

Fault diagnosis of thermal instruments and its preventive strategies

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Abstract: If the thermal instrument fails in use, it will not only affect the safety of power operation, but also hinder the implementation of related functions of the instrument. In modern manufacturing industry, the mode of production by experience is replaced by the mode of ensuring production process parameters with advanced instruments, so that the quality and consistency of products themselves are well guaranteed. The control of thermal instruments is the main difficulty in the work of thermal power plants. The focus of the maintenance and repair department of power plants lies in the control and repair of the liquid level control system. By controlling the opening of the outlet or inlet valves, the change of water flow is realized, but the control of water temperature needs to be based on the adjustment of heating power. In this paper, the fault diagnosis and preventive strategies of thermal instruments are analyzed and discussed, and the corresponding maintenance measures are given, hoping to help front-line staff.

1. Introduction

Thermal instruments used in thermal power plants have the characteristics of large quantity, various types and high precision, such as aberration pressure transmitter, pressure calibrator, flow totalizer, etc. Once these thermal instruments are polluted, vibrated or seriously worn out, they will lose their original calibration and measurement functions, which will pose a security threat to the working environment of thermal power plants. The measurement parameters of thermal instruments are divided into four categories, namely, pressure, flow, temperature and liquid level [1]. The maintenance and verification of thermal instruments in the factory requires not only a good equipment system, but also rich experience and superb technology of thermal instrument maintenance personnel, so as to strengthen the training and training of instrument maintenance personnel. From the point of view of normal operation of power station, thermal instruments can guarantee the effective and safe operation of power station, so it is of positive significance to strengthen fault diagnosis and prevention of thermal instruments.

2. Importance of thermal instrument maintenance

Industrial enterprises should put the detection and maintenance of thermal instruments in the first

place in the daily production and maintenance process. Because the detection and maintenance of thermal instruments is the key factor to ensure the accurate operation and measurement of the system, and it is also the fundamental guarantee for the production safety and economic benefits of industrial enterprises, it is necessary to put the detection and maintenance of thermal instruments in an important position in industrial production. The control of thermal instruments is the main difficulty in the work of thermal power plants. The focus of the maintenance and repair department of power plants lies in the control and repair of the liquid level control system. By controlling the opening of the outlet or inlet valves, the change of water flow is realized, but the control of water temperature needs to be based on the adjustment of heating power.

If the measurement of thermal instruments in the liquid level control system is inaccurate or fails, it will cause the fluctuation of liquid level, which will further affect the stability of boiler operation, lead to the failure of effective control of steam transportation and even adversely affect the efficiency of cogeneration [2-3]. Therefore, improving the comprehensive quality of maintenance personnel and improving the calibration and maintenance of thermoelectric instruments in thermal power plants are the main links in the working process of power plants.

Overhaul of thermal instruments is conducive to saving the cost of fault diagnosis and equipment maintenance. If the thermal instrument fails in use, it will not only affect the safety of power operation, but also hinder the implementation of related functions of the instrument. In modern manufacturing industry, the mode of production by experience is replaced by the mode of ensuring production process parameters with advanced instruments, so that the quality and consistency of products themselves are well guaranteed. With the rapid development of information system, the updated thermal instruments have more intelligent and practical functions, such as abnormal alarm, self-examination and correction. In actual operation, thermal instruments can basically completely replace the traditional manual stalking mode, which makes the work efficiency more efficient and the accuracy rate correspondingly improved.

3. Fault diagnosis of thermal instruments

3.1 Temperature measuring instrument failure

Temperature measuring instruments are mainly composed of thermocouples, thermometers and mercury thermometers. At present, there are some problems in hydropower plants, such as relatively complex measurement environment and high accuracy of measurement results. In modern manufacturing industry, thermocouple is often used to select temperature measuring instruments because of high testing temperature, complex measuring environment and high precision.

In principle, two kinds of material conductors with different compositions form a closed loop. When there is a temperature gradient at both ends, there will be current in the loop, and there will be electromotive force-thermoelectromotive force between the two ends, which is the so-called Seebeck effect. If the meter is not completely inserted into the bottom of the cylinder when measuring the temperature of the turbine cylinder, the contact between the meter and the cylinder is not close, which makes the measured temperature differ from the actual temperature. Error in measurement caused by wiring error. The model of thermocouple does not correspond to the model of compensation wire, which will lead to a large error in the measured temperature value [4]. In addition, the instrument in DCS cabinet and cable shielding system is poorly grounded or grounded at multiple points, which easily leads to the accumulation of charges on the signal line and the temperature value shaking.

3.2 Fault of differential pressure flow meter

If the differential pressure of the pressure flowmeter is too small, the indicated value of the meter

will be too small, and the main reason for the small differential pressure is the inconsistency of the condensation water level of the condensation balls on the positive and negative pressure sides; The pressure guide pipe is not completely condensed; The balance valve is not completely closed; The air in the high-pressure side pipeline is not completely released and the high-pressure side pipeline is not tight [5]. If the differential pressure is too large, the instrument value will be too large, mainly because the low-pressure side pipeline accumulates air or the low-pressure side pipeline is not tight. If the anti-freezing and heat tracing facilities are not used, the indicated value of the instrument will not change, and eventually the liquid in the pressure guide pipe will freeze or the balance valve will be fully opened, and the differential pressure flowmeter will fail.

