Research on Fault Technology of Power Transformer

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Abstract: Power transformers are important electrical equipment in power systems. Research on power transformer fault diagnosis methods is of great significance for early detection of potential transformer faults and improving the safety of power systems. In view of the complicated mechanism of transformer faults, this paper focuses on extracting state features with the help of transformer vibration signals, partial discharge signals and dissolved gas content data in oil, and combining machine learning theory to study transformer fault diagnosis methods. The paper proposes a method of using local waves to divide the vibration signal of the transformer body. In view of the fact that the vibration signal of the transformer body can effectively reflect the condition of the internal windings and iron core of the transformer, the local wave method is applied, and the vibration mode in the signal can be used to better understand the characteristics of the vibration signal when a fault occurs. Determine whether the transformer is faulty.

1. Introduction

The Dissolved Gas Analysis (DGA) technology in transformer oil is based on the corresponding relationship between the type of dissolved gas in the oil and the internal fault. The content of various gases determines whether there are abnormalities in the IE device, and the technical national standard DL/T596-1996 “Preventive Test Regulations for Power Equipment” and DL/T722 for the diagnosis of its fault type, approximate location, severity and development trend -2000 “Guidelines for the Analysis and Judgment of Dissolved Gases in Transformer Oil” pointed out that analyzing the composition and content of dissolved gases in oil is one of the most effective measures to monitor the safe operation of oil-filled electrical equipment, and is to ensure the safe operation of power systems Effective means. Practice has proved that the use of DGA technology to detect and diagnose internal latent faults in oil-filled electrical equipment has become an important means of insulation supervision of transformer-type oil-filled electrical equipment. It is very effective for early and real-time diagnosis and identification of internal latent faults.

2. Reasons for Power Transformer Failure

As the power transformer has been put into operation for a long time, the insulation aging phenomenon has occurred, which greatly reduces its insulation performance. If the power transformer wants to operate normally and stably, it must be ensured that it has good insulation, otherwise various problems will occur due to poor insulation. Generally speaking, a certain amount of attention must be paid to the limit of the load capacity of the transformer to ensure its normal operation and absolutely prevent overloading of the transformer. This is more likely to cause the insulation performance of the insulating material of the power transformer to decrease and shorten the life of the transformer.

Due to the special functionality of the power transformer, a large part of it is installed and used in an outdoor environment, and its performance is extremely susceptible to the influence of the surrounding environment. Therefore, it is necessary to arrange lightning protection equipment for the transformer scientifically and reasonably, otherwise, once a thunderstorm occurs, it is extremely easy to cause the power transformer to malfunction.

Scientific and effective management and maintenance of the power system are the prerequisites for ensuring the stable operation of the power system. However, as an extremely important

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equipment in the power system, it is necessary to be responsible for its inspection and maintenance work. However, in fact, under the influence of many factors, some areas have not done enough to check and maintain power transformers, and the aging transformers cannot be found in time, or they cannot be replaced in time, resulting in poor insulation performance. Cause the failure to occur.

3. Analysis of High Voltage Test Technology of Power Transformer

Test the maximum voltage that the insulation equipment can withstand under different voltages (such as power frequency AC, DC, operating shock and lightning shock). This is the insulation withstand voltage test. This test is a destructive test because the test results are only two possibilities of tolerance and breakdown. The accuracy of this test is very strong, but due to its huge damage, if a large number of such experiments are carried out, it will bring certain harm to the equipment. Take the DC withstand voltage test as an example. The DC withstand voltage test method is the most commonly used. It can help the staff to accurately determine the fault of the line joint part, and can also accurately determine the short-circuit and open-circuit problems in the line. This is very important for the detection circuit system.

The test transformer is used as the main power source for the high-voltage test power supply. Employees can design it to meet the requirements of high-voltage testing, and then improve it by discovering and studying problems in the operation process. In order to ensure the success of the test, the correlation coefficient of the test transformer should be carefully checked to ensure that it can fully function and avoid unnecessary problems in the working process. Generally, when testing small capacitors, a test transformer will be used.

When the polarity of the power transformer winding changes, the water content in the resistor also changes; when the polarity of the positive electrode changes, the water content in the resistor decreases and the circulating current is significantly reduced, thereby increasing energy consumption. When the polarity of the negative electrode changes, the water content in the resistor increases, and the current flowing through the resistor increases significantly, thereby reducing the energy consumed. Therefore, different changes in current polarity will also have different effects on the high-voltage test results of the power transformer. Based on this, in order to improve the accuracy of the experimental results of the current loss value of the power transformer, it is necessary to understand the impact of current polarity on power consumption in detail.

