

# Reliability Analysis of Electrical Automation Control Equipment

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**Abstract:** Automation technology has also been well developed in real life, especially in today's widespread electrification, people have been inseparable from the electrical industry in life, so now we should ensure the stability and reliability of its operation, so as to greatly improve people's quality of life. In this paper, through in-depth understanding of electrical automation equipment, many aspects of understanding and analysis of various factors affecting the reliable operation of electrical equipment. In this paper, field test, laboratory test and interdisciplinary research methods are used. Under the background of wide application of automation technology, this paper studies the development and exploration of equipment control, trying to find out the main body, content, principle and strategy of resource development in the context of current social development and application. The research results of this paper show that the definition and significance of the reliability of electrical automation control equipment can be clarified, and the relevant measures to improve the reliability of electrical automation control equipment can be summed up by integrating its detection methods, which can provide some reference for relevant staff.

## 1. Introduction

With the rapid development of social economy and science and technology, electrical automation technology plays an increasingly important role in people's production and life [1-2]. Only by improving the reliability of electrical automation control equipment, can we ensure the quality and safety of electrical equipment in daily operation, avoid unnecessary failures, and better ensure the safety of citizens' life and property. Electrical automation control equipment plays an irreplaceable role in industrial production with its high efficiency, high accuracy and high reliability. With the help of electrical automation control equipment, production and processing personnel can supervise and control the whole production process without leaving home. On the one hand, it improves the production quality and efficiency of industrial production; on the other hand, it improves the equipment operators the safety of staff plays a better role in protection. But at the same time, it needs to be clear that in the current increasingly fierce market competition environment, only to ensure that the electrical equipment [3-5].

Only by quality and reliability can the economic benefits of mechanical equipment be brought into full play[6]. Method reliability can measure the quality of electrical automation equipment, which is a very important index [7]. The product quality of electrical automation control equipment can realize the basic value of the product, meet the normative requirements, and ensure that Reliability and safety. Only by ensuring the reliability of the equipment, can we ensure that the equipment can reduce the accident rate in the actual operation and application process, so that the safety performance of the equipment will continue to improve, and can also effectively prevent the failure, and save the maintenance cost for the enterprise. Therefore, the reliability of electrical automation control equipment is an important core element for the product quality to reach the standard, and it is also the development goal pursued by manufacturers [8-9].

With the rapid development of computer technology, it also brings opportunities to the development of industrial electrical automation. In order to realize electrical automation, we need to take digital technology as the support, and use digital technology to provide technical support for electrical automation [10-12]. Computers can be used as auxiliary equipment to detect and control

electrical automation. The computer test system can test and study the high voltage and high current power, so as to achieve the goal of industrial electrical automation. The modern production can not do without the support of digital technology. The modern society with the increasing degree of information must learn to apply digital technology to the actual production, realize the automation of control system and production, so as to realize the industrial automation [13-15]. Digital technology also needs to be better integrated with industrial production to make contributions to China's industrial development.

## 2. Method

### 2.1 Core Concepts

#### (1) Electrical automation

Electrical engineering and automation is a new discipline in the field of electrical information, but because it is closely related to people's daily life and industrial production, it develops very rapidly, and now it is relatively mature. It has become an important part of high-tech industry, widely used in industry, agriculture, national defense and other fields, and plays an increasingly important role in the national economy. Its tentacles extend to all walks of life, ranging from the design of a switch to the research of aerospace aircraft. Students of this major can be engaged in system operation, automatic control, power electronic technology, information processing, test technology, research and development, economic management, electronic and computer technology application and other fields related to electrical engineering, and are wide caliber "compound" senior engineering technical talents. There is a great demand for high-level talents in this field. It is estimated that with the entry of large foreign enterprises, there will be a large gap in this professional field. At that time, there is likely to be a shortage of talents.

#### (2) Automatic control equipment

It refers to the equipment that is produced by a single automatic equipment instead of being linked into an automatic production line or semi-automatic production line. Electrical automation is that the mechanical equipment automatically completes the operation, control and monitoring of the product according to the plan and program in advance under the condition of nobody or few people. With the rapid development of mechanical electronic technology and microelectronics technology, electrical automation control is widely used in various industries. Electrical automation improves the production efficiency, improves the reliability of work, improves the economy of operation, ensures the quality of electric energy, greatly improves the working conditions, and greatly facilitates people's life.

