

# Reliability Analysis of Electric Automation Control Equipment in Hydropower Plant

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**Abstract:** With the vigorous development of science and technology in our country, the technical level in various industrial fields has been greatly improved, including the electrical automation control technology in hydropower plants. Based on this, this paper discusses the factors that affect the operation of electrical automation equipment in hydropower plants, and puts forward measures such as improving the reliability of equipment design, selecting the best electronic components and strengthening equipment testing, hoping to promote the continuous development of electrical automation technology in hydropower plants.

## 1. Introduction

The development scale of hydropower plants is expanding with the stability of the economic situation, and the electrical automation technology is constantly being innovated and improved. In the actual operation process, many factors will affect the electrical automation of hydropower plants, including working environment, component quality, maintenance and operation technology and so on. Therefore, how to master the relevant factors and effectively improve the reliability of electrical automation equipment in hydropower plants has become a new topic.

## 2. Influencing Factors in the Process of Electrical Automation Operation of Hydropower Plants

### 2.1 Working environment of electric automation control equipment in hydropower plant

The operating environment of the equipment will have a greater impact on the electrical automation of hydropower plants. Due to the complexity of the working environment, the reliability of automation equipment will fluctuate greatly, and the failure probability will also be greatly increased. At the same time, in the process of equipment operation, it is more vulnerable to electromagnetic interference, thus affecting the effect of equipment instruction reception and feedback, resulting in reduced automation performance and increased loss. In addition, temperature, humidity, pollution and other factors in the natural environment will also affect the operation of the equipment, which will lead to the failure of the electrical automation operation of the hydropower plant to perform its normal functions.

### 2.2 Whether the components of automation equipment meet the actual operation requirements

Compared with traditional thermal power generation, hydropower plant power generation can reduce consumption and pollution, which is in line with the concept of environmental protection at this stage. In the actual operation process, there are still having difficulties in the operation of automation equipment in hydropower plants. For example, the internal fuse fails in thunderstorm weather, making the transformer short circuit unable to operate normally. In addition, if the wiring device is burned down, the transformer will inject oil along the oil storage tank and the safety air passage, causing abnormal noise, and some opening and closing control devices are relatively easy to be damaged, which will cause damage to the components of the automation equipment, thus affecting the normal operation of the equipment.

### 2.3 Maintenance and Protection of Automation Equipment

The operation of electrical automation equipment has improved the traditional power generation mode and promoted the development of hydropower plants. However, in the actual operation process, it is necessary to strengthen the supervision of the stability of equipment and parts to avoid the occurrence of various kinds of faults. Take a power plant as an example, the specific breakdown and accident consequences between January and August are shown in the following table.

Table 1 Statistical Data Sheet of Electrical Automation Equipment Faults

Timing sequence	Element	Cause of trouble	Consequences of the incident
Jan	Air switch	Aging in long-term operation	Shutdown for 1.20h
March	Power supply	Switching power supply line disconnected	Stop for 0.60h
july	Relay	Stop running if the temperature is too high	Stop for 3.20h
August	Terminal	The aging end of the line falls off	Stop for 1h

Once shutdown is caused for various reasons, it will cause time and economic losses to the hydropower plant. Therefore, it is necessary to strengthen the repair and maintenance of automation equipment to avoid the failure of equipment under the condition of continuous operation, which will affect the normal operation of hydropower plants.

### 2.4 Operating techniques of staff

In the daily equipment operation process, the operation of the staff will also affect the reliability of electrical automation control equipment. Due to the inadequate pre-job training and the lack of equipment control skills and experience of the staff, improper operation resulted in operational problems [1]. Therefore, putting more high-quality staff into the work can effectively improve the reliability of the operation of automation equipment, prolong the service life of equipment, and promote the safe and stable operation of hydropower plants.

