

Design and Research on the Information Management System of Qinhuai River Intelligent Pump Station

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Abstract: The intelligent pump station information management system is located between the computer monitoring system of the pump station and the management information system of the superior management department. Combined with the actual situation of Qinhuai River, this paper presents the design idea, software and hardware structure of the information management system of the intelligent pump station, and introduces the main functions of the information management system so as to provide reference for related construction.

1. Introduction

Since the 12th Five-Year Plan of China, intelligent water resources have become the development trend of water resources in the new era. Water informatization is promoting the transformation from traditional water resources to modern water resources [1-3]. Making full use of the new generation of information technology to ensure the benefits of water resources and hydropower projects is the development trend of the water resources and hydropower industry. At present, intelligent water resources construction has been carried out in Jiangsu, Fujian, Zhejiang and other places. New technologies such as big data, cloud computing and Internet of things have been fully utilized to excavate water resources and comprehensively improve the efficiency and efficiency of water resources management [4-5].

Qinhuai River Water Conservancy Project is one of the main control projects in Qinhuai River Basin. The Qinhuai River Pumping Station undertakes the functions of irrigation, flood control, drainage and pollution scouring. The station is equipped with 1700ZWSQ10-2.5 bidirectional horizontal axial flow pumps and total installed capacity is about 3150kW. It benefits the flood control and drainage and water quality improvement [6]. However, due to the lack of planning and coordination, the efficiency of system maintenance is low, the existing data integration is poor, and the data are not fully utilized, leading a certain extent limit on the management ability and information of Qinhuai New River. This paper introduces the design idea and main project of the information management system for the intelligent pumping station based on the actual situation of Qinhuai River, and provides a reference for improving the information level of Qinhuai River

2. Overview of the Information Management System

Qinhuai River Intelligent Pumping Station Information Management System is located between the computer monitoring system of the pumping station and the management information system of the superior management department. It is the working platform of the pumping station. For one thing, it



receives all kinds of real-time running data of the computer monitoring system before analyzing, processing and reporting the relevant statistical results to the superiors. For another thing, it receives instructions and data from the superior management and dispatching department. At the same time, this system also has daily management functions of pumping stations, such as on-duty management, dispatching management, equipment account management and so on. Fig. 1 indicates a hierarchical diagram of the information system of the intelligent pumping station which is divided into four layers. The lowest level is the computer monitoring system of the pumping station, and the top two levels are the management information system of the superior operation dispatching management system and the superior engineering management department. Pumping station information management system is an important link between computer monitoring system and superior dispatching management system of pumping station. It is the basis of standardizing the operation management process, improving the operation level and ensuring the safe operation and maintenance of pumping station.

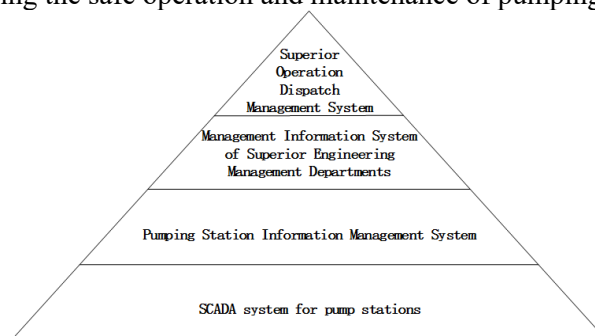


Fig. 1 Schematic diagram of intelligent pumping station information system

Before the operating of information management system of Qinhuai River Intelligent Pumping Station, the system of pumping station only had some functions such as data storage, statistics and report forms by a single function monitoring computer. There was no security measurement to realize data sharing and remote browsing of operation status. The single-machine version of daily affairs management software can not realize the network. The research and application of pumping station information management system is seriously lagging behind with the development of modern management. Information management system of intelligent pumping station adopts advanced system architecture and cross-platform system integration development tools. By integrating the operation monitoring, operation process management and transaction management of the pumping station on one platform, it not only facilitates the daily work of the operators, standardizes the work flow, but also records and manages various data in the operation, maintenance and management of the pumping station. The information management system is helpful for further event tracking, historical data analysis, and joint operation optimization of pumping stations.

