Research and Application of Substation Site Maintenance Assistant Safety Management System Based on Computer Control System

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Abstract. With the continuous development of China's economy and the continuous improvement of people's living standards, people's demand for power energy is increasing, directly promoting the continuous expansion of China's power system construction. However, the increasing number and scale of transformer substations have also increased the complexity and difficulty of their maintenance work. In recent years, the auxiliary safety management system based on new communication technology has been put forward and applied, which has improved the safety level of transformer substation maintenance work to some extent and reduced the probability of related safety accidents. This paper will start with the existing problems in the process of transformer substation maintenance at this stage, and mainly discuss the auxiliary safety management system of maintenance and its application.

Keywords: Transformer Substation Maintenance, Intelligent Maintenance Center, Auxiliary Safety Management System, computer control system

1. Introduction

As an important part of China's power system, transformer substation is an important guarantee for its safe operation. Once the transformer substation has potential safety hazards, the power system cannot run normally and the power cannot be transported to the terminal if the degree is relatively light, and the degree is relatively heavy, leading to major safety accidents and casualties [1]. Therefore, the importance of transformer substation maintenance is obvious. Only when the safety work of the transformer substation is done well, can the normal transportation of electric energy, the normal life of people and the normal operation of society be guaranteed, and the occurrence of safety accidents can be effectively avoided [2]. However, in the on-site maintenance process of the transformer substation, the working area of the transformer substation is large and the activity scope of the maintenance staff is large, so the supervisors cannot supervise every staff at all times. In addition, the professional quality of some relevant personnel is insufficient, which leads to many risk factors in the maintenance
process and easy to cause safety accidents. Therefore, the related equipment auxiliary safety management system is put forward and is gradually applied in practice [3].

2. Safety status of transformer substation on-site maintenance

2.1. The lack of professional skills and professional quality of maintenance personnel

Among the maintenance personnel of transformer substation, some of them have weak safety awareness and low professional quality. In the actual maintenance process, these maintenance personnel will be unable to effectively prevent safety accidents due to various factors, such as poor maintenance technology, unfamiliarity with overhaul equipment and safety hazard points, and lack of safety prevention technology, leading to an unsalvageable situation [4]. With the continuous development of science and technology, the equipment involved in the transformer substation is becoming more and more advanced and complex [5]. Therefore, its maintenance work has become increasingly demanding on professional technology, and the maintenance workload and difficulty are also increasing. Once the maintenance personnel's professional skills and professional qualities do not meet the standards, not only the maintenance work is difficult to achieve the desired results, may also bury a catastrophic potential safety hazard.

2.2. Imperfect safety management for on-site maintenance

The reasons for the imperfect safety management of on-site maintenance work mainly come from the impact of the maintenance environment itself and the lack of supervision by supervisors. The maintenance environment of some transformer substation is relatively complex, among which some high-voltage operations and high-altitude operations in the maintenance work have many risk factors and cannot carry out effective safety management work, which is greatly influenced by the site factors of maintenance site. In addition, there are many working areas in the transformer substation, and some supervisors are less active in their work, so they cannot carry out the supervision work in strict accordance with the work requirements [6]. As a result, the work efficiency of safety management is low, and it is impossible to truly prevent safety accidents.

3. Research on auxiliary safety management system of maintenance

The work of the auxiliary safety management system mainly relies on the intelligent maintenance center and intelligent maintenance module. Among them, the main function of the intelligent maintenance module is to detect whether there are safety hazards in the operation of the equipment and quickly generate alarm signals such as sound and light. The main task of the intelligent maintenance center is to receive the alarm information from the intelligent maintenance module and record the warning information. As a kind of auxiliary equipment system, the safety management system can detect the safety hidden danger in time and reduce the probability of safety accident caused by subjective factors or errors of staff.