3.3 Pressure measuring instrument failure

In the production and operation of hydropower plants at this stage, differential pressure flow is usually used. According to the different working principles, pressure measuring instruments can be divided into the following types: liquid column type, elastic type, load type and electric measuring type. Pressure instruments need to be inspected and maintained regularly during use. If they are not inspected regularly or the control system is not set properly during use, it is easy to cause the pressure instruments to be damaged or the displayed data to be inaccurate. Because the working principles are quite different, the causes of its failures are also different [6-7]. For example, the required liquid of the liquid column pressure measuring instrument is stored in the glass tube, but the fragility of the glass tube is uncontrollable, which greatly increases the possibility of failure of the liquid column pressure measuring instrument; Verification and maintenance cause errors in the measured values, and if the method used in the maintenance and verification of measuring instruments is wrong, it will also cause errors in the measured values or failures such as jumping and rotating.

3.4 Fault of liquid level measuring instrument

Simply from the failure rate of instruments, liquid level control equipment is the thermal equipment with the highest failure rate, and it is also the most threatening instrument in the process of safe production. There are many factors that affect the measurement accuracy of liquid level measuring instruments, and the most critical ones are feed water flow and outlet flow, both of which have their own disturbances. At the same time, if the feed water temperature is low, it may cause the phenomenon of "false water level", and the response of measuring instruments is relatively slow [8]. Therefore, when the measured data of the liquid level control system fluctuates, the liquid level should be calculated by comparing the operation records, checking the situation, and then manually controlling the regulating valve to see the change of the liquid level. If the liquid level is stable, the problem lies in the control system.

4. Prevention strategy of common faults of thermal instruments

4.1 Strictly control the installation and inspection of instruments

During the installation and inspection of instruments, the construction personnel should accurately calculate the deviation value from the specification requirements according to the actual installation slope that can be achieved by field measurement, and then feed the data back to the instrument inspectors, who will conduct secondary calibration on the instrument to ensure that the data collected by the control system is the actual detection data, so as to minimize the deviation in instrument installation and calibration.

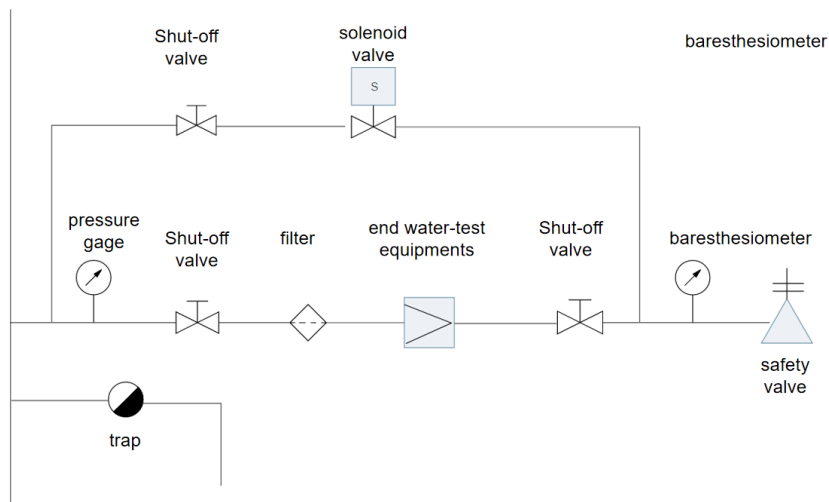


Figure 1: Installation and inspection of instrument

When installing the pressure guide pipe, the response will be delayed if it is too long, and the pressure change cannot be accurately reflected [9]. Therefore, in order to speed up the response, the pressure guide pipe should be as short as possible and keep a certain slope, so as to facilitate sewage discharge and deflation (Figure 1). For pressure measuring instruments, incorrect maintenance and calibration methods are also important reasons for faults such as large variation and jumping rotation [10]. The problem of pipeline valve should be treated synchronously with the rigorous system test of the main system to save time. After the problem of instrument pipeline valve is treated, it can be tested again by using the system pressure of the rigorous test of the main system to ensure that the pressure on the instrument is reduced, so as to avoid damage to the instrument and ensure that the quality and efficiency of instrument installation can meet the needs of power plant system operation.