The system provides a network operation monitoring and management platform. Operating managers can complete the management of pumping stations through the network. Relevant personnel can browse the operation status of pumping stations or inquire information through the Internet or mobile phones. The Rich Internet Applications (RIA) architecture based on Silverlight is adopted to realize the integration of real-time monitoring and management system for pumping station operation. The architecture is open and easy to expand or reconstruct. The data gateway based on OPC technology and the network gate based on double ferry mechanism are both used to realize the high-speed and safe transmission of data between the monitoring system and the management system of the pumping station. It stores a variety of key operation, statistics and management data, which provides a basis for operation optimization, benefit analysis and fault tracking of pumping stations in the later stage.

3. Design of the Information Management System

3.1 Hardware Architecture

The lowest level of information management system is the computer monitoring system of pumping station. JX-300X DCS system is used to realize the functions of data acquisition and control of main unit, auxiliary equipment, substation, gate and so on. The middle layer is the information management system of pumping station. It obtains all kinds of real-time data of pumping station operation through OPC server, and provides real-time data to the higher management department. Qinhuai River Management Office or higher dispatching management department can browse the real-time operation conditions of pumping stations remotely through LAN or Internet.

3.2 Software Architecture

The bottom part of the information management system is the software module of pumping station operation data acquisition, which realizes the data acquisition and processing of the main unit, auxiliary equipment, substation, gate and so on. These software modules are at the bottom of the information management system of large pumping station, in which the data gateway service is provided. The end software realizes the centralized processing and data forwarding of the collected data. In order to realize the security isolation between the bottom and the top of the system and avoid the security threat to the bottom software and hardware system, the technology of double ferry security isolation and information exchange is adopted. The client software of the data gateway in the upper layer can use the double ferry information exchange method to obtain various data of the computer monitoring system of the pump station in the lower layer, thus realizing the data opening and sharing of the management network, and facilitating further access to the corresponding tables of the database in the management network.

4. Main Functions of Information Management System

The information management system of Qinhuai River Intelligent Pumping Station includes: operation status, duty management, dispatch management, safety management, engineering management, equipment management, data management and other sub-modules, which basically covers the main business of the management process of the pumping station. Fig. 2 is a block diagram of the pump station information management system.

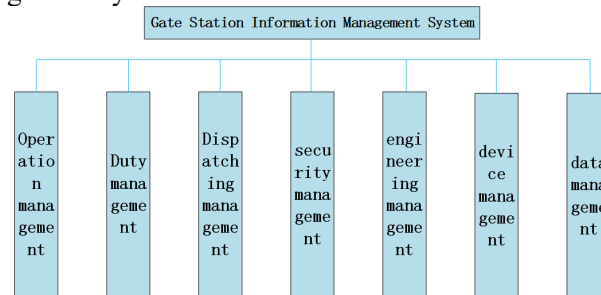


Fig. 2 Composition block diagram of pumping station information management system

4.1 Operation Management

Operational management monitoring interface includes: overview of equipment status of pumping station, main wiring diagram of substation, operation status of main engine, operation status of diversion gate, diversion status of lower channel, auxiliary system, trend diagram, data statistics and other real-time monitoring interface. It collects all kinds of real-time operation status and real-time data of computer monitoring system of pumping station. Besides, it can provide the function of inquiring and browsing of upstream and downstream water level, number of start-ups, pumping flow, pumping flow, unit operating time, diversion flow, total diversion flow and other data in the form of reports.

4.2 Duty Management

Duty management includes three sub-modules: duty management, pump gate value recording and start-up value recording, realizing paperless office and consulting. The sub-directory of duty

management is divided into shift management, on-duty event recording and on-duty inquiring, which could record the problems handed over, matters needing attention and important reminders. The problems which are not completed or handled are in the on-duty person. After members log on to the system, they are reminded in prominent positions. The two sub-modules of pump station gate operation value recording and start-up operation value recording mainly record on-duty gate, unit operation and on-duty execution of dispatching instructions, on-duty start-stop main engine record, blade adjustment and auxiliary machine adjustment record.

