

Monitoring and Analysis of Distribution Transformer

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Abstract—Transformer is a key element in electrical power system. The main purpose of this project is to gather information about distribution transformer. Monitoring of Transformer on the basis of their increase in voltage and current and their effects on temperature of Transformer oil and cables of the distribution transformer. This project also includes analysis of different faults which are responsible for failure of Transformer, failures of Transformers such as insulation failure, winding failure, bushing failure and core failure. Monitoring and analysis of distribution transformer are necessary and advantageous as it plays very important role in distribution system.

Keywords— Bushing, Core, Distribution transformer, Insulation, Winding

I. INTRODUCTION

A distribution transformer is a static device that transfers power from one circuit to another circuit without changing its frequency and keeping power constant on both side. Monitoring is important because: it provides the only consolidated source of information showcasing project progress. Monitoring is the regular observation and recording of activities taking place in a project or programme. It is a process of routinely gathering information on all aspects of the project. To monitor is to check on how project activities are progressing. A distribution transformer of 100 KVA is monitor during different time, events and observe its increasing voltage, current, temperature. Due to increase in temperature, overheating takes place and insulation of transformer is deteriorates due to which hotspots is creates in insulation. Most of the fault in transformer are due to internal winding faults this is increasing day by day since loading transformer closes to their rated capacity. These internal faults result in degradation of the transformer winding insulation, which tends to cause a breakdown in dielectric strength. There are also different types of faults that occurs in transformer such as short circuit, open circuit, earth fault. These faults causes failure in transformer such as winding failure, core failure, bushing failure, tank failure and insulation failure.

II. MONITORING OF DISTRIBUTION TRANSFORMER

We have conducted a small experiment to calculate and monitor the overall load distribution of three phase transformer at our college. We have monitored different values of voltages, currents and frequency at secondary side of the transformer on panel and at primary side of the transformer using clamp on meter at different intervals (i.e. in morning, afternoon and evening) and on different occasion. From that data we have calculated power and plotted graph of voltage and current with time.

From graph it is seen that voltage on B phase and current on R phase was more. An unbalance was observed between phases and as a result current was flowing through neutral. We also checked temperature of incoming and outgoing cable by using temperature sensor and observed that temperature of incoming Y phase was more.

It was observed that voltage on B phase and current on R phase was more because of unequal distribution of single phase loads. An excessive level of voltage unbalance can have serious impacts on power quality and unbalance in the line currents can lead to excessive line losses and malfunctioning of relay. Hence by proper load distribution problem can be solve and temperature of Y phase was more so care should be taken before any further problem arises.

TABLE 1

Date	Time	Vry	Vyb	Vrb	Iry	Iyb	Irb	Power(KW)
31/07/2018	08:45 A.M.	387	400	396	88	64	44	40385.5
31/07/2018	12:10 P.M.	376	383	381	107	89	62	47332.8
31/07/2018	03:45 P.M.	374	381	381	106	85	73	51792.0
01/08/2018	09:30 A.M.	365	368	374	143	133	128	76987.4
01/08/2018	11:31 A.M.	358	369	368	119	96	65	52852.4
01/08/2018	03:45 P.M.	381	387	389	81	68	55	40162.8
02/08/2018	08:50 A.M.	387	399	400	100	67	53	46009.3
02/08/2018	12:00 P.M.	363	375	372	137	110	88	59497.4
02/08/2018	03:41 P.M.	378	381	388	70	78	51	37470.8
03/08/2018	09:11 A.M.	390	401	404	112	86	66	54121.3
03/08/2018	12:35 P.M.	408	419	420	127	110	82	67200.1
04/08/2018	09:32 A.M.	387	394	396	76	62	46	36620.6

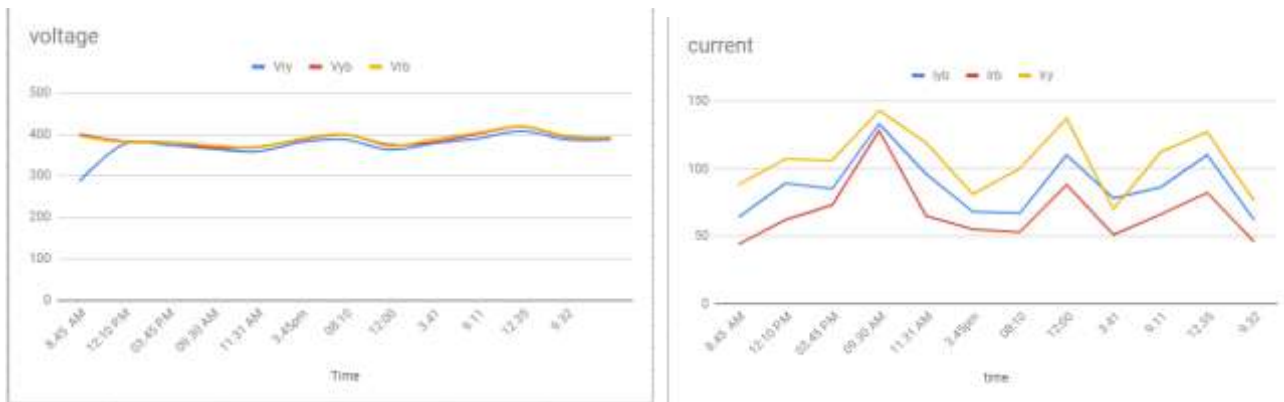


Fig. 1 Current and voltage waveform

III. ANALYSIS OF DISTRIBUTION TRANSFORMER

3.1 Causes of Failure

3.1.1 Winding failure

Winding are an essential part of transformer. Its purpose transfer power from one winding to another through electromagnetic induction. Main reasons for failure are due to a stress which causes braking in transformer winding and leads to breakdown of dielectric strength. Insulation breakdown results in flashover of winding turn and short circuit.

