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Failure of Power Transformer and Diagnosis Method

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Abstract

As one of the most important electrical equipment, power transformers have important significance for their stable operation. Takes the power transformer as the research object, analyzes the causes and characteristics of the faults in operation, studies the main methods of transmission line fault detection and the current research results, and looks forward to the future development direction of transformer fault diagnosis.

Keywords

Power transformer, Failure analysis, Diagnostic technology.

1. Introduction

Transformer as an energy conversion device is an important device in the power system. It mainly uses the principle of electromagnetic induction to increase or decrease an AC voltage to another voltage of the same frequency and output it. However, because of its complicated internal structure and uneven electromagnetic field [1], it is easy to fail. The current accident rate on site is still very high. The losses caused by it account for the dominant position of power system failure losses, so the reasons for abnormal operation of transformers are studied. The diagnostic methods of signs and abnormal operation are very important for the reliable and stable operation of the power grid.

2. Possible causes of transformer failure

Under ideal conditions, the life of a transformer can reach 30 to 40 years, but this is not the case. There are many factors that affect the service life of insulating materials [2]. The main reasons for possible failure are as following.

2.1 Line surge

This is the most common cause of transformer failure, including abnormal conditions such as switch overvoltage and voltage peak line failure [3].

2.2 Insulation aging

Long-term operation of the transformer is prone to insulation aging, which greatly reduces the insulation performance of the transformer.

2.3 Lightning impact

Most of the power transformers are used in outdoor environments, so they are easily affected by the surrounding environment, especially bad weather such as thunderstorms. Therefore, the arrangement of lightning protection equipment is essential to ensure the safe operation.

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2.4 Improper maintenance

Insufficient maintenance work for power transformers is also the main cause of transformer failure. It mainly includes coolant leakage, transformer failure to find and replace in time, aging of transformer dirt and corrosion [4].

2.5 Overload

When the transformer is in an overloaded state for a long time, too high temperature will cause premature aging of the insulation. After the transformer insulation ages, external shock is more likely to cause insulation damage and failure [5].

2.6 Wet

3. Common characterization phenomena of abnormal transformer operation

3.1 Abnormal oil level of oil-immersed transformer

The oil level in the transformer is affected by changes in ambient temperature and transformer oil temperature. The oil temperature of the transformer changes, and the oil level does not change, indicating an abnormality. It is also possible that the oil level is abnormal due to oil leakage, clogged tubing, and staff not refueling in time[6].

3.2 Abnormal temperature rise

During the operation of the transformer, it will cause losses and inevitably generate heat. In general, the oil temperature on the upper part of the transformer is not higher than 55℃. If the temperature of the transformer during operation is much higher than the normal temperature, it indicates that the transformer has failed[7].

3.3 Oil quality deterioration

Because of the long-term operation, the insulating oil in the transformer inevitably causes the deterioration of the oil quality, which in turn affects the overall operation of the transformer and affects its overall insulation performance. It is very easy to cause internal failures. Under normal circumstances, the newly invested transformer oil is transparent and light yellow.

3.4 Abnormal sound inside the transformer

When the transformer is running normally, the sound is even and continuous. When there is discharge sound, cracking sound or noise inside the transformer, it indicates that the transformer may have faults such as excessive load, excessive voltage, partial discharge and so on [8].

4. Research on transformer diagnosis technology

4.1 Study on dissolved gas in transformer oil

Dissolved gas in transformer oil is one of the most important state detection methods for power transformers [9]. Mainly conducts oil and gas sampling and analysis on the oil and gas and oil and gas relays in the transformer body oil, continuously measures and analyzes the gas content in the oil, and analyzes the type and content of the gas. At present, the commonly used methods are characteristic gas method and IEC three ratio method [10]. As one of the most important detection methods, many scholars have conducted research in this regard, and believe that combining traditional methods with intelligent algorithms solves the problem that traditional algorithms have absolute boundaries and are likely to cause misdiagnosis. For example, neural network function approximation rule extraction method, genetic algorithm for network optimization, fuzzy clustering and complete binary tree for transformer fault classification, time series and AdaBoost integral algorithm for calculation.

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4.2 Fault infrared diagnosis method

With the development of science and technology, photoelectric technology has also been greatly developed, and infrared diagnostic technology has become more and more mature, and it is used in the analysis of transformer faults. It mainly uses the heat radiation of the equipment to pass the infrared rays of the transformer through the equipment. Detection, and scientific and reasonable analysis, according to the temperature rise limit, relative temperature difference and other standards [11],which can determine the location and cause of transformer failure.

4.3 Winding fault deformation analysis

The winding frequency response test can detect whether the transformer winding is deformed. Through horizontal, vertical and comprehensive comparison of the winding frequency response test data, it can be judged whether the transformer winding is deformed according to the relevant values of different frequency bands.

5. Summary and outlook

The role of transformers in power production is very important. Only by strengthening the operation and maintenance of transformers can the electric network be more reliable. Real-time inspection of the transformer should be conducted to discover the existing problems in time. At the same time, it is necessary to pay more attention to the importance of preventive experiments and to avoid the occurrence of failures as much as possible to improve production efficiency while ensuring safe operation. In the future transformer detection, online detection technology, artificial intelligence technology and other automatic detection methods will be more widely used in transformer detection, and more new detection methods such as inductive behavior circuit breaker detection will become the main development direction in the future. On the other hand, a more detailed information database should be established based on the test results to improve the high intelligence and information level of transformer detection efficiency, thereby improving economic efficiency and work efficiency, and improving the reliability, safety and economy of grid operation.

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