4. Improved Countermeasures for High Voltage Test of Power Transformer

First of all, with the help of professional equipment and technology, the actual operating status of the power transformer is checked and analyzed to ensure the normal operation of the power transformer. Secondly, according to the actual requirements of electrical high-voltage testing, select appropriate test equipment to ensure the reliable performance of the test equipment, so as to ensure that the test work can be carried out in an orderly manner, and the expected results can be achieved. Third, according to the actual composition of the power transformer, select appropriate technical measures to ensure that the selected technical measures are scientific and reasonable. Fourth, in the process of high-voltage electrical testing, if the power supply capacity used is relatively large, then it is necessary to select reliable test equipment at this time to ensure a reasonable match between the test equipment and the power supply capacity. , So as to ensure the smooth progress of the test. Fifth, the relevant personnel also need to control the temperature within a reasonable range before conducting the test work.

An important part of the high-voltage test process is a comprehensive inspection, which is also very important for safety and security work. Because high-pressure work is an extremely complex and special task, preparations must be made before actual operation. First check the quality of each application and its connection method, and then try to get the closest to the standard. In addition, we must strictly control the work of each link to ensure that its design is scientific and reasonable. Finally, since this is a work related to electricity, it is important to pay attention to the safety aspects of electricity use to avoid safety accidents.

5. Research on Fault Diagnosis Technology of Power Transformer

When testing power transformers, you must pay attention to the dissolved gas in the transformer oil, and compare the measured dissolved gas volume with the standard comparison table to determine the power transformer fault. In addition, the rate of gas generation from total hydrocarbons can also be used to determine transformer failure. Once a certain fault of the transformer is detected, the fault type should be determined first, and DGA is usually used for preliminary analysis. Refer to the characteristics of the dissolved gas in the oil to determine the changes around the power transformer fault. The surrounding hydrocarbon gas is closely related to the corresponding energy density. The power transformer fault is analyzed in detail and recorded in the table. After the identification of the nature and type of transformer faults, it is necessary to further analyze its internal characteristics, predict the temperature changes caused by the fault, fully understand the important components and proportions of the gas generated at the fault location, and then analyze the relationship between the various components The relationship is generally based on the three-ratio method, that is, based on the ratio of 5 gases, the fault can be accurately determined.

In this era of rapid development of science and technology, photoelectric technology has also made great progress. Infrared diagnosis technology has become more and more mature, and it has been widely used in transformer fault analysis. The corresponding fault infrared diagnosis is actually based on the principle of infrared rays. , Use some professional instruments to perform infrared detection on the transformer to obtain the detection results, and then conduct a scientific and reasonable analysis on it. According to the infrared wavelength measured by the infrared instrument and the temperature of the fault location, the power can be determined extremely accurately. Failure of the transformer. There are many methods of infrared diagnosis technology, including temperature difference method, image analysis method, and relative temperature judgment method. Generally speaking, infrared diagnosis technology is applied to thermal faults of power transformers. There are two types of internal thermal faults and external thermal faults. . First, analyze the external thermal faults. Such faults are generally exposed outside the equipment and can be directly observed. The main external thermal faults include: damage and aging of the insulation layer, faults caused by poor contact of the external joints, and possibly It is a thermal failure caused by electromagnetic effects or a problem with the cooling system. This kind of fault can basically be analyzed by infrared thermal imaging, so that the fault area can be accurately found. Secondly, internal thermal faults are analyzed. Internal thermal faults are generally generated inside the transformer. In this way, infrared diagnosis technology can be used to analyze and preliminarily determine the fault area using thermal imaging, and then conduct in-depth research to determine the exact location of the fault. Generally speaking, circuit components, coils and switches are prone to internal thermal faults in power transformers. These components can easily spread to other components after heat generation, which is extremely unfavorable for power transformers. Due to the extremely complex structure of the power transformer, after the thermal imaging is obtained through infrared technology, other components should be detected in time and then analyzed, so that the specific area of the fault can be found and the type of the fault can be judged.

Short-circuit faults are very likely to occur in power transformers. Short-circuit faults are the most common faults in power transformers. The short-circuit phenomenon has a great impact on the power transformers, and may even cause the transformers to be burned out, which causes great economic losses. Among them, there are many factors that cause short-circuit of the transformer, the most important of which is the short-circuit caused by the deformation of the winding. Winding deformation actually refers to the obvious structural change in the axial direction after the winding is affected by a certain force, and this change is irreversible. Winding deformation forces a great change in the structure of the power transformer, which greatly affects the insulation performance of the insulating material. At this time, a potential transformer fault with safety hazards. For this fault, we are analyzing the transformer winding deformation. It can be carried out through the winding deformation test.

6. Conclusion

Transformer fault diagnosis is gradually transitioning from the traditional “application guide” diagnosis method to the automatic intelligent diagnosis method based on artificial intelligence technology. At present, people have done a lot of research on the intelligent diagnosis method of transformer faults and made great progress, but there are still many problems, which are far from the requirements of power enterprises. In this paper, we make further research on the intelligent diagnosis method of transformer faults by using the multiple state detection or monitoring data of the transformer which is relatively easy to obtain at present.

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