Research on Electrical Automation Control System and Design Based on Geographic Information Technology

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Abstract. As the pace of power plant construction accelerates, higher requirements are placed on the application performance of the control system. From the current development status of the current electrical control system, it reflects the characteristics of multi-function, miniaturization and intelligence, and provides an important guarantee for the reliable operation of the electrical system. This paper analyzes and studies GIS in geographic information technology and power system application. The structure and function of electric power GIS system are designed. According to the structure and particularity of distribution network, a new distribution network database model is established. The overall planning and design of the network information database are carried out. The design idea of electric automation control system is discussed, and the development trend of electric automation control system in the future is prospected.

Keywords: Geographic Information Technology; Electrical Automation; Control System.

1. Introduction
With the continuous development of science and technology, the electric automation control system has played a very important role in the development of the industry. The electric automation control system not only improves people's attention to the industry, but also directly illustrates the reliability of the system design [1]. As an important part of power system, automatic control system can provide protection and automatic detection function for the whole power system. It can be seen that the electric automation control system plays a great role in life. Electrical automation control systems have been widely used in modern manufacturing, space flight, medical research, transportation and other fields [2].

The design of electrical automation control system needs to take a professional road, and achieve the combination of decentralized control and centralized monitoring to ensure the function of the electrical system is more perfect. This paper focuses on the design and implementation of the continuous casting machine process and its electrical automation control system, hoping to promote the optimization of the product and process structure of the smelting steel enterprise. The emerging GIS technology has created conditions for the scientific management of power system equipment and the “visualization” of data. Therefore, GIS has been widely used in the management information system of the power sector offline.
2. Methodology
The electrical automation system can utilize the templating and centralized structure, and the centralized monitoring mode also has its own operation and maintenance characteristics. Therefore, in order to increase the processing speed of the monitoring object, all functions must be centralized and processed together. There are many ways to choose the control system design, but different design methods have different advantages and disadvantages, and it is required to select according to the actual application requirements [3]. However, since the main feature of centralized is to concentrate the functions of the system into one processor for processing, the task of the processor is quite heavy and the processing speed is affected. Power Management System GIS technology is a new method for power management. Electrical automation control system monitors current and voltage in real time by computer, and installs protective and controllable devices during construction to avoid the harm caused by electrical equipment problems. Thus, the switch control and operation are disconnected; the protection procedures for controlling power generation units, plant transformers and excitation transformers are controlled; and an important excitation system for generators is formed, which consists of start-up and de-excitation operations and switching operation of excitation increase and decrease control modes [4]. At the same time, the operation lock of isolation switch and the interlock of circuit breaker adopt hard connection. Because the auxiliary contact of isolation switch is often not in place, the equipment can not be operated. One of the important application functions of power automation control system is that when the equipment fails, the circuit can be switched off in time to prevent safety accidents.

As shown in Figure 1 below. This structure is based on the power system infrastructure consisting of power conversion, transportation, consumption and driving devices. They include power plants, transmission lines, transformers, intelligent instruments, capacitor banks, reclosures and various equipment. Smart meters enable two-way flow of electricity between utilities and consumers, enabling consumers to produce and supply energy to the grid, thereby becoming a "consumer."

![Fig. 1 Smart grid structure](image)

For the continuous caster, its electrical automation control system mainly includes the following parts: various electrical components, AC and drive related devices and intelligent instruments, etc. Data exchange occurs between such equipment and PLC control system to provide field measurement parameters and receive control parameters [5]. The system design fully takes into account the expansion of the system scale in the future, the demand of users and so on. The system is composed of hardware and software. Users can configure flexibly according to their needs. The system software must adapt to the rapid development of computer technology [6]. However, it should be noted that the disadvantages of centralized monitoring are more obvious, requiring all functions of a processor control system, which requires a very high performance of the processor, if its performance is poor, it will be difficult to
guarantee processing speed. The remote monitoring mode has the advantages of saving a large number of cables, saving installation costs, saving materials, high reliability, flexible configuration, etc. The GIS system organically combines grid facility graphical information with database information and geographic information. In this way, geographic information is added to the graphical information and device data, and the power supply facilities and the grid structure are linked to the geographic location, so that the management unit can accurately grasp the spatial distribution of the distribution network. The electrical part of the power plant is relatively large, and all of this method is suitable for small system monitoring, but not for the construction of the entire plant's electrical automation system. By connecting with the monitoring system through the communication line, a large number of control cables can be saved, saving a lot of investment and installation and maintenance workload, thereby reducing the cost.

Figure 2 shows the three functional communication data paths and the basic components of the SA system. Although this is the case with energy management systems (EMS), data flows are similar for distribution management or SCADA systems.

Whether the design of electrical automation system is scientific and reasonable directly affects the operational safety of power equipment, so the standardized design process is necessary. The system decentralized control level uses the field bus, and the centralized control level uses high-speed Ethernet. Through the network segmentation, the interconnection of the electrical room, the operation room and the machine room is realized by means of the switch technology, which facilitates the subsystems. The mutual transfer of data. In the current automation system design, more field bus, Ethernet, etc. have been introduced into it, which provides the possibility for the realization of the network control system. The functions of analysis, calculation and research of power application GIS system have been strengthened continuously. From the original simple graphics processing system, it has developed into a comprehensive information application system which can provide a variety of technical solutions for power system. Intelligent electrical equipment has also developed rapidly, which lays a good foundation for the application of networked control system in power plant electrical system. The field bus monitoring mode makes the system design more pertinent, and has different functions for different intervals, which can be designed according to the situation of intervals. The communication bus of field monitoring is a two-way transmission of data by serial connected intelligent equipment and automation system. This serial cable can effectively link PC, monitoring software, PLC and CPU in the central control room, and connect remote frequency converter, instrument, motor starter and low voltage circuit breaker.
3. Result Analysis and Discussion

