International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 2 Feb 2022, pp: 173-176 www.ijaem.net ISSN: 2395-5252

Experimental study of Onload Tap Changers by Dynamic contact resistance measurement

Praveen kumar

Submitted: 25-01-2022 Revised: 05-02-2022 Accepted: 08-02-2022

ABSTRACT:
Transformers are one among the most critical equipment at any stage of power cycle from Generation to consumption at all stages like Transmission and Distribution. Onload Tap changers acts as the Voltage regulator for the Transformers which basically plays vital role in grid voltage stability and maintain a balance between generation of power and load consumption.
OLTCs are the only moving part in a transformer. It requires an extensive care due to its high failure rate and deteriorating mechanical components.
In this paper we will discuss about various methodologies which are conventionally used for OLTC diagnostics and experimental study of OLTC with dynamic contact resistance measurement.
Key words – Transformers, Onload tap changers, DCRM,

I. INTRODUCTION:

OnLoad Tap changers plays a vital role in voltage regulation of power transformers in transmission and distribution. Due to their usage in wide variety of applications there are many types of OLTCs. Basically they can be divided into two types based on their switching medium as resistance type and reactance type. Reactance type OLTCs are widely used in various North American countries for LV side regulation, the Pros and cons are debatable. Resistance type OLTCs are more common which are being used to suit almost all kind of applications.

According to a study, almost 30% of Transformers failure can be traced back to OLTC. OLTCs are supposed to switch high currents Online without interrupting the load. So, high discharges and mechanical degradation are more likely to occur. So OLTCs must be treated as a highly critical equipment and requires periodic inspection and Overhauling. Usually original equipment manufacturers recommend for Diverter inspection for every 2 years or an 30,000 switching operations (whichever is earlier) for an Non-Vaccum type OLTC.

II. CONSTRUCTION OF OLTCS:

First resistance based OLTC was designed and patented by Dr. Jansen. OLTCs can be divided into two types based on their construction. Selector switch design which has a single compartment (Diverter oil vessel assembly) in which the tapping leads are terminated. A selector switch is used to select between taps. These OLTCs are used for lower power application usually lesser than 20 MVA.
Diverter switch design consists of two parts, Selector in which tapping leads from windings terminated and Diverter which is used to switch the currents. These kind of OLTCs are widely used for high power applications thanks to their robustness and high current switching capabilities.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 2 Feb 2022, pp: 173-176 www.ijaem.net ISSN: 2395-5252

Image.1 Selector switch design **Image.2 Diverter switch design**

III. TESTING METHODOLOGIES FOR TAP CHANGERS :

1.1. Winding Resistance:

This is the most commonly used method for OLTC testing. Winding Resistance measures resistance of tap changer contacts along with the winding. This low voltage test is capable of diagnosing any major deviations in tap changer contacts. For example, If the tap changer moving contacts are not properly contacting with fixed contacts or an burnt contact will increase the resistance.

1.2. Vibro Accoustics analysis:

This technology has been in the field of OLTC testing for a while now but not widely used yet effective. Vibro Accoustics analysis uses an acceleration sensor which can be mounted anywhere within Audible range of an tap change operation usually mounted on Top cover of the OLTC or mounted directly on transformer tank adjacent to the OLTC chamber. The sensor record the unique finger print of the OLTC operation and used as a reference for any future measurements. The recordings of various periods are overlaped and compared for any deviations. This method is effective for finding any mechanical errors during the course of operation.

1.3. Motor current measurement:

In this method the Current of a motor which drives the tap changer electrically is monitored and the pattern is recorded. If there is any mechanical faults during operation causes a significant deviation in current graph. Depending on the region of deviations, possible causes are diagnosed.

1.4. Dynamic Contact Resistance:

During the regular maintenance, resistance measurement can be performed dynamically in order to observe the condition of the OLTC. One of the measurement methods is Dynamic Contact Resistance Measurement (DCRM) also and can be implemented as OLTC Diagnostic System. DCRM measures the resistance at each stage of a tap change operation at extremely minimal interval rate.

