Fault Diagnosis and Maintenance Skills of Electrical Control System

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Abstract. With the advancement of industry and technology and the support of advanced technological processes, electrical control system has undergone tremendous changes. Various technologies constitute advanced technology, and their integration into electrical control system enables industrial business to be developed better. However, due to the late start of industrialization in China, there are still inadequate researches, and it is not mature enough to deal with faults in electrical control. The author first introduces the relevant content of electrical control system, then briefly introduces the electrical fault inspection and diagnosis technology, and finally discusses how to repair the electrical control system.

Keywords: Electrical Control System, Fault Analysis, Diagnosis, Maintenance Skills

Introduction
The economy and science and technology of China have developed by leaps and bounds in the past decade, and progress of industrialization is also obvious. Many industries have completed or basically completed industrialization and achieved gratifying progress. In the development of national machinery industry, electrical engineering occupies a pivotal position. The dependence of modern industry on electrical control system has increased significantly, and electrical control system is relatively safer ad more reliable, and develops more rapidly. But it will still show certain failures in its actual use, hindering industrial use [1]. To strengthen the research on faults maintenance of electrical control systems is to ensure the smooth operation of industrial electrical engineering and assist the better development of industry.

1. Introduction to the Content of Electrical Control System
The electrical control system will choose different methods for different equipment to control the loop. The classification control of electrical equipment with high-voltage and low-voltage also makes the equipment safer and more stable [2]. After completing the control of the equipment under the requirements of design plan, the system is debugged to make the equipment be operated safely and efficiently. In fact, electrical control system consists of large number of ordinary electronic components. And these components perform their duties, exerting a synergistic effect and making the system control work smoothly [3-4]. There should be certain principles for fault diagnosis and repair of electrical control systems, five of which are particularly important, namely principle of prevention,
principle of emergency, principle of value, principle of difficulty and principle of filing [5-7]. Each diagnosis should adhere to the idea of "prevention first, repair second". Spare parts in the maintenance should be prepared in advance, because they can be used to keep normal work in time after the main equipment is damaged. In addition, the maintenance value of electrical control system itself is high, and the maintenance has to be stopped for a period of time, and the production schedule is blocked and the loss is greater. Therefore, the maintenance of electrical control system must be raced against time, and hidden dangers in daily life should be eliminated. And maintenance should be carried out on the principle of "difficult thing first" to reduce downtime of the equipment, and all faults are stored in the fault query table according to the principle of filing.

2. Fault Inspection and Diagnosis Technology of Electrical Control System

According to the actual situation of electrical control system, the most common fault is the poor contact of the line. In case of poor contact, all control instructions are facing failure, and the normal use of other equipment is greatly limited. For example, poor contact between power supply and switch, and unreasonable wire connection short circuit will be occurred in the long-term use process. And the surface of the meter is not clean enough in the air for a long time, and gradually forms oxidation phenomenon. As time goes by, there will be electric shock in the circuit. These conditions affects the actual production, and threaten the safety of staff. The fault of short circuit is also one of the common types. At this time, some structural parts will be burned, the service capacity of the system will be affected, and the production capacity will be blocked [8]. Generally speaking, short circuit may result from the aging of the line or short circuit of the wire.

Methods and descriptions used for fault diagnosis are shown in the follows:

(1) Direct observation

The diagnosis and maintenance can be realized by the visual inspection of the staff. Visual observation is often used for hardware diagnosis to observe whether there is peculiar smell and whether there is light. It requires the staff to have certain maintenance experience, and be able to determine the fault according to scientific judgment. Relatively speaking, the operation of direct observation is simpler, it doesn’t require the use of auxiliary equipment, and cost investment is less and work efficiency is ideal. However, the experience and technology of the staff are vital, and the degree of accuracy should be high, otherwise the maintenance progress will be delayed. Such method can well check the relay fault, fault of switch door and power supply voltage in the mechanical part.

(2) Experimental test

Many faults can't be judged directly by naked eyes, so we can choose experimental method for fault diagnosis. Before the experiment, the technician should make sure that the whole system is in a safe state as far as possible, and the driving machine and the motor can be separated if permitting, and the regulator switch can be reset after the experiment. The separate diagnosis of the driving machine and the motor is more safe. However, in some electrical control systems, they can not be separated from each other. At this time, the main line can be cut off to minimize the scope of the impact. Professional operators should cooperate with each other to carry out fault diagnosis. During the experiment, the voltage should be kept at a stable value as much as possible, and the test should be carried out from a simple place and completed step by step. And the maintenance personnel put forward steps for maintenance from a scientific point of view, check the system switches, adjust the wires, and comprehensively check the auxiliary system. All steps are completed within the scope specified in the drawings. The analysis and exclusion methods can also be comprehensively developed in the experimental method.

(3) Resistance detection and voltage detection

The resistance is to judge the fault by resistance detection, and the voltage is to judge whether the value of the voltage is maintained in a stable range. Generally speaking, the voltage is a constant value in the normal operation. The resistance judgment mainly analyzes short circuit and open circuit, and measures whether there is leakage or the state of electron tube. The voltage is to determine the fault location by comparing the measured DC voltage with the value in the drawing and analyzing the data.
with circuit diagram.