3.1. Overall design of the system

Detection terminal and client are two major components of the auxiliary safety management system of maintenance. Among them, detection terminal, namely intelligent maintenance center, includes sensor module, CPU module, alarm module and Wi-Fi module, etc. It is responsible for monitoring all equipment in the transformer substation, collecting warning information and real-time alarm. The client, namely intelligent maintenance center, including databases, client interface integration devices and gateways, is responsible for processing and sending alarm messages. The Figure 1 is the structure diagram of the auxiliary management system for transformer substation maintenance.
The sensors of the detection terminal are mainly laser induction devices and vibration inspection devices. Usually the former is installed on the wall and equipment of the transformer substation, while the latter is installed on the counter. The Wi-Fi module is installed on the detection device. Its communication mode can use electromagnetic wave, and take electromagnetic wave as the carrier to transmit alarm information rapidly. It is easy to install and does not need to carry out wiring work.

In the client, the gateway is an important hub of the whole auxiliary security management system, which connects the detection terminal and the client. Through the gateway, the alarm information collected from the detection terminal can be packaged and transmitted to the client. The frequency of collection is high and the transmission speed is fast.

3.2. Design of system function module

In the auxiliary safety management system, the main modules include maintenance alarm, real-time detection, data reporting and system management.

(1) Maintenance alarm module

Early warning management. In order to send the alarm information to the on-duty personnel and management personnel in a timely and rapid manner, three kinds of alarm modes are designed in the safety management system, which are acousto-optic alarm, short message alarm and system alarm. The acousto-optic alarm is used to transmit the alarm information to all the people present through the buzzer and indicator light in the transformer substation. The short message alarm refers to the use of mobile phones or other communication messages to timely transmit alarm information to relevant important personnel. The system alarm system is designed to give the traditional alarm information to the personnel on duty and management personnel. It mainly prompts related personnel by popping security alarm information on the client. For alarm mode, alarm continuous time, alarm important contacts can be set up in detail.

Alarm processing. Alarm processing is mainly for system alarm. After receiving the alarm information, the management will process it. When the alarm information is released, the client will automatically record the details of the alarm information, relevant detection data and management's processing operation in the corresponding database. The detailed information of the alarm includes the date of the occurrence of the alarm, the cause of the alarm, the area of the alarm and the type of the alarm.

(2) Real-time detection module
The purpose of the real-time detection module is to monitor the status of the detection terminal and to view the alarm area conveniently.

(3) Data module

The function of data module design includes the inspection and deletion of alarm history records and the export of relevant data. The main purpose is to facilitate the management of alarm data.

(4) System management module

The system management module is designed to better view and change the relevant settings of the system. The first installation and application of the auxiliary safety management system in transformer substation is required to initialize the system function settings. For example, it is necessary to input the accurate distribution map of transformer and other system equipment in transformer substation into the client, and at the same time, it is also necessary to input the corresponding equipment of the detection terminal to the client, so as to transmit the alarm information accurately when an alarm occurs.

4. Application case of maintenance auxiliary safety management system

After the design of the auxiliary safety management system for the maintenance of a transformer substation Beside the Yangtze River in Nanjing, Nanjing, it entered the trial stage. Firstly, the maintenance area of transformer substation is divided scientifically and reasonably, laser induction device and vibration inspection device are installed on the relevant equipment and cabinet, and WI-FI module is installed on the detection device. When a detection terminal finds that a person is mistaken or mis-operation, the system will produce three kinds of alarm, alarm information in different forms will be transmitted to the corresponding personnel, and the client will record the alarm information in detail and store it in the database. During the trial period of maintenance auxiliary safety management system, the effect is good. It can not only make up for the influence of maintenance environment, as well as the hidden safety risks caused by the improper operation of maintenance personnel, but also solve the problem of supervisors managing multiple maintenance areas at the same time.

5. Conclusion

As a key part of the power system, transformer substation is of great significance and an important guarantee for the normal transmission of power energy to the terminal. With the development of society, the demand for electricity in various fields is increasing, and transformer substation in China are also constantly building and developing. However, there are still many safety problems in the operation of the transformer substation, and the transformer substation on-site maintenance work is not effective, sometimes not only failed to solve the security problem, but also buried a greater security risk. Therefore, maintenance auxiliary safety management system has been put forward and applied. The system incorporates advanced sensing technology and information science and technology. In practical application, it can effectively improve the efficiency of power production and ensure the safety of power production. It is worth further study.

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