



Study on Countermeasures for Failure of Primary Electrical Equipment in Power Supply and Distribution Stations

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Abstract

Electrical primary equipment is an important part of the power system of power distribution stations. In order to ensure the normal operation of power distribution stations, daily operation management and maintenance must reasonably deal with various problems such as electrical primary equipment failures. GPS monitoring technology, infrared detection technology, etc. are commonly used technologies for electrical primary equipment fault detection, which can effectively improve the detection efficiency of voltage, current, etc., and provide equipment fault alarm feedback in the first time. This paper mainly starts with the analysis of electrical primary equipment fault types, clarifies the basic principles followed by electrical primary equipment maintenance, and then discusses the countermeasures for electrical primary equipment failures in power distribution stations.

Keywords

Power supply and distribution station; electrical primary equipment; failure; countermeasures

Strengthening the daily management and maintenance of the primary electrical equipment of the power distribution station can effectively reduce the occurrence rate of equipment failures and extend the service life of the primary electrical equipment of the equipment. The primary electrical equipment is in a high-voltage working state for a long time, which is prone to various faults such as electronic transformer failure and intelligent circuit breaker failure. The daily operation and maintenance management needs to clarify the causes of common faults, take more targeted fault handling measures, and maintain the normal operation of the power distribution station.

1. Types of electrical primary equipment failures

Circuit breakers, transformers, disconnectors, etc. are important components of electrical primary equipment. With the increasing demand for electricity at the social level, electrical primary equipment has to bear more overload work, and the daily failure rate is on the rise. Improper operation and overload may lead to failure of electrical primary equipment. From the perspective of the causes of failure of electrical primary equipment, it can be divided into two categories: internal failure and external failure. Among them, insulation failure is a type of failure with a higher probability of occurrence, accounting for about 40% of the failure rate of electrical primary equipment. The second is the high failure rate of circuit breakers, which accounts for about 20% of the failure rate of electrical primary equipment. The failure of these devices may not directly lead to the paralysis of the power system, but to a certain extent, it will increase the power supply energy consumption, cause different degrees of loss of electrical primary

equipment, and seriously lead to the paralysis of the power system. The daily management of the power supply and distribution station must take effective electrical primary equipment failure prediction measures to eliminate the hidden dangers of equipment failure in advance. For the existing hidden dangers of failure, timely investigation should be carried out to ensure the normal operation of the power system.

2. Fault prediction technology for electrical primary equipment

2.1 GPS monitoring technology

GPS monitoring technology can improve the automation level of electrical primary equipment fault detection, and the detection information has the characteristics of visualization, which can provide a more intuitive reference basis for fault inspection and repair. The SCADA system and monitoring control system are included in the GPS monitoring technology. Fault analysis is carried out with the help of electromagnetic transient records, and the detection data has high reliability and effectiveness. The combination of GPS monitoring technology and communication technology can realize the synchronous transmission of detection data, improve the quality of online safety detection and evaluation, and provide more comprehensive reference data for subsequent fault analysis. GPS monitoring technology uses clamp sensors to trigger external synchronization, directly obtain synchronization signals from the grounding wire of electrical equipment, and can identify faults based on changes in the spectrum, with a high fault recognition rate.

2.2 Infrared detection technology

As a widely used and commonly used online fault detection technology, infrared detection technology has strong effectiveness. As a non-contact detection, it can be applied to both internal fault detection and external fault detection of electrical primary equipment, and has high safety. The occurrence of faults such as poor contact will cause abnormal temperature of electrical primary equipment. Infrared detection technology can be used to measure temperature changes and determine fault distribution. This detection technology is more suitable for judging heating faults, such as joint detection of various parts and internal faults of transformers.

3. Discussion on the importance of carrying out fault inspection and maintenance of electrical primary equipment in power distribution stations

Carrying out fault inspection and maintenance of primary electrical equipment in power distribution stations can effectively ensure the normal operation of primary electrical equipment and extend the service life of the equipment. Many power distribution stations still adopt the method of regular maintenance, lacking a complete and unified standard for the inspection and maintenance of primary electrical equipment, which makes it difficult to control the cost of the inspection and maintenance of primary electrical equipment. In this regard, carrying out condition inspection and maintenance of primary electrical equipment can detect possible fault problems earlier and reduce the cost of repairing equipment. Functional failure and non-functional failure are the main types of primary electrical equipment failures in power distribution stations. Targeted response measures need to be taken for different types of failures, so as to reasonably avoid functional failures of primary electrical equipment. Improving the technical level of fault inspection and maintenance of primary electrical equipment can determine the fault type and impact range in a relatively short time, and avoid the fault affecting the normal operation of the power system on a large scale [1].

