Review Work on Condition Monitoring Power Transformer using ANN and fuzzy logic

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Abstract - This work covers problem identification due to faults in power transformers during operation by using gas analysis such as key gas, IEC ratio, Duval triangle techniques, and with fuzzy logic approaches. Then, the status of the power converter is evaluated in terms of percentage error rate and internal error resolution. Fuzzy logic with key gas method was used to calculate the error rate and identify the problems in the power converter.

Key Words: IEC Ratio Method,ANN,Fuzzy Logic

1.INTRODUCTION

This Power transmission (transformer) is the main source of electricity transmission and distribution. During operation, it will be damaged in normal and abnormal conditions, including overload, aging and damage of oil insulation paper, internal arcing and partial discharge (PD) , short circuit, etc. - Replace the ball valve (OLTC), winding and metal core, bushing, tank and other damages [1]. Therefore, in order to prevent malfunctions and maintain the quality of the power transformer, many diagnostic and non-standard methods have been carried out to evaluate the situation. Conventional diagnostic methods include dissolved gas analysis, oil quality, power factor testing, winding resistance measurement, turn rate, and thermography, while non-conventional diagnostic methods include partial discharge measurement, dielectric spectroscopy, frequency response analysis, and tap-changer monitoring. and the internal temperature. measurement [2]. After obtaining the test results of the various diagnostic methods mentioned above, the data was further evaluated in order to assess the condition of the power transformer. Most methods performed DGA with a simple tool to find out the incipient defect. However, in industrial applications, it is inconvenient and time-consuming due to the complicated analytical process [3]. Therefore, artificial intelligence techniques have been proposed to develop more accurate diagnostic tools based on DGA data. The method of fuzzy logic is also an effective method for determining the answer where the boundary is not clear.

2. Objectives

- In this project, the work done is representing the minor and major types of faults that can rise inside power transformer.
- To collect data of power transformer from substation and analyze the fault, predict the time for maintenance.
- To estimate the dielectric strength of oil.
- To check the quality of oil.
- To reduce the burden of frequent check of power transformer, as case study provide the minimum
- time for check-up by using Fuzzy system. To improve life of transformer.
- To compare the gases generated in mineral oil, synthetic ester and natural ester as a result of thermal faults.

3. LITERATURE REVIEW

The power transformer is a key component in power transmission and distribution systems. During operation, it might be deteriorated by both normal and abnormal conditions, including overloading, aging, and degradation of paper-oil insulation, internal arcing and partial discharge (PD), short circuit, etc. Survey results show damages within power transformers including on-load tap changer (OLTC), winding and iron core, bushing, tank, and other related damages. Therefore, to prevent failure and to maintain the power transformer in the satisfactorily working condition, several traditional and nontraditional diagnostic methods have been performed to assess the condition [1].

Transformer oil degrades because of different reasons like ageing, increase in voltage, surrounding conditions, overheating and various other factors. During oil degradation, a number of hydrocarbons such as acetylene, methane, ethylene, ethane and others are generated.

Also a number of gases like hydrogen, carbon dioxide and carbon monoxide are produced. These evolved gases under enclosed condition can lead to an explosion. Generation and concentration of these gases is dependent on the oil condition and therefore, it is very important to monitor presence and

value of these harmful gases in the transformer under running condition [2].

The maximum voltage that can be applied across the insulation without any electrical breakdown is called as dielectric strength of insulation. Any significant reduction in the dielectric strength indicates that the oil is no longer capable of performing its vital function.

The degree of polymerization and furan content test of transformers decide the health status of their solid insulation. When a cellulose molecule breaks into smaller lengths or ring structures, a chemical compound known as a furan is formed. This is a measure of the insulating paper quality (mechanical strength) and hence an indicator of the consumed lifetime of a transformer [3].

On the basis of qualitative and quantitative analysis of gases dissolved in insulating liquids, it is possible to detect electrical and thermal faults. The thermal faults should be understood here as excessive temperature rise in the insulation.