3.1.2 Bushing failure

Bushing are the insulation device. Its provide current path through tank wall. Loosing of this conductor causes vibration which results in overheating. Bushing failure usually occurs over time.

3.1.3 Core failure

The function of core is to concentrate the magnetic flux. Core is laminated to reduce eddy current. The breakdown of lamination results in thermal heat due to eddy current. The heat produce damages the oil in transformer resulting in release of gas. Lamination of core can also affected by poor maintenance, old oil and corrosion.

3.1.4 Tank failure

Tank is a container which contains oil. Oil is used for insulating and cooling purpose. It is also acts as a supporting system for other equipment. Faults in tank occurs due to environmental stress, corrosion, high humidity and sun radiation resulting in leakage or cracks in tank wall. Due to this cracks oil spills from the tank causing reduction in oil.

3.1.5 Insulation failure

Insulation of transformer winding slowly breaks down and becomes brittle overtime. The rate of thermal breakdown approximately doubles for every 10 degree thermal aging has cause insulation brittle, which leads to current that passes through transformer will mechanically shake the winding, a crack will form in insulation, and internal fault will result. This is the reason hotspot is created in the winding.

The main dielectric medium in transformer is oil impregnated paper which degrades with time. Replacement of oil after deterioration is easily possible, but on the contrary, replacement of oil impregnated paper is difficult after serious degradation. Cellulose paper is the solid insulating material. There are different calculation methods to obtain the resistivity value of paper.

3.1.5.1 The Aging condition and resistivity of paper

The physical and chemical property of paper will change under its aging process. The graph (figure 1) below show different resistivity and DP value of paper impregnated with different kind of oil under aging temperature.

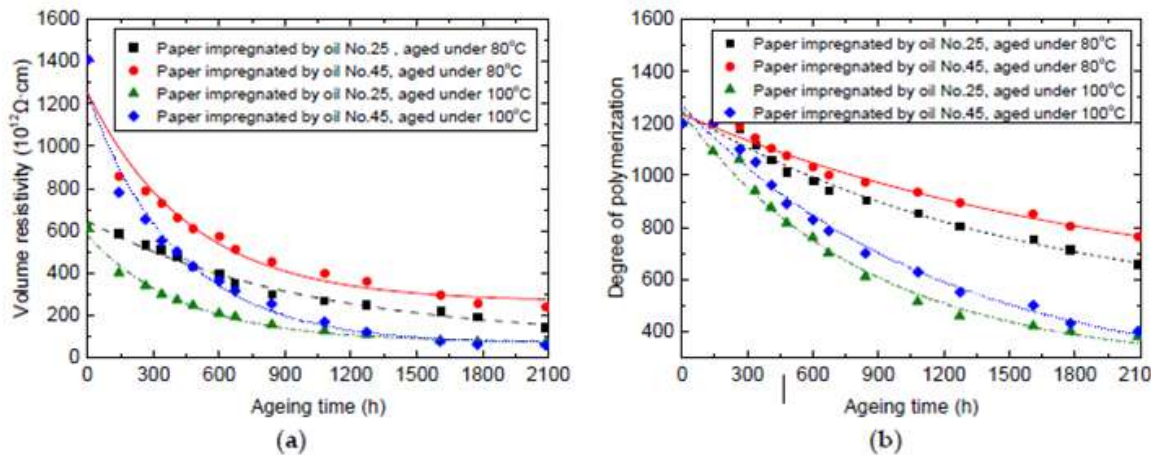


Figure 2: Measured resistivities and DP Values at different ageing stages in [37]. (a) Measured resistivities under different ageing stages; (b) Measured DP values under different ageing stage.

IV. TEST CARRIED ON TRANSFORMER

4.1 Oil breakdown value of oil

For measuring BDV of transformer oil, a portable BDV measuring kit is used. There is a port in which oil is kept which has a pair of electrodes with a gap of 2.5mm between them. Slowly voltage is increased between the electrodes at 2kv/s rate. Mostly 10 reading are taken and average of them is considered.

BDV for new oil- 40 to 70 KV

BDV for old oil- 30 to 40 KV

4.2 Flash point test of oil

Flash point is important because it speed the chance of fire hazard in transformer, so it is desirable to have a very high flash point of transformer. In general it is more than 140°.

4.3 Viscosity test of oil

Viscosity test are about the resistance of flow, under normal condition. Good oil should have low viscosity, so its offers less resistance to the conventional flow of oil there by not affecting the cooling of transformer.

4.4 Megger test

The main purpose of this test is to find overall insulation of the transformer. It checks the insulation level between HV and LV side of transformer with respect to earth.

PE= 72GΩ

SE= 7GΩ

PS= 59GΩ

V. CONCLUSION

The forced outage of transformer has serious impact on blackout, revenues. The prediction of remaining life of transformer helps to take decision on replacement or relocation of asset. Monitoring and analysis helps us to study about different faults and their effects on different parts of transformer. It also helps to know how failure of insulation affects the life of transformer. Also come to know different type of test carried on transformer, which helps us to know about the life of transformer.

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