4. Discussion on countermeasures for failure of primary electrical equipment in power supply and distribution stations

The maintenance of primary electrical equipment is shown in Figure 1, which is mainly divided into condition maintenance, post-maintenance, regular maintenance and hidden danger inspection. Condition maintenance is a common maintenance type for primary electrical equipment. Daily maintenance of electrical equipment requires the formulation of targeted maintenance plans based on actual conditions. When carrying out maintenance of primary electrical equipment, it is also necessary to refer to the operating data of electrical equipment. As shown in Figure 2, expert evaluation, fault tree analysis and fuzzy comprehensive evaluation are the three main methods for managing the operating data of electrical equipment. In addition, live testing, power outage inspection and other means are also used to carry out fault detection of primary electrical equipment.

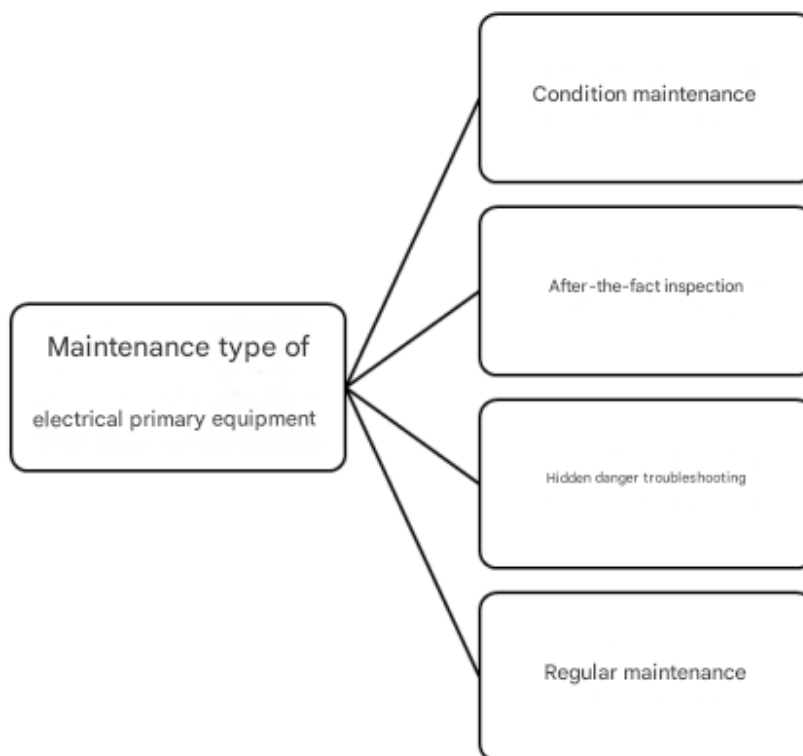


Figure 1. Maintenance types of electrical primary equipment.

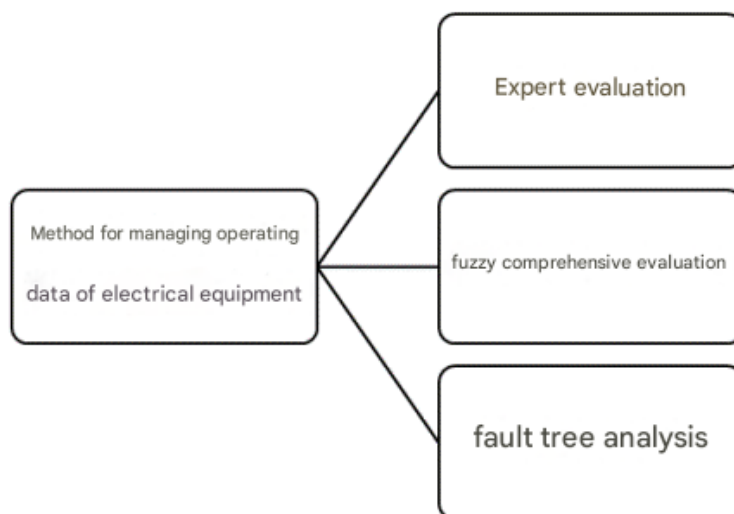


Figure 2. Electrical equipment operation data management method.

4.1 Failures caused by degradation of transformer insulation performance

Oil-immersed transformers are more likely to experience reduced insulation performance, which in turn causes electrical primary equipment failures. When the transformer's insulating oil comes into contact with air, it may oxidize, which in turn affects the normal function of the insulating oil and even reduces the insulation of the transformer coil, resulting in poor transformer insulation in electrical primary equipment. For such faults in electrical equipment, the cause of the problem must be found as soon as possible and prevented. For transformers with larger capacity, this fault may manifest as an abnormal hydraulic press. A double float relay can be used to solve this type of fault [2].

4.2 Handling of short circuit or grounding fault of transformer and generator equipment

If the coils of transformers, generators and other equipment are short-circuited or grounded, the power supply circuit may be disconnected. To handle such faults, it is necessary to follow the established process step by step and return the transformer or generator to the original factory for repair. Considering the possible risk of failure, the primary electrical equipment of the power distribution station needs to be equipped with corresponding fault protection devices inside the transformer. Once the transformer fails, it can be powered off in a short time and the equipment ratio differential relay can be started for emergency treatment.

