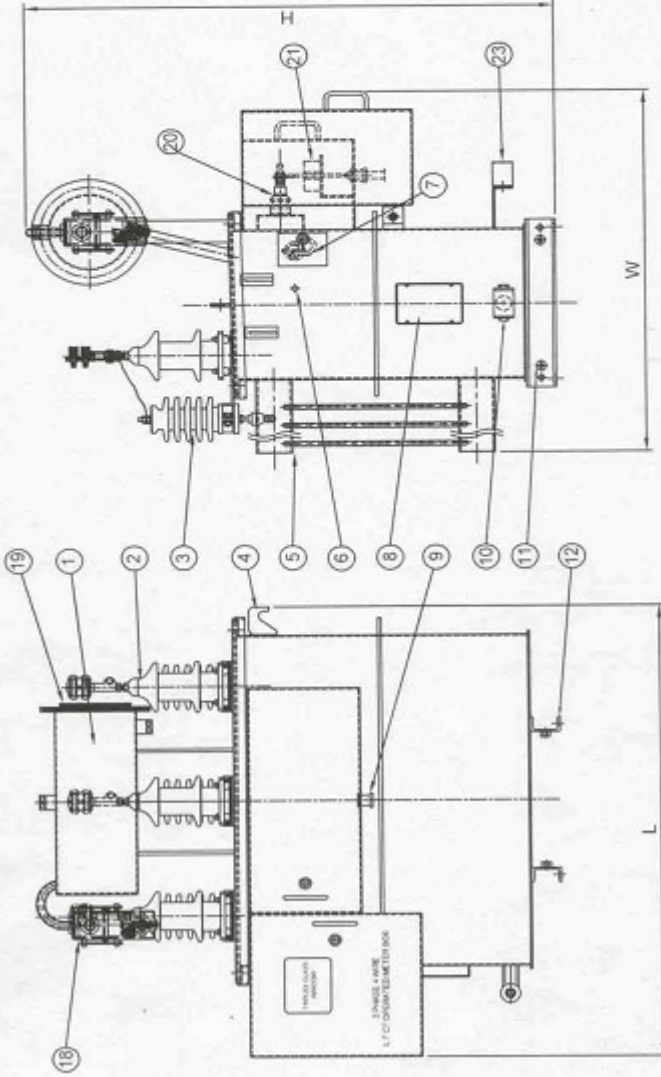
DRG. NO 03

Note: HT Current referred to LT Side

HT Current	10	20	30	40	50	60	70	80	90	100
LT Current	254	508	762	1016	1270	1524	1778	2032	2286	2540

MUMBAI

ANNEXURE - V



23	CABLE HOLDING CLAMP	1
22	C.T. MOUNTING BOX	1
21	CURRENT TRANSFORMER	3
20	L.V. BUSHING (1.5/0.250A)	4
19	OIL LEVEL GAUGE	1
18	ALUMINIUM CAST SILICONE BREAKER	1
17	PRESSURE RELIEF DEVICE	1
16	AIR RELEASE PLUG	1
15	3 PHASE L.T. CT OPERATED METER BOX	1
14	THERMOMETER POCKET WITH CAP	1
13	TOP COVER LIFTING LUGS	2
12	BOTTOM CHANNEL WITH PULLING EYE	2
11	EARTHING TERMINAL	1
10	DRAIN GUM SAMPLING VALVE	1
9	CABLE GLAND FOR 25 CORE CABLE	1
8	RATING AND TERMINAL MARKING PLATE	1
7	CIRCUIT BREAKER OPERATING HANDLE WITH PROTECTION COVER & LOCK	1
6	INDICATION LAMP FOR OVER LOAD	1
5	RADIATOR	2
4	LIFTING LUGS	4
3	LIGHTNING ARRESTER (BWS 6A)	3
2	L.V. BUSHING WITH BRASS METALLIC CONNECTOR (1.5/0.250A)	3
1	CONDENSATOR WITH OIL FILLING PLUG & DRAIN PLUG	1
NO.	DESCRIPTION	QTY

MAHARASHTRA STATE ELECTRICITY  
DISTRIBUTION COMPANY LTD.