4.3 Dispatching Management

Dispatching management includes water regime dispatching, substation operation ticket, pump station inversion operation ticket, start-up operation ticket, stop operation ticket and work ticket. According to various typical operation tasks, the system automatically generates relatively fixed but modifiable operation task tickets. The rest of the operation tasks are filled in according to the specific operation conditions. Different operation tickets are numbered separately. After all dispatching orders and operation tickets are executed, they cannot be edited and deleted.

4.4 Safety Management

Safety management includes safety documents, safety regulations, safety account, safety measures and firefighting facilities. In the sub-module of security documents, it provides a platform for issuing security documents, which can include all kinds of safety production documents and notifications issued by superior management agencies and functional departments, and security documents and notifications issued or forwarded by the department. In the sub-module of safety regulations, it provides a platform for issuing safety regulations, which can include all kinds of safety regulations related to engineering, equipment and personnel, relevant industry safety regulations and internal safety regulations. Safety appliances and security networks are included in the security measures sub-module.

4.5 Project Management

Engineering management includes rules and regulations, engineering memoirs, engineering project management and equipment maintenance records. The functions of the sub-module mainly include browsing, querying, adding, modifying, editing, deleting and so on. The regulation sub-module is mainly to establish a release platform, classify according to national standards, ministerial standards, industry standards and self-compiled by management departments, and input rules and regulations related to the management of pumping stations. The sub-module of the project memorandum has a unified form, which is filled out by the technical person in charge of the pumping station. It truthfully records the major technical problems found in the project management every year, and fills in and arranges them according to the time sequence of events. The sub-module of project management has a unified form, which is classified according to specific projects and filled in by the project manager or technical person in charge. It implements process management from project implementation plan formulation and approval, project procurement, construction management, project completion, fund management to project assessment.

4.6 Equipment Management

Equipment management includes engineering technical manual, equipment revealing chart, equipment account and defect management. The functions of the sub-module mainly include browsing and querying (downloadable files), adding (uploadable files), modifying and deleting. The sub-module of the engineering technical manual establishes a unified table, and inputs the information of the names, manufacturers, specifications, models, parameters and quantities of various components of the main equipment into the system. The equipment revealing sub-module establishes a unified table, which reflects the name, specifications and models of the main equipment of the pumping station, installation time, repair and test status, equipment grade and so on. The equipment account subsystem establishes

a unified form, introduces the basic information of equipment, records the information of equipment repair and test, various kinds of defects and disposal, and the inventory of main spare parts, which can be related to the information of equipment maintenance, equipment defects and other sub-modules. Defect management sub-module establishes equipment defect information management form, including the time, person, content and treatment of equipment defect discovery, fails to eliminate equipment defect in time, the system automatically generates tracking list, and reminds us to take necessary safety technical measures until the defect is eliminated.

4.7 Data Management

Data management in information management system refers to equipment data and technical data of pumping station, which can be learned and consulted by technicians inside the management office. Data management includes archiving, registration and destroying records of equipment data and technical data. Technicians can inquire the data number according to the title of the case file and borrow it from the reference room.

5. conclusion

The construction of intelligent pumping station is an important measure to improve the benefit and management efficiency of water conservancy projects. The information management system of intelligent pumping station is an information platform between the computer monitoring system of pumping station and the management information system of higher management department. It is of great significance for standardizing the operation management process of pumping station, improving the operation level of pumping station and ensuring the safe operation and maintenance of pumping station. The information management system of intelligent pumping station adopts advanced system architecture and cross-platform system integration development tools. It integrates the operation monitoring, operation process management and transaction management of the pumping station into one platform. This not only facilitates the daily work of the operators, standardizes the work flow, but also records and manages various data in the operation, maintenance and management of the pumping station. It is helpful for further event tracking, historical data analysis, and joint operation optimization of pumping stations. The construction of information management system of Qinhuai river intelligent pumping station will greatly improve water management and water management capacity.

Acknowledgments

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