The Function and Application of 3D Visualization in Power Operation and Maintenance System

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Abstract. Traditional power system monitoring of substation and distribution related equipment often relies on sensor measurement parameters and relay action displayed on the system platform, and it is often difficult to intuitively obtain power system operating status information. In unmanned operation and maintenance, smart substations and other systems there are many shortcomings in the design process. Three-dimensional visualization technology provides a boost to the upgrade of the power operation and maintenance system, which can realize the identification of the physical image of the power equipment and the display of the three-dimensional model, and can combine the big data processing technology to realize the efficient operation and maintenance management of the power equipment. In the process of specific applications, electric power companies can correlate the actual operation of power equipment with the operation and maintenance system, and can also assist operation and maintenance managers in decision-making analysis by obtaining relevant data including three-dimensional time and space, but can also build a simulation platform Space to assist in relevant training.

Keywords: 3D Visualization, Power Operation and Maintenance System, Functional Application

Three-dimensional visualization technology is an important technology for the power industry to achieve higher development goals and an important technology for the construction of smart substations and smart grids. The traditional power operation and maintenance system is difficult to adapt to the current intelligent needs, and the three-dimensional visualization technology highly integrates the existing information and electrical related technologies to achieve a new upgrade to the operation and maintenance system. With the help of the three-dimensional visualized power operation and maintenance system, the operation and maintenance manager can also have a more intuitive understanding of the operation of the power system, so as to carry out daily inspections, fault handling, load analysis and other related tasks more efficiently.

1. Analysis of the Role of 3D Visualization in the Power Operation and Maintenance System

At present, in the process of operation and maintenance management of substations and transmission lines, electric power companies often can only use the system to realize data viewing and analysis on a
two-dimensional plane. The acquired equipment status information, sequence control information and alarm information are dependent on the main source of information obtained by sensors, relays and other equipment is mostly electrical signals. It is difficult to fully discover the role of monitoring information, resulting in a relatively single operation and maintenance management mode, and a certain lack of application effects [1].

The application of three-dimensional visualization technology has achieved improvements and breakthroughs in the functions of the power operation and maintenance system. With the help of this technology, the system can obtain multi-dimensional real-world information on the spot, and can more intuitively observe the control status of the equipment and its control while monitoring the data. Appearance [2]. In the process of assisting operation and maintenance managers to make decision-making analysis on equipment operation and failure conditions, the 3D visualization technology model builds a multi-dimensional visual model from multiple angles such as category, time and space, and displays more intuitive and clear equipment information for operation and maintenance managers, Improve the efficiency of scheduling decision-making. In addition, 3D visualization technology can assist in the construction of corresponding virtual platforms, helping operation and maintenance managers to more intuitively carry out related training content such as inspections, drills, troubleshooting, and equipment operations, effectively improving the skill level of personnel, and providing a powerful force for the reliable operation of the power system Guaranteed.

2. Specific Application of 3D Visualization Technology in Power Operation and Maintenance System

2.1. Associate the Physical Image of Field Equipment with the Operation and Maintenance System to Realize Reliable Monitoring of Field Equipment

The three-dimensional visualization technology is implemented on the basis of obtaining various electrical signals from the traditional power operation and maintenance system. It can monitor working conditions, visual sequence control, equipment status monitoring, intelligent alarms, remote browsing, environmental monitoring, safety protection, auxiliary control, etc. The direction realizes the technical application of real scene association, which can realize the real scene visual function of the equipment indicator and other related equipment status under the condition of monitoring system images near the linked equipment. In the process of linking image monitoring and real-life correlation functions, power companies need to focus on related issues such as communication protocols and security partitions [3]. Generally speaking, the various real-scene correlation functions mentioned above usually have security partitions that are not used in the monitoring system near the equipment. The two have not adopted a consistent communication protocol. Related technical personnel need to focus on solving communication problems to achieve efficient linkage between the two.

