RELIABILITY AND EFFICIENCY OF DTRs

A Presentation By

A.K. Khatri
CGM (BR), MPMKVVCL,
BHOPAL (M.P)

INTRODUCTION

- India's manufacturing sector, heavy industries, various global service centers, agriculture production and household usage are all dependent on reliable power supply. This makes it utmost important that 'Transformers', the heart of power system, must function reliably. Failures of critical transformer-assets not only impact industries but other consumer categories also, It affects the economy of the country and have social and political ramifications.

- A transformer is a vital equipment that connects the Generation to various types of loads. The right kind of design, manufacture, test, operation and protection increase normal life of transformer.

- All power utilities are much worried these days due to high rate of failure of distribution transformers and services. The failure rate of transformers in India is in the order of 12 to15% as against less than 1% in developed countries.

- By knowing the causes of failure, we can take steps to overcome it and thus reduce the fault occurrence in transformers and make the power supply more reliable. In Central DISCOM we have reduced DTR failure rate substantially by adopting standard practices for installation and regular maintenance.

DTR Failure Statics in Central Discom Bhopal

Bhopal Region				Gwalior Region			Central Discom		
Period	Total No. of DTR	No. of DTR Failed	% Failure	Total No. of DTR	No. of DTR Failed	% Failure	Total No. of DTR	No. of DTR Failed	% Failure
FY 2009-10	41373	6736	16.28%	43528	4899	11.25%	84901	11635	13.70%
FY 2010-11	44397	7011	15.79%	50114	4988	9.95%	94511	11999	12.70%
FY 2011-12	49432	7044	14.25%	57053	4588	8.04%	106485	11632	10.92%
FY 2012-13	63189	7740	12.25%	67355	5049	7.50%	130544	12789	9.80%
FY(2013-14)	76667	8978	11.71%	71734	7002	9.76%	148401	15980	10.77%
FY(2014-15)	82632	8455	10.23%	84158	5350	6.36%	166790	13805	8.28%
FY (2015-16)	98893	10806	10.93%	93552	5937	6.35%	192445	16743	8.70%
FY(2016-17) UPTO JAN	104738	10919	10.42%	94687	4699	4.96%	199425	15618	7.83%

DTR Failure Statics in Central Discom Bhopal

- It is evident from the statics of failure of DTR that Central Discom has reduced its failure rate from 13.7 % in year 2009-10 to 7.83% in the year 2016-17.
- The failure rate in India is 12-15%.
- Though we have reduced DTR failure rate as compared to failure rate in India the Central Discom is still committed to reduced it down further as in the developed countries around 1%.

REASONS CAUSING DTR FAILURES

Failure causes at manufactures end

- Faulty design
- Poor quality of material
- Bad workmanship
- Improper transportation
- Sharp edges of conductor
- Incomplete drying
- Bad insulation covering on conductor
- Improper joints or connection

REASONS OF DTR FAILURE

Failure during working condition

- Deterioration of oil
- Faults in magnetic circuit
- Inadequate pre shrinkage of the winding
- Inter turn faults

REASONS OF DTR FAILURE

Failure attributed by users

- Prolonged over loading
- Single phase loading
- Un-balanced loading
- Faulty terminations
- Power theft by hooking
- Faulty earth connection to tank body as well as LV terminal
- Failures due to external short-circuit
- Less maintenance
- Improper installation

OBSEVATIONS BY DISCOM

- To reduce the failure rate to 1% as in the developed countries, not only the Discom but manufacturers also need to be precise and committed to produce good quality material as per standards
- Discom is already trying hard to reduce the failure rate for the reasons attributed to the utility, however it can not be achieved without support of manufacturers.
- It is right forum to discuss the reasons of failure attributed to manufacturer side.
- Few of the cases as regard to the failure of DTR due to the reasons attributed to manufacturer side are following

Case study- Inter turn fault

- 63 KVA, 11kV/440 V
- **Cause of failure**
- Failure of transformer took place due to shorting of few turns of winding of the same phase. This was due to bad wrapping of paper insulation which results into inter turn fault.