In recent years, thermal power units with high parameters and large capacity have become the main units in the domestic power industry. Thermal control technology of thermal power plants has also reached a new level with the increase of single unit capacity of thermal power units and the progress of control instruments. Through the management of data resources in each field, many functions are realized. As far as application software is concerned, there are many types. For the configuration of the rack, the configuration of the PLC system rack includes the configuration of the main rack and the extended rack. The configuration of the main rack should be based on the actual distribution of each module, and the module can be added one by one by right clicking on the backplane with the mouse. The real-time data (such as feeder current, bus voltage, transformer temperature, user load) provided become attributes of the corresponding components in the GIS database, which are refreshed by users or at regular intervals, and the real-time information of the power grid is "written" into the "power grid model". In the design process of the remote electrical control automation system, it is necessary to pay attention to the presence of more logic quantity control variables in the control variables. The purpose of the application is to ensure that the electrical equipment can follow the specified sequence when the auxiliary machine is turned on/off, and to ensure the equipment room. Protection, sequence control. The task of the coordinated control system is to control the energy balance and mass balance between the input and output of the unit. Constantly eliminate various internal and external disturbances in operation, meet the load demand of the grid to the unit, and stabilize the unit operation. Compared with remote monitoring, the form of field bus is more targeted, different areas have different functions, and all the advantages of remote monitoring also complement that part.

For systems that connect one module at a time, control functions are assigned to automation or operators based on the frequency of switching between modules. If switching between modules is frequent and requires no operator's permission, the switching function can be assigned to automation. Figure 3 shows the switch controlled by automation.

![Fig. 3 Switched by an automated system](image)

For main protection and safety automatic devices such as generator and transformer protection, it is difficult to implement the functions in DCS because of the mature equipment, and it may increase the considerable cost, so it can be retained. At the same time, the communication system can be used to connect the monitoring system and the smart device, which is beneficial to the cable usage. With the development and continuous improvement of science and technology, the distribution network is also constantly improving. Therefore, the power automation technology has also developed rapidly. The extended rack configuration includes the configuration of the network, the remote OI cabinet, and the attached equipment. In addition, when setting the module parameters, you need to describe the name of the module, arrange the slot number of the rack, and select the matching method. Thereby supporting
the integration of electrical equipment management and control, achieving an organic collection of power equipment management and production automation. Electricity Business Management System (ESMS) is an application of GIS for power users, which is used to provide user information. Utilizing the integrated management and control system to realize the dispatch of power equipment, and to issue corresponding safe production operation instructions, effectively cope with faults and emergencies. With the use of high-pressure fuel-resistant servo mechanism, the electric control system is more and more matched with the turbine, which realizes the three loop control of speed, pressure after regulation stage and electric power, as well as the function of valve management and connecting stress start-up. It not only reduces the cost, but also makes the functional devices relatively independent, realizes network connection and flexible configuration. At the same time, it improves the reliability of the system so that the system will not be affected or even paralyzed by single device failure or connection problems.

With the rapid development of electrical technology, more advanced technologies and platforms will gradually be integrated with electrical technology, such as Windows platform, OPC technology and so on. With the continuous development of science and technology, electrical automation technology has been widely used. People can use electrical automation technology to realize distribution network automation, realize self-repair of distribution equipment, and prevent equipment failure. For multi-task operating system, it mainly achieves the reasonable sorting and timely processing of tasks through task scheduling function. In addition, the functions of each device are relatively independent, the devices are connected only through the network, and the network configuration is flexible, which greatly improves the reliability of the whole system. Any device failure only affects the corresponding components, and will not lead to system paralysis. In the power GIS system, due to the particularity of its application purpose, and different from the ordinary geographic information system, the data can be divided into two types: spatial data and attribute data. On the basis of ensuring the safety of the unit, the goal of extending the life of the unit as much as possible in the fluctuation of the operating state and improving the economics of the unit as much as possible in the steady state operation is achieved. In this trend, these factors have become more important for the structural rationality and development space of the software, the acceptance of communication data, and the higher requirements for the use and unification of the configuration environment. With the realization of such a trend, electrical automation will be continuously improved and improved, and will play an important role in more fields.

4. Summary

In summary, the design of electrical automation control system is a relatively complex process, which needs to make a trade-off between system cost, flexibility, and available tools to ensure its practical application. In fact, the development trend of electrical automation control systems should be decentralized, open and informative. The decentralized results ensure that each module function in the network is independent and thus decentralizes the system to achieve safe and reliable system operation. On the basis of the completion of the development of the distribution network management system based on geographic information technology, the actual operation, testing and modification of the functions of each module of the system are carried out, and the practicability of the distribution network management system developed by the test is verified by the test. The improvement and expansion work laid a good foundation. However, because it is closely related to people's lives, people attach great importance to it, so that its development speed is very fast now, all aspects are becoming mature and perfect, and electrical automation technology can improve the monitoring efficiency. In contrast, field bus monitoring is more effective in achieving the goal of automatic control. At the same time, according to the characteristics of GIS and the application demand of power system, the specific application of power GIS system in load forecasting and power network planning is explored and analyzed. And under the background that more advanced technologies are constantly integrated into the control system, the application of automatic control system will be more extensive.
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