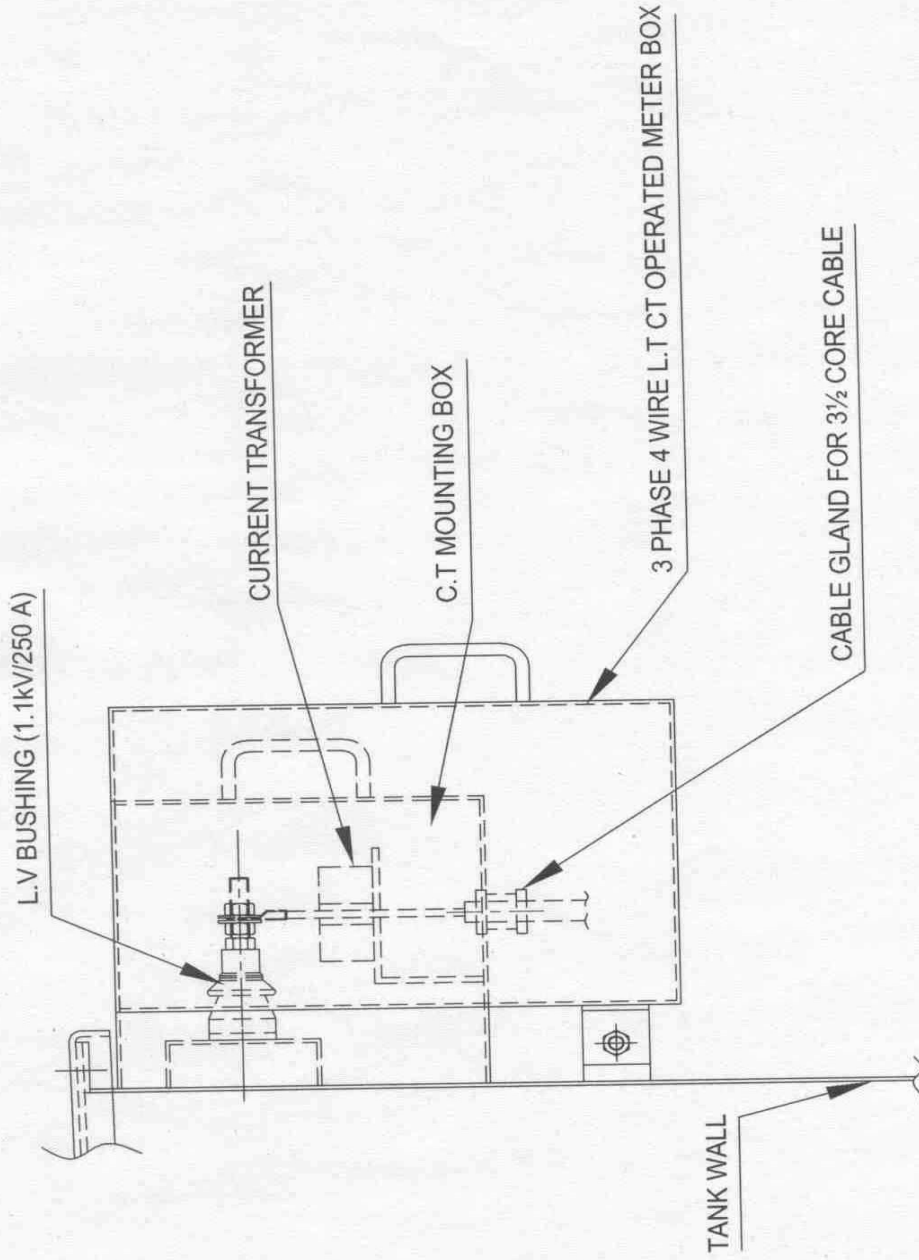
LOA NO SP/7-

TITLE : OUTLINE GENERAL ARRANGEMENT  
FOR 63 & 100KVA DISTRIBUTION TRANSFORMER  
DRAWING No. : MSEDCL/MM II / 63-100 DT/01

SCALE	NTS	DRAWN	CHECKED	RECOMMENDED	APVD
		<i>[Signature]</i>	<i>[Signature]</i>	10/9	<i>[Signature]</i>
		10.9.07			