Fig. Inter turn faults...

Case study: (Fault in magnetic circuit)

- Rating: 11kV/440V, 25 KVA
- **Cause of failure**
- Insulation between lamination got damaged (due to poor quality lamination), which resulted into local overheating and due to which many laminations got short circuited. Thus, winding temperature got increases and its insulation failed.

Fig.: Core insulation failure

Case study- Inadequate pre shrinkage of the winding

- Rating:11KV/440V,63 KVA
- **Cause of failure**
- As shown in the figure (below), due to shrinkage of paper blocks, the coil got loose. During external short circuit fault, failure of the transformer occurred due to movement of discs.

Fig. Failure due to paper block shrinkage

Case study-
Improper joints or connections

- The local heating generated by improper joints or connections may slowly lead to a deterioration of the oil if the joints are oil immersed.

Fig. : Improper joint

OIL LEKAGE DUE TO BAD QUALITY OF GASKET, POOR QUALITY RADIATOR AND IMPROPER MANUFACTURING OF TANK

- If the oil leaks from the transformer tank due to some reason, the oil level in the tank will drop. In the worst case, the connections to bushings and parts of the winding will get exposed to air. This will increase the temperature of the windings. This in turn, would damage the insulation of the winding. Apart from this moisture can get in through the leak, and degrade the transformer oil – leading to an overheated transformer.
- Oil leaks can occur from many parts of transformer tank : Radiator fins, Bad welds, Cracked voltage bushings, Gaskets, Butterfly valves.

Adoption of BIS specification by MPCZ

- As a further step to reduce the failure of DTR's central Discom has also adopted BIS specification in guideline of GOI since Feb-16.
- By adopting BIS specifications the Discom will not only reduce the DTR failure rate but will also save lot of energy as compare to the conventional transformer.
- By using BIS specification transformer a full loaded 100KVA and 63 KVA transformer will reduce loss load of 220 & 165 watt respectively on it which in turn will save energy of about 1927 & 1445 units respectively in a year.
- There are around 2 lac. transformer in central Discom of different capacity.

MAXIMUM TOTAL LOSSES & IMPEDANCE VALUES UPTO 11 KV CLASS TRANSFORMERS (BIS)

S.No.	Rating (KVA)	Impedance (%)	Max. Total Loss (W)					
			Energy Efficiency Level 1		Energy Efficiency Level 2		Energy Efficiency Level 3	
			50 % Load	100 % Load	50 % Load	100 % Load	50 % Load	100 % Load
i	16	4.5	150	480	135	440	120	400
ii	25	4.5	210	695	190	635	175	595
iii	63	4.5	380	1250	340	1140	300	1050
iv	100	4.5	520	1800	475	1650	435	1500
v	160	4.5	770	2200	670	1950	570	1700
vi	200	4.5	890	2700	780	2300	670	2100

MAXIMUM LOSSES & IMPEDANCE VALUES UPTO 11 KV CLASS TRANSFORMERS (CONVENTIONAL)

S. no.	Rating in KVA	No load loss (W)	Load loss at 75 C (W)	Total at Full Load	Impedance (%)
1	16	90	325	415	4.0
2	25	110	400	510	4.0
3	63	180	1235	1415	4.5
4	100	260	1760	2020	4.5
5	200	500	3000	3500	5.0
6	315	580	4200	4780	5.0