## 3. Specific Strategies to Enhance the Reliability of Electrical Automation Control Equipment in Hydropower Plants

### 3.1 Improving the reliability of automatic control equipment design

The stability and reliability of automatic control equipment are the basic conditions for the operation of hydropower plants. In the process of its operation and management, strengthening the comprehensive analysis of various factors is conducive to the further implementation of electrical automation technology. Through the comprehensive consideration of different influencing factors, the paper puts forward more perfect countermeasures to improve the reliability of the equipment, organize the relevant parameters needed in the work, and strengthen the understanding of the equipment operation and its performance. In the production process of electrical automation control equipment in hydropower plants, factors such as production scale, quantity and economic characteristics should be effectively controlled in combination with the actual situation, so as to fundamentally improve the reliability and stability of the equipment.

### 3.2 Selecting the appropriate electronic components preferentially

With the continuous improvement of the requirements of all aspects of the operation of electrical automation control equipment in hydropower plants, higher standards have been set for the selection of components. The choice of components is different for different operating environments and production technologies. This requires the staff to strictly control the quality and performance of electronic components when selecting them to ensure the normal operation of the equipment. The allowable temperatures of various components are shown in the following figure.

Table 2 Allowable Temperature Data for Common Components

Element	Allowable temperature (°C)	Element	Allowable temperature (°C)
Carbon-film resistor	120	Silicon transistor	150~200
Printing resistance	85	Valve	150~200
Dielectric capacitor	60~85	Germanium transistor	70~100
Mica capacitor	60~85	Transformer	95
Thin film capacitor	70~120	Choke	95

Electronic components are greatly limited by temperature. Whether they are at a reasonable temperature is closely related to the reliability of the overall equipment operation. Therefore, it is necessary to select qualified and qualified electronic components according to specific conditions to promote the smooth operation of electrical automation equipment.

### 3.3 Strengthening the quality and stability of the control system

Factors affecting the overall stability sometimes occur in the operation process of the electric automatic control system in hydropower plants. When setting the parameters of the detection system, the quality parameters and performance indexes of the equipment under normal conditions can be obtained only after the actual operation conditions of the relevant equipment are closely measured [2]. At the same time, professional technicians should pay attention to improving the working environment of automation equipment and control the set temperature according to the actual climate conditions when compiling programs. So we should strengthen the all-round investigation on the working state of the equipment to effectively improve the stability and safety of the equipment operation.

### 3.4 Strengthening the inspection of electrical automatic control equipment

The probability of failure of electrical automation control equipment in hydropower plants is greatly increased after long-term operation. In order to avoid such a situation, it is necessary to regularly detect and update the automation equipment. Common test methods include laboratory test, field test and guarantee test. In general, laboratory tests are the most reliable, ensuring that although tests are reliable, they require a long testing time, so large-scale tests cannot be conducted. The field experiment is the most common test method, and the test results can be obtained directly in the real environment.

### 3.5 Strengthening the management of working environment and personnel

The working environment will have a great impact on the operation of electrical automation equipment in hydropower plants, so it is necessary to ensure that the environmental conditions conform to the standard of stable operation of equipment. For example, if the equipment is in an excessively humid environment, it will cause damage to components and even short circuit of the equipment. Therefore, the equipment should be isolated from inappropriate working environment. At the same time, the circuit principle in the automatic control equipment is very complex, and the staff need to combine the circuit principle with the actual operation condition in the actual operation process, and strengthen the learning of professional knowledge, so as to promote the reliability of the electric automatic control equipment in the hydropower plant to continuously improve.

## 4. Conclusion

To sum up, strengthening the reliability analysis of electrical automation control equipment in hydropower plants and effectively managing and monitoring the equipment play an important role in the production and operation of hydropower plants. In daily management, it is necessary to optimize the design of automatic control equipment, improve the quality and stability of the control system, timely detect the operation of equipment, provide a good operating environment for

automatic equipment, and promote the further development of electrical automation technology in hydropower plants.

### **References**

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