Design and Implementation of Power Communication Optical Cable Account Management System Based on GIS Technology

Tian Zhifeng*, Chen Jia, Zhou Jing, Zeng Xu

Shenzhen Power Supply Bureau Co., Ltd., Shenzhen 518021, Guangdong, China

Abstract: At present, the management mode of optical cable account data is mainly based on the traditional manual document entry method, and the electronic forms, CAD drawings, electronic documents and other types are used for manual recording. This method not only has large workload and low accuracy, but also can not accurately record the specific geographical location of the optical cable, thus affecting the efficiency of the operation and maintenance personnel in troubleshooting. There is an urgent need for a set of auxiliary system to facilitate the management of optical cable account data, so as to improve the efficiency of optical cable account management and optical cable operation and maintenance. On the basis of the existing new technology, the operation mode and information management mode of the power cable are analyzed to make the relevant data flow direction. This paper introduces a set of power communication optical cable account management system based on GIS to meet the needs of relevant users, combining the current status and requirements of optical cable account data management.The system can implement a comprehensive management of the communication optical cable, including the operation, maintenance, overhaul and accident management of the optical cable, which plays a positive role in improving the operation and management level of the optical cable.

1. Introduction

With the rapid development of China's electric power communication industry, all regions have strengthened the management of communication network resources. As for the overall management of power communication network resources, it is still basically at the level of manual management and computer management, and the management of communication resources is independent, without organic combination and unified management. In particular, a large number of maintenance data and data of pipelines, cables and equipment related to geographical information are distributed in the hands of different departments and individuals in the form of cards or drawings, lacking effective and consistent maintenance management. The route design also adopts manual mapping and drawing management. The management of switching equipment and transmission circuit is not perfect, and it is between manual and computer automatic management. There is also the problem of acting independently, which is not organically integrated with other resource management. How to strengthen the management of power communication resources and equipment, improve the level of service management, and better provide effective support for the power system has become an urgent issue for power enterprises.

2. GIS research and application

With the continuous development of geographic information technology, the definition of GIS consists of two parts, that is, it is both a science and a computer system serving for geographic research and geographic decision-making. It is a computer system for collecting, storing, managing, analyzing, displaying and applying geographic information. It is a general technology for analyzing and processing massive geographic data. The application of GIS is mainly used as a technology rather than a special theory, which analyzes and output the results.The optical fiber communication monitoring system adopts advanced computer control technology and Internet wide area network to monitor the deterioration of the optical cable line transmission performance in real time, find the hidden obstacles in time, and quickly locate the obstacle points of the monitored optical fiber and effectively compress the obstacle duration. The system complies with the international and domestic telecommunications technical specifications

China's geographic information technology research started late. Since the early 1980s, it was marked by the establishment of the first national geographic information system research office by the Institute of Remote Sensing Applications of the Chinese Academy of Sciences in 1980. During the seventy-five years, the research of geographic information system was officially included in the national science and technology research plan. Through nearly five years of efforts, remarkable benefits have been achieved in the application of GIS technology.

*Corresponding author's email: 1158852782@qq.com

Since the 1990s, the domestic geographic information system has entered a stage of rapid development. Emphasize the practicality, integration and engineering of geographic information system, make it practical and productive, and provide analysis and decision-making basis for major issues of national economy. It has promoted the first practical application of geographic information systems in regions and cities with relatively developed economies, relatively strong technical forces and more urgent user needs. At the same time, the number of companies operating GIS business is increasing.

After ten years of development, China's geographic information system has made significant progress, creating conditions for industrialization. In the 21st century, China's geographic information technology has entered a period of rapid development. At present, GIS has been widely used in energy, transportation, telecommunications, land resources, disaster prevention and other fields. The research and development and application of the GIS-based distribution network planning auxiliary platform in China have developed to some extent, but there is no precedent for the mature application of GIS in the State Grid system.

The system is advanced and mature computer and communication technology as the main means, can remote, real-time, automatically monitor the whole cable line, monitoring the change of optical fiber characteristics and change trend, effectively reduce and prevent cable fault, it automatically monitor the status of the cable, found fault timely warning, and quickly and accurately determine where the fault occurs, convenient maintenance personnel quickly reached the fault point, reduce the burden of maintenance personnel, improve the maintenance quality. As a new means of optical cable line maintenance, it ensures the safe and efficient operation of the line, thus further improving the reliability of the power system communication. Through the establishment of the optical cable line maintenance system, in addition to the basic functions of spatial and attribute data management of the optical fiber network, but also comprehensive analysis of relevant data, to provide auxiliary decision support for network planning, design and maintenance management.