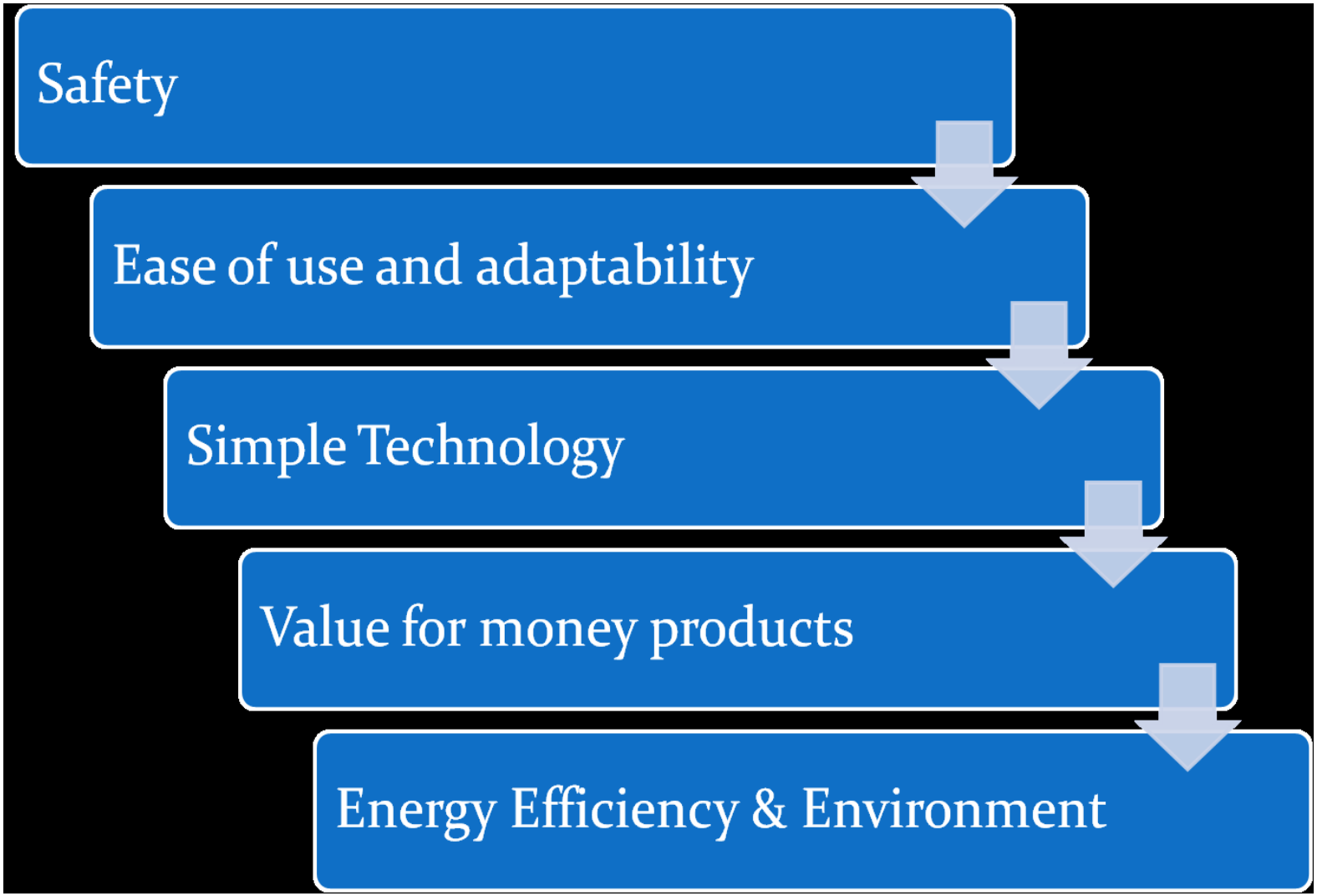
Bureau of Indian Standards

- The Bureau of Indian Standards was established on 1 April 1987 under BIS Act, 1986 as a statutory body.
- The National Standards Body of India
- Bureau of Indian Standards (BIS) took over work of Indian Standards Institution (ISI) through enactment of BIS Act (1986) by the Indian Parliament
- ISI was set up in 1947 as a registered society, under a Government of India resolution.