### 2.2 Research Methods

(1) Field test method. The field test method is a commonly used test method for electrical automation control equipment. In the test process, the normal operation of the equipment and the equipment itself will not be affected. The relevant data can be collected in the normal operation of the equipment. The tester can determine the reliability of the electrical equipment by analyzing the collected data. Because this test method is most close to the actual production, so the accuracy and availability of the measurement results are high. The results of the test analysis directly show the operation reliability of the equipment.

(2) Laboratory test. Different from the field test method, the laboratory test method is to test the reliability of electrical automation control equipment in the laboratory. Industrial production can be divided into continuous process, discrete process and batch process. Each process needs to take corresponding control methods according to different characteristics. In the electronic automatic control system, the digital PID controller technology can be used, and the control law of the controller is shown in formula (1).

$$u(t) = K_p \left[ e(t) + \frac{1}{T_i} \int e(t) dt + T_D \frac{de(t)}{dt} \right] \quad (1)$$

The transfer function of the corresponding analog PDI regulator is:

$$D(t) = K_P \left( 1 + \frac{1}{T_I S} + T_D S \right) \quad (2)$$

Where,  $K_P$  is the proportional gain,  $u(T)$  is the control quantity, and  $E(T)$  is the deviation quantity. During the test, the operation environment and parameters of the equipment are simulated manually by the tester. Therefore, the advantage of this test method is that it can test the reliability of the equipment under various operation environments in the same test. The analysis environment and results are more comprehensive. The disadvantage is that the operation environment simulated manually is inevitable to the actual operation environment there are some gaps, so the test data is not accurate.

(3) Guarantee test method. Compared with other industrial machinery and equipment, the mechanism of electrical automation control equipment is more complex, and the number of parts is more. The existence or problem of any part may cause equipment failure. Therefore, some enterprises take the method of ensuring test for electrical automation control equipment, that is to say, the equipment manufacturer is required to do a good job in the quality of parts when the equipment leaves the factory. Through testing, we can find out the problem before the equipment is put into use, and reduce the failure rate in the process of using the equipment. The disadvantage of guarantee test method is that it is relatively difficult to test and the test cycle is long, so it is usually used as automatic control equipment with high reliability requirements.

### 3. Experiment

#### 3.1 Experimental Data Source

In this study, 120 sets of electrical control equipment were randomly selected for investigation and study. These equipment come from different factories, and the specific control direction of each equipment is not the same. At the same time, the equipment staff was also familiar with the relevant parameters. The selection of these research objects is mainly based on industrial development level factors, use intensity, loss situation factors and economic factors. The comprehensive consideration of these factors is conducive to the representativeness and typicality of experimental data.

#### 3.2 Experiment Implementation

The basic experiment platform of electrical automation includes the basic experiment platform of electrical automation A and the basic experiment platform of electrical automation B. The basic experiment platform of electrical automation A adopts the structure of m218 (24I / O) + atv312 + HMI, which can be used for the teaching experiment of the courses of electrical control and programmable controller, electric drive automatic control system, computer control technology, distributed control technology, configuration software, etc. And related training; the configuration can complete the motor direct start, motor forward and reverse control, intelligent motor start and control, motor frequency control, inverter analog control, inverter multi-stage speed control and communication control, PLC logic control, PID control, temperature control, MODBUS communication, Ethernet communication, touch screen operation interface and other related experiments. Basic experiment platform B of electrical automation is composed of m218 (40i / O) + lxm23c + HMI, which can be used for teaching experiment of control motor and electric drive automatic control system, teaching experiment of configuration software, PLC Course Design, computer control course design, graduation design and relevant training. This configuration can complete precise servo speed control, precise servo position control PID control, temperature control, high-speed count input, Ethernet communication control, touch screen operation and other related experiments.

### 4. Discussion

#### 4.1 Data Visualization

In the questionnaire survey, a total of 120 questionnaires were sent out and 100 questionnaires

were recovered, of which 90 were valid questionnaires with an effective recovery rate of 90%. The experimental results were valid. The basic information of the respondents is shown in Table 1.