The current flow impact causes contacts deterioration by eroding the contact material usually copper and tungsten. Resistive layer formation is another major issue in OLTC contacts. It is developed on contacts due to the heating of insulation oil by the load current. All the anomalies can be detected by using DCRM by analyzing current graph, timing & ripple percentage of an tap change operation.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 2 Feb 2022, pp: 173-176 www.ijaem.net ISSN: 2395-5252

Various stages of a tap change:

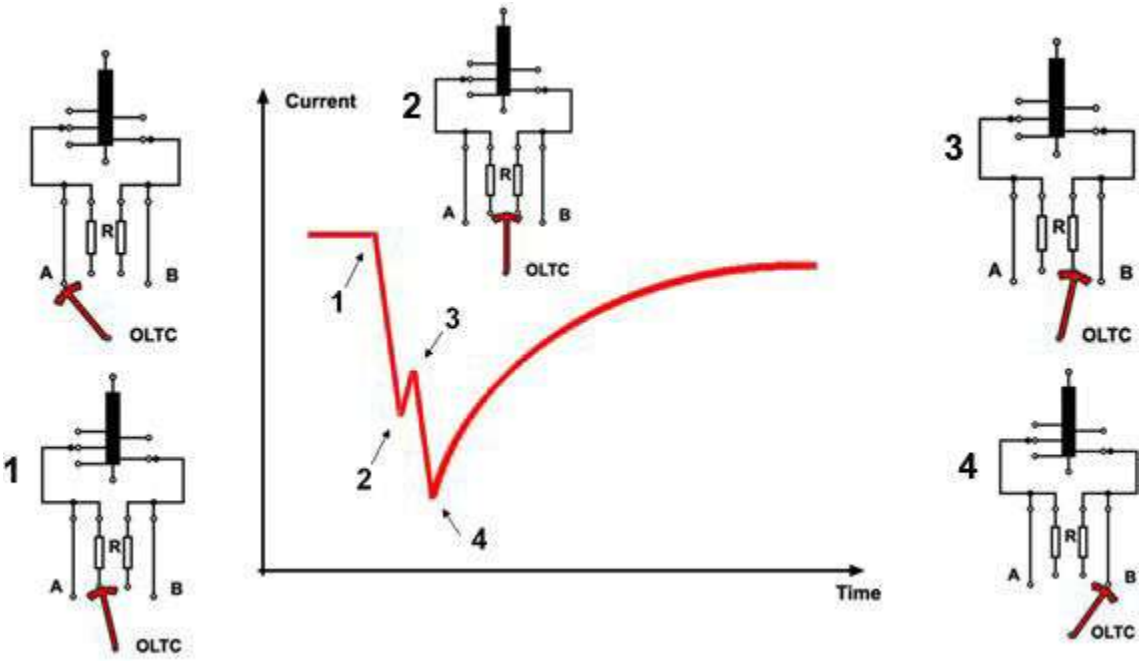


Image.3. Process of tap change and there graph formation

The graph is linear (Point 1) when the contact is in 'A' position. As soon as the tap change occur the resistors 1 comes into picture due to which the current drops (point 2). Then another resistor 2 is added in series so a small spike is formed in current graph (Point3). Again the current drops (Point 4) since Resistor 1 is no more connected to the circuit. Finally the current starts to gradually increase as both the resistors are bypassed and the contact is made in adjacent main contact.

The below picture represents an ideal graph for an OLTC.