(4) Logical analysis

There will be many principles and relationships of internal accessories in electrical control system. Logical analysis is to analyze the fault range with the use of these principles and logic. But it is worth noting that this is largely a theoretical diagnostic method. Because the internal structure of electrical control system itself is more complicated, there are more parts, lines and devices, and inspection is completed by manpower, but it is time-consuming and ineffective [9]. Therefore, maintenance personnel should refer to design drawings for detailed analysis and careful investigation of each point to avoid mistakes.

3. Maintenance Skills of Faults in Electrical Control System

(1) The use of computer automation technology

In the electrical control system, there will be lines and components inside the system. When the line and components are shut down for diagnosis and troubleshooting, it will face the shutdown directly with great losses. At this time, spare devices can be selected. But it is impossible to design more spare lines, and only some small instruments can choose parallel two states of AB to play a backup role. Therefore, the most needed thing for electrical control system at this time is to assist maintenance with computer automation technology. After the computer is connected to the system, the internal rated data of each device can be checked one by one. Professional inspectors and maintenance personnel can observe and analyze the fault diagnosis data notified from the computer. In addition, with the understanding of the system, they can well assist the maintenance of the system and avoid major losses caused by the shutdown and production to the greatest extent.

(2) The use of new technology

With the gradual development of science and technology, traditional diagnostic methods and maintenance methods of electrical control systems are facing evolutionary upgrade or elimination. The maintenance personnel should include new technology in the primary development goal when they start to analyze their work prospects. The study and research of new technology is helpful to obtain more maintenance skills. When checking the electrical system, we should first start from the main circuit, then deeply understand the various operating states of components, and analyze each device in conjunction with technical drawings. Only in this way can we ensure higher efficiency and accuracy during the maintenance [10].

(3) Troubleshooting for maintenance

After the electrical control system fails, it is of high practical value to choose troubleshooting method together with other methods to carry out maintenance. The troubleshooting method includes self-examination of the system, the multimeter to check such fault as short circuit, and the troubleshooting of the fault code, which can reduce the impact of the fault on the system while operating normally. The troubleshooting method can simplify the maintenance procedure and guarantee the industrial production better [11]. Furthermore, the maintenance personnel must improve their understanding of electrical control system, and make clear the logical relationships; improve their ability to learn more advanced science and technology, and use efficient processing capabilities of the computer to really help electrical control system operate in a good environment.

For example, China's electrical control system contains more electronic components, and each device can coordinate with each other under the action of power to control the entire system. When the circuit connects the devices, it is easy to form a short circuit and cause failure. Short-circuit faults are very common in the entire electrical control system. Once there is a short circuit in the electrical control system, the service capacity of the entire system is greatly reduced, and it may even cause damage to some important devices. Facing the cost increase, the efficiency of the entire electrical control system decreases. Combined with actual analysis and diagnosis, there may be two factors causing short circuit faults in the electrical control system. The first reason is that after long-term use of the circuit connecting the devices, the insulation gradually decreases, forming a short circuit; the second is because the wires are unreasonable when connected. When overhauling a short-circuit fault,
it can be combined with the follow-up characteristics. Instantaneous characteristics as the most basic feature of short circuit, cut off the power immediately after checking out, and check the short-circuit protection equipment such as fuse in time. The three-phase short-circuit protection fuse should also check the phase failure. In the normal operation of the electrical control system, a large current will cause the torque of the motor to increase, causing the internal parts of the mechanical rotation to be damaged. Therefore, attention should be paid to the overcurrent problem in motor inspection and control loop inspection. Overcurrent protection control equipment can be added to some large-capacity motor and asynchronous motor control systems to avoid overcurrent.

(4) Routine maintenance and active maintenance

In addition to the use of various technologies, inspection and maintenance personnel should be more aware of improving diagnosis and maintenance. The daily maintenance of electrical control system can ensure the normal operation of the system. By combining with the protection device of the system itself, it can achieve multi-directional electrical control troubleshooting. In order to avoid the failure of electrical control system, we should keep a high degree of vigilance to the intuitiveness of the failure. The daily maintenance can help maintenance personnel to further understand the system and have a certain understanding of the operation of the system. In this way, some small problems can be well solved in the accumulated daily maintenance. The idea of using hidden dangers to solve problems is worth the deep understanding of maintenance personnel. After the routine maintenance, it is the active maintenance. Comprehensive consideration should be given to the electric quantity before maintenance. Measures such as leakage protection and low-voltage protection can be selected for maintenance. The user should also formulate the equipment maintenance cycle according to the suggestions when the equipment is purchased and its own reality, such as one major inspection every quarter, three to four regular inspections every month, and random inspections every quarter. The contents of the inspection shall be made into a form according to the system conditions, and each inspection shall be registered one by one. In this way, the routine maintenance and active maintenance can be routinely and refined, and the probability of system fault can be reduced.

4. Conclusion

There are many methods for analysis and diagnosis of electrical control system. Direct observation, experimental test, voltage and resistance inspection and logical analysis have their own advantages, which can be used comprehensively in daily diagnosis. In the maintenance work, routine maintenance and active maintenance are highly positive. In addition, the computer automation technology and new technology are deeply understood, and the maintenance combined with troubleshooting method can effectively improve the efficiency of maintenance.

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