Condition monitoring and fault diagnosis of power equipment

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Abstract. With the rapid progress of modernization, power equipment can smooth and safe operation, relates to the enterprise's production level, production safety, product quality assurance and other aspects of the smooth development of the electric power equipment fault are often referred to in a specific time and condition, the equipment does not have the specified function, touch the occurrence of this situation is mostly due to a component. The fault diagnosis of power equipment is actually the analysis of the specific location and nature of the fault. This paper is to detect the state of electric power equipment and to find fault, and gives some suggestions for the power equipment fault diagnosis.

Key words: power equipment, condition monitoring, fault diagnosis.

1. Introduction
In our country, the state monitoring and fault diagnosis of electric power equipment have been studied earlier. Since the 1960s, we have carried out live-related testing. However, because of the unscientific testing methods, the related methods have not been further promoted. Since the 1980s, with the development of new power technology, the technology of on-line diagnosis of power equipment in our country has been improved rapidly. During this period, the rapid development of our country's industry, the problem of electricity shortage has always existed, and power equipment failure occurs frequently, so the level of power equipment condition monitoring and fault diagnosis have to be improved urgently.

2. Overview of state monitoring and fault diagnosis
In the process of our power equipment failure, there are usually several nouns, such as fault prediction, fault diagnosis, condition monitoring, usually they are relatively close in understanding, but in the process of power equipment condition monitoring and fault diagnosis, it is very different, so the following nouns to enter Detailed introduction.

Fault prediction - this kind of reflection is the fault may occur, a forecast, about the time, location, size of the prediction.

Fault Diagnosis - is the identification of the location of the fault that has occurred and the assessment of the loss caused by the fault.

Condition monitoring - is to monitor and record the condition of the running equipment closely to ensure the convenient execution of equipment maintenance.
From the above analysis of several concepts, we can know that figure 1 shows. This is described in terms of the sequence of failures.

**Fig 1.** Fault handling methods classified according to fault development process.

In Figure 2, the relationship between the three theories is theoretically demonstrated. We usually need to establish a relevant data model or carry out simulation tests for fault prediction, and fault diagnosis is to analyze the root causes of the fault deeply, and can not be judged only by the signal itself, so there is a certain degree of difficulty. Therefore, in the process of dealing with the problem, we should fully consider the various factors, so as to ensure the smooth operation of the work.

**Fig. 2.** Basis for fault prediction, fault diagnosis and condition monitoring
3. Equipment condition monitoring and fault diagnosis technology

The method of condition monitoring is usually acquired by fault information features, and the system analyzes the results of detection, which is a predictive monitoring mode.

| Task                                      | Processing process | Technology used                              | Fault feature | Output                                      |
|-------------------------------------------|--------------------|----------------------------------------------|---------------|---------------------------------------------|
| Judge whether there is any defect.        | Detection fault    | Signal processing, neural network, etc.       | Forecast      | Compress data and alarm signal              |
| Consequences of failure and corresponding countermeasures | State evaluation    |                                              |               |                                             |
| Getting information and analyzing data    | Collection of data | Analog / digital conversion, sensor and data communication Expert system, fuzzy logic, neural network, digital analysis and computer technology. | Online and continuous | Raw data, or preprocessed, may contain noise. |
| Defect type and defect location           | Identify patterns and classify them |                                              | Online and automatic processing | Fault name, maintenance suggestion and other detailed diagnostic results. |

3.1. Simple vibration diagnosis technology

Simple vibration diagnosis, usually signal conditioning period, vibration sensor and other related equipment. General is to choose the first measuring shaft or bearing needle, of course, better monitoring shaft, and more accurate information directly. On the other hand is to determine the test position, the position of choice, is to be able to reflect the global vibration, generally choose the core position of equipment vibration, but also damage the frequent failures. Therefore, it is necessary to detect frequently, so that the occurrence of faults is very serious. At the same time, we should consider the economic factors and choose a suitable testing cycle.

3.2. Precision vibration diagnosis technology

Precision vibration diagnosis equipment is generally used signal sensors, vibration sensors and other equipment integrated use. In the process of precise vibration diagnosis, there will be a large amount of information. There are two kinds of information, one is useful information for diagnosis, the other is useless information for diagnosis. Therefore, in the process of diagnosis, we need to do some processing to extract the characteristic parameters related to the state. Usually, information acquisition is usually in the form of signals. If the information can not be analyzed effectively, then it is impossible to get accurate analysis content. Therefore, information processing is widely used in equipment diagnosis.

Mechanical fault diagnosis and monitoring of the various mechanical aspects of the physical unit is usually used to change professional sensors into electrical signals for further processing. Amplitude domain analysis generally uses the waveform of sampling time to analyze, it does not take into account the sequence of data occurrence, so the data before and after the confusion, for the results have no impact. If the method of time domain analysis is used to diagnose mechanical faults, the content of diagnosis is very limited. Generally, it can only detect whether there are faults and the general situation of the faults, but the specific location of the faults cannot be accurately judged.
3.3. Temperature monitoring and diagnosis technology

3.3.1. Contact temperature measurement. In the normal test, we usually use a very direct way, that is, contact measurement, it requires that the thermometer and the object to be measured in the process of testing can have full contact, so that accurate values can be measured, this measurement method is often used in our daily life, in this case in the testing process, thermal expansion and resistance thermometers are usually used.

3.3.2. Non-contact temperature measurement. In the process of contact temperature measurement mentioned above, because it is in direct contact with the object under test, this will inevitably lead to the temperature value of the object under test is inaccurate, there will be a certain number of errors, so this requires the measurement process to keep the temperature unchanged, along with our requirements for temperature monitoring become higher. The contact temperature measurement in the past can not meet the relevant requirements.

In recent years, non-contact temperature measurement has been widely promoted, mainly because of the vigorous promotion of sensitive element technology, and because this test method will not damage the temperature of the test object, so it is more widely used.

3.4. Nondestructive testing

3.4.1. Osmotic detection. Penetration testing usually uses yellow-green or red liquid to show the actual situation of the defect image clearly, so it can be very intuitive with the eyes directly to identify the defect of the equipment. There are generally two kinds of equipment, two kinds of portable and internal pressure equipment. The general treatment process includes pretreatment, penetrant addition and dripping, penetrant cleaning, drying, imaging agent and so on.

3.4.2. Acoustic emission detection. Acoustic emission (AE) is a common phenomenon that produces strain energy in the form of elastic waveforms when a material is subjected to a force, which detects the intrinsic damage of the device.

4. Summary

In recent years, the development of state monitoring and fault diagnosis technology for electrical equipment in our country is close to the international advanced level. But there are still some problems in the development of condition monitoring and fault diagnosis technology at home and abroad because of its many contents and links. Therefore, in the later research, we should increase the research in this area to ensure the smooth operation of power equipment and improve the security and stability.

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