International Journal of Electrical and Electronics Engineering (IJEEE)
ISSN 2278-9944
Vol. 2, Issue 2, May 2013, 63-66

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

INTELLIGENT MONITORING OF BUSHINGS IN AN ELECTRICAL TRANSFORMER

KARTHIK BALASUBRAMANIAN[1], VINEETH CHANDRASEKAR[2], RAHUL MENON[3] & R SUDHA[4]

[1,2,3]Student, School of Electrical Engineering, VIT University, India

[4]Assistant Professor, School of Electrical Engineering, VIT University, India

ABSTRACT

This paper introduces the new intelligence technology in the transformer fault diagnosis i.e. to monitor the bushings and inform the control room if the bushings are faulty mainly due to partial break down. This results in the change in capacitance and the partial discharges in the setup. The effect of partial break down with high voltage can be very dangerous, ultimately leading to complete failure.

We make use of Partial discharge signals that can be detected by the UHF sensor. The electrical sensors are used to detect the change in capacitance. The sensors can be either mounted inside the insulation or outside the bushings and are controlled by intelligent functions.

The sensor pulses are digitized, analyzed and processed in order to generate an appropriate data output, supervisory control and data acquisition alarm. The intelligent system detects the fault in the bushes with the help of intelligent sensors and notifies the engineers about the fault in the bushing. Hidden faults achieve the possibility and accuracy of primary diagnosis when this method of diagnosis is applied.

KEYWORDS: Bushing, Sensors, Transformer, Fault Sensing, UHF Sensor, Electric Sensor

INTRODUCTION

Figure 1: Transformer with Bushing

A bushing is a hollow electrical insulator through which a conductor may pass. They are used where high voltage lines must pass through a wall or other surface on transformers. The purpose of using the bushing is to keep the conductor insulated from the surface it is passing through. They are placed in the terminals of the primary to secondary winding of the transformer and are made up of porcelain or glass.

A varying current in the primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic field through the secondary winding. This magnetic field induces a varying electromotive force (EMF) in the secondary winding. This effect is called inductive coupling which can lead to fault occurrence.

Figure 2: Faulty Bushing

There are many faults in a transformer, the most important one being the Bushing failure. Bushing sometimes fails due to partial discharge break down in the Transformer. There are a lot new diagnostic tests for the equipment it is in service on line. The online test overcomes the limitations of the offline tests like the reducing effect of outliers, and early diagnosis of the initiating failures and supporting the maintenance scheme. This paper describes a new method of intelligent monitoring of the capacitance and the partial discharge in the bushings of the transformer. Since the bushings are subjected to stress; the bushing failures are one of the main causes of forced leakages and transformer failures.

MONITORING OF BUSHING CAPACITANCE AND PARTIAL DISCHARGE

Bushing Failure Modes and Requested Sensitivity

A monitoring system for HV bushings should early detect common failure mechanisms for transformer bushings. Partial discharge, ageing and moisture are the major failures in the transformer bushing system. Partial breakdowns between field grading layers result in an increase of capacitance and partial discharges. Monitoring systems should be able to provide an appropriate accuracy to evaluate the bushing's condition according to relevant standards. Failure mechanisms results in partial discharges and a slight change of capacitance and finally corroded contacts which results in partial discharges. From the points above we can conclude that a monitoring system with sensitive management of capacitance and partial discharges has the capability of an early diagnosis of all typical initiating failure modes in the bushing of a high voltage transformer. An On-line Monitoring system is required to monitor the health of High Voltage Bushings in Transformers.

THE PROBLEM

Figure 3: Transformer with Bushing

For measuring capacitance or partial discharge, a reference signal is necessary. For off-line measurements, the applied test voltage is measured and used as reference. In the on-line application, that is not possible. Therefore, we have to bring in a new method to measure these parameters and find a solution to solve the problem.

BUSHING SENSORS

Figure 4: Sensor Attached to the Bushing

The mechanical installation of an on-line bushing sensor replaces the cap's function of rounding the insulation layers as well as protecting the taps internal components from Contaminants. At the same time, the sensor creates an excellent electrical connection that allows the measurement of voltage and/or current present at the tap. With these Measurements, changes in capacitance and partial discharge can be determined and trended.

ON-LINE PARTIAL DISCHARGE MEASUREMENT

Partial discharge (PD) is a localized dielectric breakdown of a small portion of a solid electrical insulation system. Since partial discharges are early indicators of incipient faults, their on-line observation is of prominent interest.

Electromagnetic Measurements with UHF Sensors

The transformer tank functions as a shield against external partial discharge, thus internal partial discharges can be detected relatively undisturbed by the electromagnetic waves.

The combination of signals in the UHF range with electrical signals from the bushing tap provides a high sensitivity together with suppression of external noise like corona. The UHF signal serves as a trigger or gating signal for the electrical signals. The individual PD patterns do not allow for a pattern classification. After their combination, where the UHF signals serve as gating signals, a PD pattern can be recognized. The UHF signals that correspond to the partial discharge are transmitted to a display or measuring device. Online monitoring algorithms are used to decode the signals. The monitoring algorithm tells the users when there is any damage in the bushings of the transformers by measuring and sensing the partial discharge.

ON-LINE CPACITANCE MEASUREMENT

Partial breakdowns between field grading layers result in an increase of capacitance. This change in the capacitance can be measured by electrical sensors.

Sensing Capacitance Change

An electric sensor can indicate the change in the capacitance. When the sensor senses a change in capacitance in

the bushing setup the voltage signal corresponding to the change in capacitance is given by the sensor. These voltage signals are then transmitted to a display or a measuring device. They are decoded and evaluated using various online monitoring algorithms. This will be shown to the users by the intelligent system and the problem can be easily cleared without any major damage. Thus, the damage in the transformer bushings is measured and sensed by the change in the capacitance using this algorithm.

CONCLUSIONS

This paper describes a new online monitoring system using intelligent algorithm to measure the bushing capacitance and partial discharges of the transformer bushing. While using the intelligence concept, the level of accuracy will be more compared to the other existing methods. For the partial discharge measurements and capacitance measurements the UHF sensors and the electric sensors are used respectively. This method of monitoring aims to provide reliable, automated monitoring functions for observation and warning and, with hardware, an advanced diagnostic tool in case of bushing failure in transformers.

REFERENCES

1. Maik Koch & Michael Kruger: “New Method for Online Monitoring of Bushings and Partial Discharges of Power Transformer”
2. K.Viereck,C. Hillinger: “Transformer Monitoring Trends”.
3. P.Picher, C.Rajotte: “Integration of new transformer monitoring technologies into a modern it infrastructure”,techcon 2011 , Sydney, Australia.
4. W. Koltunowicz, R.Plath “Synchronous multi-channel PD measurements “IEEE trans. Dielect. Elect Insulation 15.6 (Deck 2006), pp.1715-1723