BIS OBJECTIVES

- □ Harmonious development of
- –Standards
- –Marking
- –Quality Certification
- □ Provide new thrust to
- –Standardization
- –Quality Control
- □ To evolve a National Strategy for according recognition to standards and integrating them with growth and development of production and exports

BIS Standards are developed with following in mind



Standard Materials

- **Major material used in the transformer shall conform to the following Indian Standards:**

- Cold Rolled Grain Oriented electrical steel – IS 3024
- Amorphous core material – (IS under preparation)
- Copper/Aluminum conductor – IS 191, IS 1897,IS 7404,IS 12444,IS 13730/IS 6162 series as given in Annex A.
- Kraft paper –IS 9335 series as given in Annex A.
- Press Board – IS 1576
- Mineral oil – IS 335 (Note: use of other insulating liquids namely natural ester, synthetic organic ester -IS 16081 subject to agreement between User and Supplier)

TESTS

- • Routine Tests (to be conducted on all units)
- The following shall constitute the routine tests:
- • Measurement of winding resistance (IS 2026 Part 1)
- • Measurement of voltage ratio and check of phase displacement
- (IS 2026 Part 1)
- • Measurement of short-circuit impedance (principal tapping, when applicable) and load loss at 50% and 100% load (IS 2026 Part 1)
- • Measurement of no-load loss and current (IS 2026 Part1)
- • Measurement of insulation resistance (IS 2026 Part 1)
- • Induced over-voltage withstand test (IS 2026 Part 3)
- • Separate-source voltage withstand test (IS 2026 Part 3)
- • Pressure test } Additional Tests
- • Oil leakage test }

Contd….

- **•Type Tests: to be conducted on one unit**
- •The following shall constitute the type tests:
- •Lightning impulse test (IS 2026: Part 3)
- •Temperature-rise test (IS 2026: Part 2)
- •NOTE - **Maximum measured total loss (No load at rated excitation + load loss at maximum current tap converted to 75 °C reference temperature) at 100 percent loading shall be supplied during temperature rise test.**
- • Short-circuit withstand test (IS 2026 :Part 5) (up to 200 kVA)
- NOTE - **Routine tests before and after short circuit test shall be conducted as per IS 2026 (Part 1)**
- • Pressure test (see 21.5)

Contd..

- •Special Tests: (to be conducted on one unit)
- The following shall constitute the special tests which shall be carried out by mutual agreement between the User and Supplier.
- a) Determination of sound levels (IS 2026: Part 10)
- b) Short-circuit withstand test (IS 2026: Part 5)(above200 kVA)
- NOTE - Routine tests before and after short circuit test shall be conducted as per IS 2026 (Part 1)
- c) No load current at 112.5% voltage (see 5.9.3)
- d) Paint adhesion test
- The test is performed as per ASTM D3359 (Standard Test Methods for measuring adhesion by Tape test).
- e) BDV and Moisture content of oil in the transformer (IS 335)
- NOTE Tests at d) and e) may be carried out on more than one unit subject to agreement between user and supplier

DIFFERENCE IN QUALITY OF TYPE TEST SAMPLE DTR AND SUPPLIED DTRs

- Few of the DTRs are getting failed in first charging or very shortly after first charging without any cognizable reason.
- A DTR having passed all the necessary tests during type testing/routine testing when similar material is supplied and used in the field are getting failed after first charging clearly develop a doubt in mind that supplied material is not at par as was the type test sample.
- Quality of DTR is a very important factor for failure. It is observed that many times there are difference in quality of testing sample and supplied material. A transparent mechanism should be developed so that there is no deviation in quality of supplied material from testing sample.

SCARCITY OF TEST HOUSES

- To ensure the quality of various electrical equipments including Transformer type/routine testing is inevitable.
- To ensure the quality of the equipment Central Discom is investing huge amount of money towards type/routine test of the material being procured.
- Due to scarcity of the test houses there is always a long queue in CPRI (The only test house in MP) for electrical equipments testing.
- Even after the testing is completed in CPRI, there is abnormal delay in getting the reports resulting delay in utilization of the material after its supply.
- Review regarding enhancing test house capacity as well as quick delivery of final report is expected from CPRI.

Thank You