MAHAVITARAN
Maharashtra State Electricity Distribution Co Ltd

(A Govt. of Maharashtra Undertaking)

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CIRCULAR NO-11

Subject: Failure of Power Transformers and need to follow maintenance schedule thereof.

There are more than 6000 power transformers of 3MVA, 3.15MVA, 5MVA and 10MVA capacity in MSEDCL distribution network. They are situated in the 33/22/11 KV substations and are adequately protected by protection switchgear systems.

Electrical faults are developed on the supply lines / feeders occasionally due to various reasons such as snapping of line conductor, falling of tree branches on line etc which cause phase to earth, phase to phase and over-current faults. During fault condition, heavy fault current flows in the system till the time the fault is isolated by protection systems. This fault current also flows through the power transformer windings weakening its insulation. Similarly, lightening stokes (voltage surges) during stormy weather also flow through the power system affecting the electrical equipments and the insulation of transformer windings. These two types of electrical faults predominantly affect the health of transformer insulation.

Oil is used in the transformer tank for cooling as well as for providing electrical insulation between the windings. Due to higher ambient temperature and humidity in the atmosphere, the oil quality gets deteriorated causing increase in moisture content, breakdown and internal flashover / faults. The transformer oil occupies all space inside the power transformer tank and hence oil quality & characteristics have significant effect on the overall health of transformer.

In view of the foregoing discussion, various causes and their effects on power transformer could be summarized as below:-

Sr. No.	Cause	Effect on transformer
1	Heavy Fault, Higher Fault Current	Mechanical jerk and deformation of cores / windings.
2	Lightening Surges, switching Surges, Voltage surges	Insulation failure, insulation weakening at one location could get deteriorated further causing internal flash-over / fault
3	High Oil temperature	Insulation strength of oil decreases, Can break down if hot-spot /internal arcing is developed
4	High Moisture content	Damages inside oil & paper insulation, Just 1% Moisture can reduce insulation resistance by 90%.
5	Loose connections	Could give rise to higher contact resistance, I^2R loss, heating, delayed isolation of fault if ground terminal is loosely connected.

Therefore, the major parameters to be observed regarding transformer are Loading in MVA, Voltage (Primary & Secondary), Current (Primary & Secondary), PF, Oil Temperature and Winding Temperature.

The power transformer in the substation is the most costly equipment in the power system and hence needs to be protected well at all times from all possible faults. Apart from the cost, failure of power transformer it cause major supply interruptions to consumers causing huge revenue loss MSEDCL. Therefore, it is imperative to continuously monitor the health of the power transformer, carry out proper

maintenance of the transformer components & its protection system and endeavour to reduce the faults on the power system.

The following monitoring and preventive maintenance schedule is recommended for ensuring the good health of the power transformers.

Sr.No	Activity	Operation	Frequency	Responsibility
1	**Monitor**	Ambient Temperature, Oil & Winding Temperature, Load Current & Voltage	Hourly/ Weekly	Operator/ S/stn-Incharge
2	**Monitor**	Oil level in Transformer tank, Oil level in OLTC, conservator tank Check Oil level gauge / window, If low, top up, attend the leakage if any Explosion Vent diaphragm--Replace if broken/cracked	Daily/ Weekly	Operator/ S/stn-Incharge
3	**For the oil**			
3A	Breather checks	Check colour of the silica gel- : **Blue** If found pink, Replace it with new or dehydrate it, till it turns blue	Weekly/ Monthly	Operator/ S/stn-Incharge
		Check the oil cup has oil/water- If water content is more, replace it by oil	Monthly/ HY	Operator/ S/stn-Incharge
		Check if breather breaths during oil temperature rise- Bubbles appear in oil	Half-Yearly/ Yearly	Operator/ S/stn-Incharge
3B	Oil sample testing	Check BDV for oil in main tank/OLTC. If BDV is found low, Filtration of oil is recommended.	HY	S.D.O.
		Check DGA of oil	Yearly	S.D.O.
3C	Oil leakages and circulation	Check oil leakages through radiator joints, Top cover gaskets, and bushing gaskets; If leakages are observed-Replace gaskets and stop leakages.	Monthly	Operator/ SDO
		Check all radiators are working- check radiator temp with ordinary Infra-red (CORONA) thermometer- If different temperatures are seen for various fins, take cognizance and analyse and resolve the issue	Yearly	SDO
		Check free oil circulation between conservator and main tank- with oil draining	HY	SDO
		Check oil in Bushing by releasing it thru Bushing oil nut	HY	SDO
		Check PRV switch operation	HY	SDO
4	**Electrical connection checking**			
4A	Check Main HV/LV connections	Check temperature of contacts on load by non contact type IR thermo-meter for hotspot on bushing- If GT 75 deg. Redo the connections.	Monthly	S.D.O.
		Check neutral and earth connection;	HY	S.D.O.
		Check earth pit resistance. It shall be < 1 Ohm Take suitable action if it is more	Yearly	AEE(M).

4B	Check auxiliary Electrical connections	Check all auxiliary electrical connections for the proper operation of relays and annunciation- If wrong/ non-operative call testing batch to rectify	Yearly	AEE(M)
		Check operation of OLTC/RTCC and its alarms, All shall be operational	HY	AEE(M)
5	**Checking of the protection system and complete tests on transformer**			
	Checking of the protection system	Check the Remote & Local Operation of HV & LV Circuit breaker manually & through protective relay with proper indications during shutdown & Call testing team if any problem.	Yearly	Substation In-charge /AEE(M)
		Do not bypass T/F protection; replace failed protection equipments on priority.	--	E.E.(O&M)/S.E. (O&M)
		Test the Over current + Earth fault relay settings and its operation, Check differential protection operation by stability test	Yearly	E.E.(Testing)
		Check Auxiliary protection of transformer- All aux relay and master trip shall operate on the trial	Yearly	E.E.(Testing)
		Check operation of OSR and OLTC operation /protection	Yearly	E.E.(Testing)
6	**Painting**	Check for rusting / colour Touch up to be done	Yearly	S.D.O./ AEE (M)
7	**OLTC Maintenance**	After 50000 Operations, Check the arcing contacts, lubricating oil in gear box Replace if necessary	--	S.D.O./ AEE (M)
8	**Transformer Overhauling**	Check the oil and paper insulation visually, if found degraded re-insulation is recommended. Overhauling of transformer shall be carried out.	After 7 years	EE(Testing) / SE(O&M)

If the transformer is in the substation which is supplying power to sensitive area having Major Hospitals, Important Government Offices etc, frequency of maintenance should be increased.

The above maintenance is recommended for the transformers in general. In addition to the above, the maintenance schedule for associated substations equipments shall be followed scrupulously.

This circular shall come in force with effect from the date of issuance. This circular is available on MSEDCL website i.e. www.mahadiscom.in . So hard copy of the same shall not be issued.

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