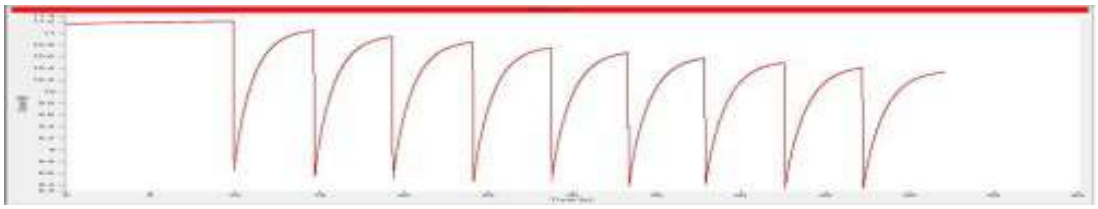


Image.4 The overall graph for an linear OLTC of 9 Taps

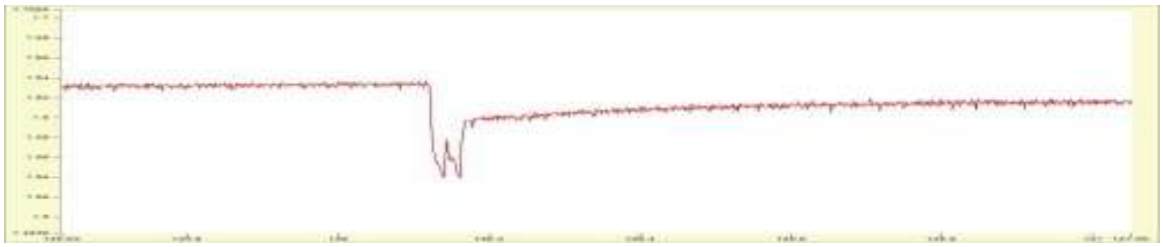


Image.5 The ripple of an single tap change operation.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 2 Feb 2022, pp: 173-176 www.ijaem.net ISSN: 2395-5252

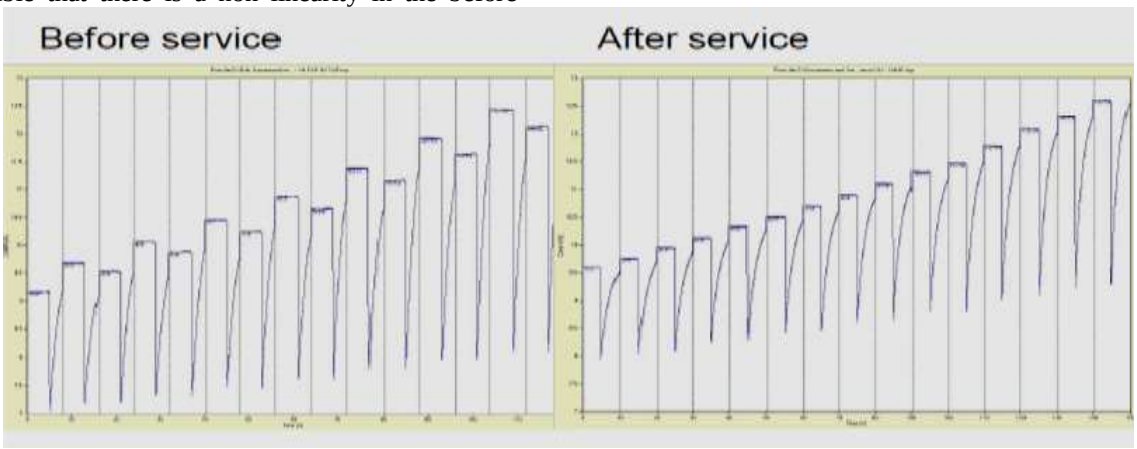
IV. OLTC DIAGNOSTICS USING DCRM

Usually the DCRM shall be conducted before and after the service in order to diagnose the deviations OLTC and the data shall be used for rectification of the same.

An OLTC at national grid has been tested and with DCRM, in which before tests revealed that there is a contact problem in Odd phases. It is clearly visible that there is a non linearity in the before graph.

During overhauling of the OLTC it was found that odd phase moving contacts were arced and carbonized heavily. The same has been rectified so the graph is linear.

OLTC DETAILS-
Type- M III 350 Y 72.5/C 18.19.0
Make- MR



There is an significant improvement in the graph linearity and the contact bounce is even in after service graph.

V. CONCLUSION:

Though the existing conventional tests such as ratio, static winding resistance give an picture of OLTC in broader terms, In some cases, however, it is not possible to detect defects using the static winding resistance measurement. DCRM provides critical data on mechanical intactness, contact deterioration and contact bounces with more accuracy. It serves as a perfect tool for detecting any workmen errors during maintenance by comparing before and after overhauling graphs.

REFERENCES:

[1]. P. Kang and D.Birtwhistle, "Condition assessment of power transformer on-load tap changers: Transient vibration analysis using wavelet transform and self organizing map" IEEE Trans. Power transformer delivery, vol. 16, pp. 394-42. CIGRE SC 12 WG 12.6,

[2]. CIGRE SC 12 WG 12.6, "An international survey on failures in large power transformers in services," ELECTRA, no. 88 pp. 21-48, 1983P.