Transformers are an important part of electrical primary equipment and bear the important role of electric energy transmission. They must be maintained in accordance with the "Guidelines for Maintenance of Power Transformers" (DL/T573-2010). Maintenance of important equipment such as transformers can be carried out by combining planned maintenance and condition-based maintenance, and dynamically adjusted according to the actual situation of the transformer [3].

4.3 Power outage operation errors

The primary electrical equipment of the power distribution station needs to be shut down for maintenance every year. During the maintenance process, the primary electrical equipment is generally not directly in contact with the equipment. In order to avoid mistakes or errors, the power outage operation must be carried out in strict accordance with the maintenance standards and relevant regulations. Maintenance personnel must enhance their sense of responsibility, standardize their own operations, and perform recovery confirmation after the maintenance work is completed to avoid accidents [4].

4.4 Power supply line failure

There are many factors that affect the power outage during the operation of the primary electrical equipment in the power distribution station. It may be a short circuit to the ground or a short circuit between lines in the line problem, which affects the normal operation of the electrical equipment. However, under normal circumstances, it is difficult to accurately determine the location of the fault. It is easier to solve the problem of line breakage or burnout in low-voltage circuits, but it is more difficult to handle such faults in high-voltage circuits. In the daily maintenance and management of primary electrical equipment, it is necessary to do a good job in line insulation maintenance and management, and use AC reverse circuits and AC three-phase circuits to cooperate with the use of primary electrical equipment, so as to improve the operation quality of the power supply line [5].

4.5 Control circuit and control equipment failure

With the development of technology, various information systems can now be applied to the operation and maintenance of electrical primary equipment, which has improved the efficiency and quality of operation and maintenance of electrical primary equipment to a certain extent. However, the complexity of the operating environment of electrical equipment often interferes with the control circuit and the signal of the control equipment, increasing the difficulty of fault inspection and repair. Circuit breaker input error is a common type of fault, and it is necessary to re-power the circuit breaker after the electrical equipment is installed and modified. First activate the power supply of the control circuit, and if there are no other abnormal conditions, you can turn on the power supply.

Comprehensive inspection of the control room is the daily basic work of electrical primary equipment maintenance, and it detects whether there is leakage in the water pipe. The internal structure of the motor control system is inspected with the help of magnetic resonance. The winding electronic device is used as the measurement platform, and the data is distributed to different channels in the form of wave points. Then the degree of wear is determined by the actual value [6].

4.6 Lightning rod status detection

The zinc oxide arrester moa has strong protection performance. For this type of overvoltage protection equipment, the status monitoring can be carried out by online monitoring of the full current and live measurement of the resistive resistance. Under normal voltage conditions, the current flowing through the zinc oxide arrester valve plate is a flexible current. The harmonic analysis method is often used to monitor the resistive current, while the measurement of

the zinc oxide arrester's live resistive current uses the compensation method and the harmonic method. After the arrester is struck by lightning, the grounding voltage of the monitoring equipment may be too high. The current sampling end and the detection and processing end can be processed with the help of radio and television technology [7].

4.7 Flexible application of fault diagnosis methods for electrical primary equipment

4.7.1 Diagnostic method based on signal transformation

The diagnostic method based on signal transformation for electrical primary equipment fault diagnosis mainly uses modern mathematical exchange methods to demodulate and separate fault signals. Specifically, the prominent points of the signal are detected with the help of wavelet transform, and then the fault information of the motor stator winding is extracted. Then the change of current is observed, and the cause of the abnormal change is obtained, which may be due to external load changes or load asymmetry. Wavelet transform, a diagnostic method based on signal transformation, can be applied to the diagnosis of power faults [8].

4.7.2 Diagnostic method based on artificial neural network (ANN)

based on artificial neural networks (ANN) have obvious advantages in complex fault diagnosis, among which the BP network method is one of the methods with the widest application range. This method uses sensors to obtain fault signals of electrical equipment, analyzes the characteristics of voltage, current and noise, and then performs Fu Liye transformation. The spectrum peak of the characteristic signal is used as the input sample of the BP network, making full use of the self-learning ability and associative memory ability of the BP network, and then diagnoses the faults of electrical primary equipment in a short time.

5. Conclusion

As an important part of the power system of power distribution stations, electrical primary equipment is directly related to the production and use of electric energy, and also affects the safety of the production, transmission and use of electric energy. It is necessary to pay attention to the fault handling of electrical primary equipment. The application of sensing technology, automation technology, etc. can improve the accuracy of electrical primary equipment fault prediction, and at the same time can reasonably control the cost investment of fault detection.

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