In order to solve the communication protocol problem and realize the reasonable application of three-dimensional visualization technology, electric power enterprises can adopt two modes of IEC61850 communication and serial communication [4]. Among them, the IEC61850 communication is connected to the communication protocol through the network. The electric power enterprise needs to set the direct communication protocol of the front-end equipment, image monitoring system, integrated application server, station control host and other related equipment to IEC61850 during the application process to manage the operation and maintenance. The protocol between the dispatch center where the personnel are located and the station control host and the main station of the image monitoring system is set to IEC104/101. The specific settings are shown in Figure 1.
The power operation and maintenance systems set up by power companies for smart substations, etc. usually adopt a monitoring integrated design scheme, and divide the equipment system into real-time control safety zone I and non-control safety zone II. Generally speaking, the monitoring system described in the application of functions such as intelligent alarm and sequence control function application is the safety zone I, and the system that does not affect the operation and operation of the equipment such as image monitoring belongs to the safety zone II, and the system of the two safety zones has not been established. Direct communication [5-7]. In order to integrate the system functions in the two security zones, electric power companies can use serial communication, and use the extended CDT protocol to establish a communication link between the image monitoring system and various real-life functional applications.

Relatively speaking, IEC61850, a protocol that relies on network construction, has stronger versatility and is relatively simple to operate during the implementation of the program, but compared with serial communication in terms of security, there is a certain gap. If the safety problem is solved, electric power companies can use the IEC61850 protocol to achieve reliable applications of real-world correlation functions. In response to security issues, power companies can set up corresponding physical firewalls for different security zones, restrict ports during daily use, and stipulate that only open specific ports can be used, and avoid using ftp ports and firewalls that may affect the security of communication networks Ping function. To this end, power companies can use the IEC61850 protocol to jointly apply image monitoring and real-world correlation functions to realize the reasonable application of 3D visualization technology in the power operation and maintenance system, and ensure that relevant operators or dispatchers can view the impact on equipment control in real time and after alarms The field status of the equipment.

2.2. Assist Operation and Maintenance Managers to Make Decision Analysis
In the process of assisting workers in analyzing fault conditions, identifying data, and optimizing load and reactive power, traditional power operation and maintenance systems can only combine a single variable to provide workers with data information on a two-dimensional plane, which is difficult for
personnel to make decisions. Effectively help. The integration of 3D visualization technology and big data processing technology can realize the expansion of operation and maintenance system functions, providing operation and maintenance personnel with a three-dimensional visualization curve that integrates multiple levels of information such as category, space, and time, and helps staff quickly obtain effective decision-making basis. For example, in the process of reactive power optimization of the power system, the operation and maintenance system constructed by 3D visualization technology can introduce the amount of time based on the current Q and U data, and obtain the voltage and reactive power changes in different time states. The obtained relevant information is combined with the reactive power regulation system, which can realize the dynamic adjustment of reactive power compensation and maintain the reliable operation of the power system.

2.3. Used to Carry out Training Related to Operation and Maintenance Management

The operation and maintenance of the power system is relatively complicated, involving many content with high security risks and high technical difficulties. In the past, the training for the staff was usually more theoretical than practical, and it was difficult to explain in-depth on-site equipment. Using 3D visualization technology, electric power companies can build a corresponding virtual simulation platform, through which operation and maintenance staff can explain equipment inspections, operations, maintenance, troubleshooting and other related content, and can even be accurate to the structure of each equipment component and The application of functions can effectively improve training efficiency and quality effects, and provide a strong guarantee for the reliable operation of the power system.

The virtual simulation platform constructed by 3D visualization technology can realize the reliable restoration of the field equipment and environment. The high degree of reduction and strong immersion encourage the trainees to experience the various operations, inspections and inspections of the field equipment from both physical and psychological aspects. Treatment methods to achieve excellent training effects. At the same time, short-circuit and other faults of power equipment can cause serious damage. Electric power companies cannot spend a lot of money to simulate short-circuit faults in actual equipment. Three-dimensional visualization technology can realize the simulation of this fault and restore the true fault when it occurs. The phenomenon promotes the operation and maintenance personnel to have a deeper understanding of the handling methods, failure phenomena, principles and effects of related faults in the process, and effectively improves the emergency handling and fault repair capabilities of the operation and maintenance management personnel.

Conclusion: 3D visualization technology has gradually become the key technology of power system operation and maintenance management in the continuous development of information technology and digital technology. Integrating it into the existing power operation and maintenance system can effectively improve the The grasp of on-site equipment plays an important role in equipment operation, equipment monitoring, equipment analysis and other processes. In the specific application process, electric power companies need to repeatedly exert the functional effects of 3D visualization technology, apply it to auxiliary decision-making analysis, realize the association between the operation and maintenance system and the physical scene, and build a virtual system to improve the skill level of operation and maintenance personnel. The platform provides guarantee for the stable operation of the power system.

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