The thermal faults should be understood here as excessive temperature rise in the insulation. In accordance with the thermal faults can be divided into three temperature ranges: T1 (<300◦C), T2 (300◦C − 700◦C), and T3 (>700◦C). In the case of T1 range, a high temperature is most often caused by overloading of the transformer in an emergency situation and blocked items restricting oil flow in windings. The temperature increase up to the range of T2 may result from defective contacts (between bolted connections) and circulating currents[4].

Dissolved gas analysis (DGA) is powerful technique has been used to identify the incipient power oil transformers faults. In this technique can be identified according to the gases concentrations dissolved in oil of transformer, hydrogen (H2), (CH4), (C2H6), (C2H4), (C2H2), various interpretative DGA methods has been established, such as Gas key method, IEC ratio method, and the graphical representation method.

In this study adaptive IEC ratio (AIEC ratio) method as first incipient diagnosis of the possible faults of oil transformer, in order to identifying the fault types based incipient possible faults diagnosed by IEC ratio method, case study report uses the ratio of gases as input data to fuzzy systems diagnosis model and the output fuzzy shows results [5].

In this method the concentration and gassing rates of the key hydrocarbon gases is monitored. The key gases analyzed are, hydrogen (H2), methane (CH4), ethane (C2H6), ethylene (C2H4), acetylene (C2H2), carbon monoxide (CO), and carbon dioxide (CO2). The concentrations are expressed in ppm. Normal concentration during operation of these gases with reference to IEC 60599 (Mineral oil-filled electrical equipment in service) ratio method [6-7]

3. PROBLEM STATEMENT:

The work done is primarily focuses on the fault that will raise or arrives in oil of Power Transformer. If the transformer suffers under any faulty or abnormal condition then the dielectric strength of oil reduces also the several types of gases are produced in the transformer tank.

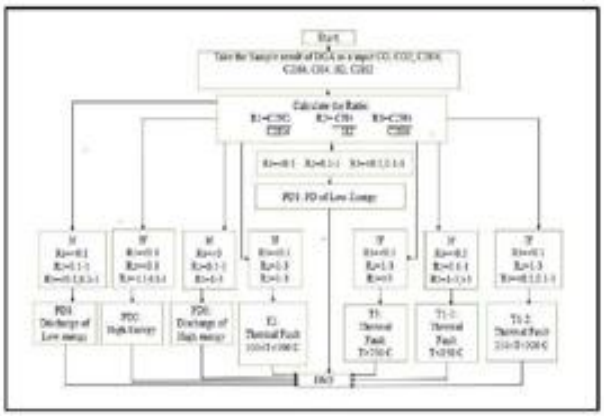
This will leads to the gases produced in the transformer tank will get saturate on the top of the oil in the conservator tank.

This gases has their own chemical composition and different nature that gases will create a major fault, if the transformer is not kept under surveillance after a specified period of time. For the better operation and efficiency of transformer needs to be get checked to maintained health of the transformer.

For the above purposes, with the help of DGA test and fuzzy system estimation of the dielectric strength of transformer oil and prediction of the type of fault can be done.

The Partial Discharge, Thermal Fault, Energy Arc Fault are the common incipient faults which occurs inside the transformer if the proper check-up and maintenance is not done.

Block Diagram of IEC Ratio Method



4. CONCLUSIONS

Fuzzy analysis application to DGA methods The IEC gas ratio method was used to evaluate the condition of the power transformer and determine the internal fault. In addition, the IEC fuel report can confirm the problem in different types of defects covering everything in the engine. In addition, the DGA results of the two transfer systems were also reviewed. Internal problems of power converters are clearly shown.
Fuzzy membership functions represent more accurate relation between the type of fault and DGA samples as reflected in the output results. Also with the method, more than one fault at a time can be identified, which is not correctly diagnosed by the traditional method. The case study also presents diagnosis of faults in a transformer using fuzzy logic based on IEC ratio method which is found satisfactory with the fuzzy diagnosis.

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