3. Current situation and deficiency of resource account management in power communication system

The resource account data of electric power communication system comes from all links of communication work. A daily work process is as follows: after the on-site operation and maintenance personnel carry out the equipment addition, board card installation, fiber core length and attenuation test of the optical fiber distribution frame, and cable laying at the site, they cooperate with the network management system maintenance personnel to complete the optical fiber jumper, wiring connection, cable binding, and label pasting, and the network management system maintenance personnel put on the shelf of the network element of the communication equipment at the network management side, optical channel connection, and business data opening configuration, The special person in charge of TMS resource account will consult the above personnel to create and update various resources in the TMS system. In addition, the optical fiber distribution data reflecting the situation of the optical fiber network is currently maintained separately using the offline account.

The current resource account management mainly has the following problems: First, although the TMS system can achieve full coverage of communication resources, all kinds of resource data are stored separately in the form of modules, which can not directly reflect the correlation between resources. Secondly, all kinds of personnel are only responsible for their respective tasks. After the work is completed, they do not hand over data and data with other personnel in time. When the TMS resource account specialist updates the account, they need to consult the on-site operation and maintenance personnel, network management system maintenance personnel, optical fiber wiring data recording personnel, etc. in turn. The process is cumbersome and the task is heavy. On-site operation and maintenance personnel focus on the key links such as whether the actual physical transmission channel is normal and whether the fault handling is completed, but they often ignore that the on-site data changes after the completion of the work and needs to be collated and checked, or they usually simply record in paper form, which affects the integrity of the account data record; The maintenance personnel of the network management system failed to timely feed back the adjustment and record it into the account after cooperating with the on-site operation and maintenance personnel to complete the optical path and business data configuration; At the same time, the maintenance personnel of the network management system did not master the optical cable and optical fiber wiring data of the actual communication network, resulting in the unclear correspondence between the optical path on the network management side and the actual physical optical fiber jumper, affecting the rapidity and accuracy of the fault point judgment. Moreover, optical cable data is an important supporting data for the power communication system. At present, offline tables are mainly used to record and store the length, number of cores, core loss, usage, etc. of optical cables at each station. As independent optical cable wiring data, they are not recorded with the network topology of communication equipment, which is not convenient for data sharing and real-time update.

In short, the unsynchronized and opaque communication links will increase the burden of the TMS resource account specialist, resulting in the reduction of the accuracy and reliability of the communication resource account data. All kinds of personnel lack the concept of overall situation and only grasp their relevant work one-sidedly, which is easy to cause repetitive operations and has long-term hidden dangers. In addition, the updating of the resource account

is not timely and inconsistent with the actual situation, which reduces the credibility of the data, thus affecting the stable operation of the system and the subsequent planning and design of the power communication system network.

4. Functions of GIS-based power communication optical cable account management system

4.1. System infrastructure

The software modular design can guarantee the management performance of the network system. Different modules can be distributed and run on different hardware platforms through hardware upgrade, and each software module can be loaded or unloaded when necessary according to user needs, so that the system has good scalability.

The basic framework of the GIS-based power communication optical cable account management system is shown in Figure 1. The system takes the communication site as the main directory, and the power communication site includes substation/switch station, switching station/ring network cabinet, independent communication machine room, power plant, etc. The power communication optical cable is hung under the directory of each station with the unique name of the first and last stations, the number of cores, the type of optical cable and the number of optical cable.

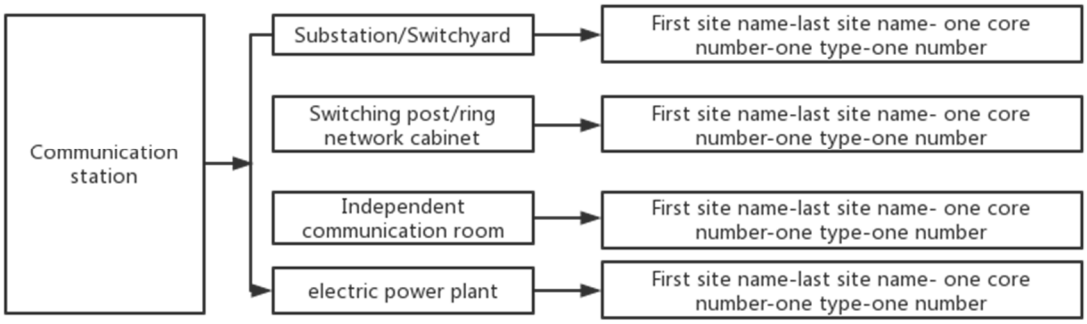

Figure 1 Basic framework of GIS-based power communication optical cable account management system

4.2. System resource management module

The system resource management module is used to enter the standardized electric power communication optical cable account information in the system, including the addition, deletion and modification functions, providing basic data for various functions in the system. It is divided into optical cable resource management, business resource management and power channel and tower information management modules.