4.2 Comprehensive application of troubleshooting methods

The maintenance of thermal instruments mainly focuses on the instability of instrument signal transmission, the abnormality of instrument data change and the stop of instrument work. If this happens, it is necessary to replace or repair the thermal instruments. The following methods should be comprehensively used for troubleshooting common faults of thermal instruments (Figure 2):

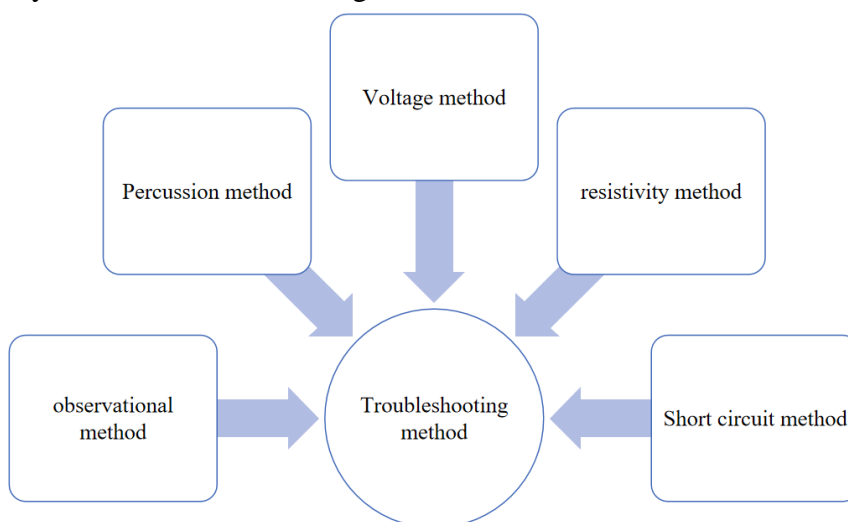


Figure 2: Comprehensive application of troubleshooting methods

Observation method is widely used in the maintenance of thermal instruments, mainly through observation to analyze the quality of component contact, whether there is a broken wire between wires, whether there is a broken wire, whether the contact of wire ends is complete, whether the wires are damaged, etc. Simple faults of thermal instruments can be quickly detected by observation, and can be solved in time.

Tap method is mainly used to check the poor contact in the fault by tapping the instrument gently, such as: there is welding leakage between the thermal instrument and the equipment, the indicator light of the instrument power supply is on and off, and there is water mist in the instrument, etc. These phenomena can be found by tapping method, and the specific reasons of the instrument fault can be found by tapping.

The voltage method uses the voltage structure of thermal instruments to detect the instruments. After the observation method, the voltage intensity of each component is measured by electrifying the whole machine, and compared with the normal value, so as to make a fault judgment. Testing instruments are mainly multimeters. By measuring various components of the instrument with multimeters, we can find out the problematic components and replace them. During testing, we should pay attention to that if the power indicator light of the thermal instrument is not on, it may be that the power supply is not connected properly or the instrument itself is disconnected, which is a problem that is not often encountered in testing and needs attention.

Resistance method is a high application rate industrial instrument maintenance technology based on the measured resistance value. In the specific maintenance, the resistance value is used as the basis for judging the running state of components and lines. If the voltage method is used at the same time, the efficiency and effect of maintenance can be obviously improved. During the testing process, the multimeter can be used to measure the DC resistance, excitation winding, stepping motor winding, etc. If there is a certain difference between the component resistance and the data, it means that the component has obstacles and needs to be replaced in time. At the same time, this technology can also be used to judge whether there is turn-to-turn short circuit and open circuit in each winding.

The short circuit method divides and determines the fault range according to the change of the working state of the instrument part on the basis of dealing with a part or element inside the thermal instrument by short circuit of wires, and makes specific discrimination through the change values of voltage and current. Under certain circumstances, this method can also analyze the faults of instruments in system operation, and judge the fault type and location, and then replace related components. If the faults cannot be solved by component replacement, the whole thermal instrument will be replaced. Then the heat treatment and aging test of the bad instrument or component are carried out, and the whole instrument is resumed.

4.3 Establish a perfect testing and maintenance system for thermal instruments

Scientific and standardized management system has a vital impact on the reliability and rationality of instrument installation and monitoring. Therefore, in the process of grasping the relevant operations of thermal instrument maintenance, we should make full use of the complete inspection and maintenance system of thermal instruments and comprehensively solve all the minor problems according to the periodic characteristics of instrument operation [11]. On the one hand, it is necessary to strictly follow the relevant installation technical standards and do a good job in sealing inspection during the installation of instruments and equipment. On the other hand, it is necessary to do a good job in the later period of maintenance. For example, some sealing covers may have some phenomena such as lax sealing and broken cover after being used for a period of time, and they should be replaced in time through maintenance.

5. Conclusions

Industrial enterprises should put the detection and maintenance of thermal instruments in the first place in the daily production and maintenance process. Because the detection and maintenance of thermal instruments is the key factor to ensure the accurate operation and measurement of the system, and it is also the fundamental guarantee for the production safety and economic benefits of industrial enterprises, it is necessary to put the detection and maintenance of thermal instruments in an important position in industrial production. With the rapid development of information system, the updated thermal instruments have more intelligent and practical functions, such as abnormal alarm, self-examination and correction. In actual operation, thermal instruments can basically completely replace the traditional manual stalking mode, which makes the work efficiency more efficient and the accuracy rate correspondingly improved. Thermal instrument is an important guarantee for product quality and consistency in modern manufacturing industry. It is not only the responsibility of equipment maintenance personnel, but also the responsibility of every enterprise employee to analyze the influencing factors and principles of its failure, so as to formulate a perfect instrument maintenance system.

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