Table1. Operation status investigation of control equipment

<b>Domestic Equipment</b>	Technical problems	Stability	Satisfaction with Use
	35%	26%	47%
<b>Foreign Imports</b>	Technical problems	Stability	Satisfaction with Use
	13%	31%	53%
<b>China and Foreign Countries</b>	Technical problems	Stability	Satisfaction with Use
	20%	30%	42%

## 4.2 Analysis and Discussion

If equipment wants to operate stably, the quality of its components and materials needs to be strictly screened. First, the concept of quality first should be established. This is a big premise. Under this premise, further work should be carried out. When the equipment is not in operation, comprehensive and thoughtful inspection and aging test should be carried out, after these steps are completed, a trial run is required. After sorting out the data parameters through the on-site simulation, then through the big data analysis to determine whether the equipment has the conditions for production, through the above operations to ensure the stability and reliability of the equipment operation. Therefore, these factors need to be fully considered in the design stage, and the external factors that will affect the reliability of the equipment will be minimized through design. On this basis, the actual production needs of various functional blocks need to be considered according to the product functions. We should think about how to make the layout more reasonable and scientific. At present, the more commonly used design layout is modular design, the working principle is to make each module responsible for a function, but here there is a special need for attention, the power module cannot be put together with other modules, in order to ensure that each module can work normally, we need to pay attention to the electromagnetic interference. Heat dissipation of electrical equipment is a very important problem. If it is handled improperly in normal times, it may cause serious consequences. Electrical equipment will form a lot of heat energy with long-term operation. It should be pointed out that the appearance of heat energy will not only seriously threaten the life of components of the equipment, but also cause a lot of ineffective work of the equipment. In addition, if the temperature in the working environment of the equipment is too high, it will affect the divergence of the thermal energy of the equipment to a large extent, resulting in the rise of the temperature of the equipment. Therefore, it is necessary to pay attention to this part when designing the equipment, and set up perfect heat dissipation measures, such as adding mechanical ventilation fan and other hardware or other methods.

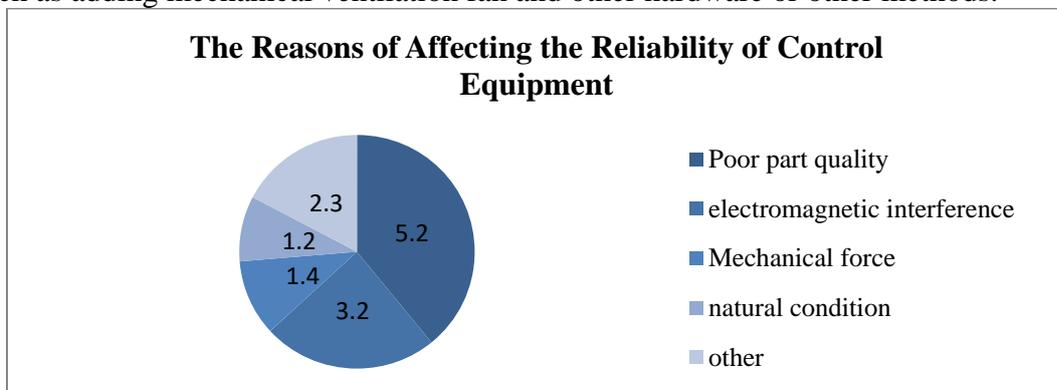


Figure1. Main reasons affecting reliability of electrical automation control equipment

## 5. Conclusion

Through the analysis of the above content, the reliability of electrical automation equipment

must be focused on in the use process, so relevant staff should fully consider the reliability of electrical equipment before manufacturing electrical equipment, first of all, all parts of the equipment must be reliable and safe. This is the sufficient condition for the safe and stable operation of the equipment. In addition, the technicians should put the scientificity and rationality first in the design of the equipment. At last, in the process of putting the equipment into the actual life work, they should take sufficient follow-up measures to ensure the work effect, so as to ensure the reliability of the electrical automation control equipment through the above solutions.

The reliability of electrical equipment in actual operation will have a very important impact on the equipment manufacturers and customers. At present, there are problems in the current situation of equipment maintenance and parts design, which makes the economic construction improve the quality and output requirements of the manufacturing industry, and the production load of the enterprise increases accordingly. Such production situation makes the working time and performance of the equipment have been improved to a certain extent, so the relevant staff of electrical automation control equipment need to make use of the site and laboratory To ensure that the test mode can conduct all-round test on equipment performance and ensure equipment quality. The basis of efficient production of electrical automation is the reliability of control equipment, and the stability of equipment will also promote the national economic construction. Relevant staff needs to strengthen the research in this area to ensure the good performance of equipment, and bring expected economic benefits and social benefits to the enterprise.

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