The optical cable resource management module is used to manage the basic information of the optical cable, including the name of the optical cable, the type of optical cable, the number of optical cable cores, the year of operation and other information. These information can be imported and exported by management personnel, and batch import, export, deletion and other functions can be set to improve the efficiency of account management.

The business resource management module manages the optical cable business information. Traditional business management uses optical fiber distribution frame business tables for record management, which cannot display multiple sites through which the business passes. The service resource management module of the new system collects and classifies all optical cable bearer services, including optical transmission links, dispatching data network services, communication data network services, etc. The system is configured with business addition, search and export functions, and supports operators to select multiple sites to automatically connect and generate business information.

The power channel and tower information management module manages the cable well and power tower resources, and is used to mark the power channel and tower position through which the optical cable passes. After collecting the information of cable wells and towers on site, naming them in a standardized manner and entering them into the system, data business support can be provided for the optical cable maintenance of communication operation and maintenance personnel.

4.3. User management module

User management module includes user registration, login, authority maintenance, role maintenance, user information management and other modules. In order to ensure the security of power system data, strong encryption is adopted for user encryption. In order to protect system account data and set user management permissions, non-management personnel only provide functions such as viewing and exporting data, while professional management personnel can provide operations such as adding and modifying.

4.4. Statistical report module

The statistical report module is used to generate information on the optical cable account data, display the optical cable topology of the region in the electronic map interface according to the user's needs and account data, and display other optical cable resource information in the form of graphics, tables, etc., to facilitate the operation of management personnel.

4.5. System detection method

Online monitoring of optical power: the spectroitter is used to separate 3% of the working light of the optical transmission equipment, and the alarm acquisition module is used to monitor the working light in real time to reflect the transmission characteristics of optical fiber in real time and find the changes of transmission quality in time. The threshold of each optical power monitoring channel can be set. When the monitored optical fiber breaks the fiber, the working optical power drops to a certain limit, or there is a large attenuation, an immediate alarm is generated, and the system will immediately activate the OTDR to test the core wire for accurate fault judgment and positioning. In this monitoring mode, the wave division multiplexing technology and the corresponding device can simultaneously transmit the communication light source and the OTDR test light source in a fiber core.

Optical terminal alarm monitoring: using the equipment alarm acquisition interface provided on the alarm acquisition module to collect the fault alarm generated on the optical transmission device. After analysis and filtering, the information unrelated to the line alarm is filtered out, and then the OTDR is started to test the optical cable lines that may cause the alarm. Each alarm acquisition port can be configured by software to access alarm signals such as switching quantity, voltage quantity and current flow. The threshold of each channel alarm can be configured independently to meet the interface requirements of the transmission equipment of different manufacturers.

This real-time monitoring method has the following three characteristics: (1) does not need to insert devices in the working optical fiber of the transmission equipment, does not affect the work of the transmission equipment, reduce the system failure trouble; (2) each monitored optical fiber is real-time monitoring to ensure the timeliness of fault alarm; (3) is able to adapt to the complex network condition, for the short cable section, can be monitored across sections without additional equipment.

The three monitoring methods are compared from the technology and the implementation. In terms of the timeliness of the alarm response, The on-line and fiber preparation monitoring mode of optical power is better than the monitoring mode of using optical terminal alarm; In terms of system reliability, The system using standby fiber for real-time monitoring of optical power does not involved in communication equipment and lines, Highest system reliability, While the online optical fiber is shared with the communication optical fiber during the real-time monitoring, Its system reliability is slightly poor, In the monitoring mode of optical terminal alarm, System reliability is the worst; In terms of the implementation difficulty, The standby fiber monitoring of optical power only needs to add a light source at the source, Minimdifficult to implement, While the on-line monitoring of optical power requires the introduction of a series of optical devices, Implementation is more complex, Alarm monitoring of the optical terminal machine, Need to add the optical terminal alarm signal acquisition interface, Implementation is the most difficult one.

5. Conclusion

The GIS-based power communication optical cable account management system can realize the efficient management of the power communication optical cable account, visually display the power communication optical cable topology according to the geographic information system technology, and realize the optimization of the basic account resources, provide convenience for the communication and other relevant user departments of the power supply company, improve the account resource management efficiency and the optical cable operation and maintenance efficiency, and provide technical support for the increasingly refined management requirements, Provide effective guarantee for communication operation and maintenance.

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