THIS IS AN INDICATIVE DRAWING

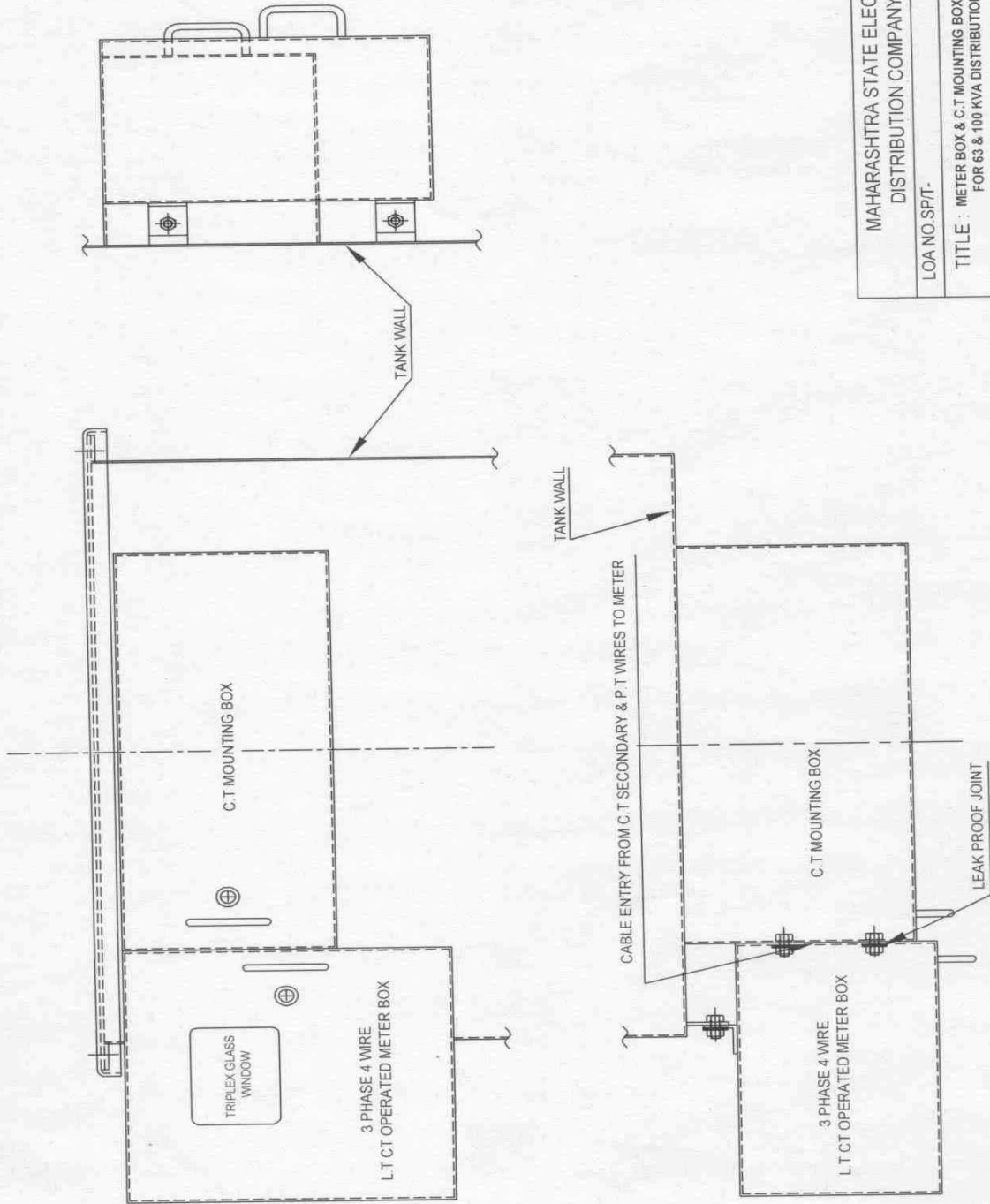
ANNEXURE - V



MAHARASHTRA STATE ELECTRICITY DISTRIBUTION COMPANY LTD.			
LOA NO.SPT-			
TITLE : METER BOX & C.T MOUNTING BOX ARRANGEMENT FOR 63 & 100 KVA DISTRIBUTION TRANSFORMER			
DRAWING No : MSEDCL/MM II /63-100 DT/02			
SCALE : NTS	DRAWN	CHECKED	RECOMMENDED
	10.9.07	10.9	
			APVD

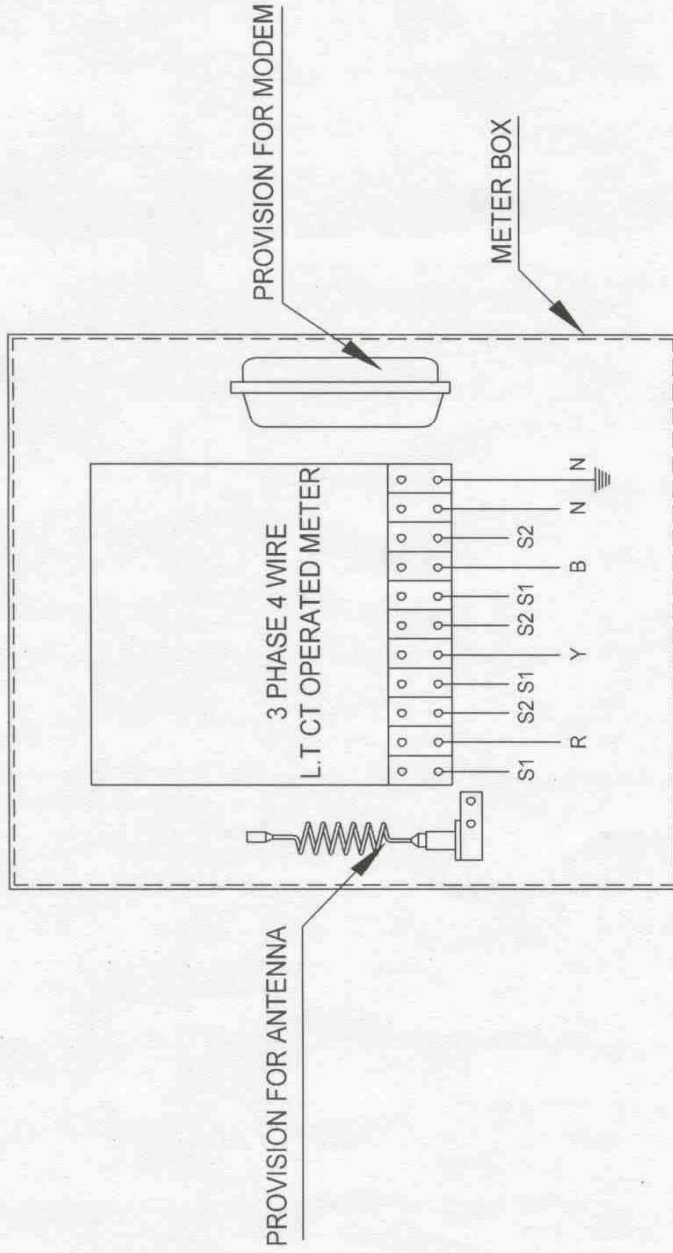
THIS IS AN INDICATIVE DRAWING

**ANNEXURE- V**



MAHARASHTRA STATE ELECTRICITY DISTRIBUTION COMPANY LTD.			
LOA NO.SP/IT-			
TITLE : METER BOX & C.T MOUNTING BOX ARRANGEMENT FOR 63 & 100 KVA DISTRIBUTION TRANSFORMER			
DRAWING No. : MSEDCL/IMM II / 63-100 DT/03			
SCALE	NTS	DRAWN	APVD
		10-9-07	10-9-07

THIS IS AN INDICATIVE DRAWING



MAHARASHTRA STATE ELECTRICITY  
DISTRIBUTION COMPANY LTD.

LOA NO SP/T.

TITLE : METER BOX WITH METER FOR 63 & 100  
KVA DISTRIBUTION TRANSFORMER

DRAWING No : MSEDCL/IMM II / 63-100 DT/04

DRAWN	CHECKED	RECOMMENDED	APVD
<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
SCALE : NTS	10/9		
	10.9.07		

THIS IS AN INDICATIVE DRAWING