Research on intelligent construction of Hydropower Enterprises

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Abstract. .Hydropower is the largest clean and low-carbon renewable energy, which can generate electricity with comprehensive utilization functions such as flood control, water supply, shipping and irrigation, and has significant social, ecological and economic benefits. However, at present, the progress of intelligent construction of hydropower enterprises is relatively slow, and the theoretical and strategic research is still relatively weak, resulting in low management efficiency and low degree of production visualization. How to carry out intelligent enterprise construction for traditional hydropower enterprises, improve the management level of enterprises and better adapt to the competitive environment of power market is a major research topic for hydropower managers. This paper mainly expounds the necessity, strategic framework and overall construction scheme of intelligent construction of hydropower enterprises. Through the application of new technologies such as cloud computing, big data and Internet of things, an efficient and scalable unified data management and analysis platform is established to provide guarantee for safe, economic, efficient and intelligent operation of hydropower enterprises and provide basis for command and decision-making.

1 Introduction

With the rapid development of cloud computing, big data, Internet of things and artificial intelligence technology, hydropower enterprises have gradually developed to the direction of interconnection, data mining, intelligent decision-making, panoramic display, etc., and the development of intelligence has become the general trend [1].

At present, the intelligent construction of domestic hydropower enterprises is faced with many difficulties [2]. The main problems are the wide distribution points of hydropower stations, bad natural environment, low degree of intensive and intelligent power stations, difficulties in transformation, difficulty in operation and maintenance, and difficulty of data sharing. This paper will introduce the realization process and overall structure of the intelligent construction of hydropower enterprises from the aspects of the necessity of intelligent construction, strategic framework of intelligent construction and the overall scheme design of intelligent construction.

2 The necessity of intelligent construction of hydropower enterprises

At present, the emergence of hydropower station brings reform and innovation to the traditional thermal power generation. However, whether from the perspective of safe operation or cost control, intelligent construction is also the only way for hydropower enterprises, and its necessity is mainly reflected in the following [3]:

- To accelerate the policy reform, it is necessary to accelerate the power side regulation capacity, and further structural adjustment and optimization of power production from thermal power to hydropower and new energy generation. The demand for flexible regulation ability of power generation industry is increasingly urgent. "Deep peak shaving" and "fast start stop" have certain impact on the life and safe operation of equipment.

- The market environment has deteriorated, the power generation market has entered into the "double reduction and double low" hydropower industry with low electricity growth rate and low load rate, the overall vertical coordination ability and horizontal joint effect are poor, the cost control is weak, and the profit mode is single.

- As the industrial competition intensifies, the major power generation groups vie to change, put forward their own industrial Internet value proposition one after another, actively explore new models, and compete for resources. It is urgent to improve the production efficiency, improve the working conditions of employees and ensure the safe operation of equipment through the new mode.

- The application of technology is not yet mature, and the ICT technology with artificial intelligence as the core is still in the exploration stage in all aspects of the industrial field. The degree of intelligence is low, and there is no unified power generation technology support system. All enterprises have

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repeated in the implementation of the scheme, and the results can not be shared, resulting in a lot of waste and fragmentation of results. The deep integration of artificial intelligence and hydropower industry still needs to be accumulated.

- The intelligent construction of hydropower enterprises will bring immeasurable benefits and benefits to the traditional mode of production and operation. It is of great significance to study the intelligent construction of hydropower enterprises, which can help hydropower enterprises solve the following practical problems and difficulties:

- Hydropower stations are scattered, located in remote areas, with poor environment and large personnel mobility，how to guarantee the quality of operation and maintenance of hydropower stations?

- The risk of equipment maintenance and repair is high, and there are many potential safety accidents, which bring great losses to personnel safety and economy. How to reduce the occurrence rate of safety accidents through analysis and early warning at the beginning of accidents? How to realize the transformation of planned maintenance into condition based maintenance, and reduce the waste of manpower and material resources?

- How much electricity can the theory generate and where are the losses? How to realize the horizontal and vertical benchmarking analysis of plants, stations and teams? How to improve the efficiency of production management?

- How to realize fault analysis and predictive maintenance of power generation equipment?
- How to establish a unified data platform to realize the opening of production operation and management information system and realize closed-loop and efficient management?

3 Strategic framework of intelligent construction of Hydropower Enterprises

Strategic framework for smart construction of hydropower enterprises smart construction of hydropower enterprises is not achieved overnight, but needs to develop plans and strategies. This section mainly introduces the strategic framework for smart construction of hydropower enterprises [4]. The specific content can be refined according to the actual situation of the enterprise. The bottom layer of the strategic framework is infrastructure, which supports intelligent advanced equipment, security system, office system, operation monitoring system, operation management system, etc. Four goals are determined, namely safety, economy, efficiency and intelligence; three sets of standard systems are formulated, namely technical support system, standard specification system and intelligent application system; two main lines of intelligent construction are determined, namely technical main line and management main line; and a platform, namely big data analysis platform, is constructed. The details are shown in Figure 1.
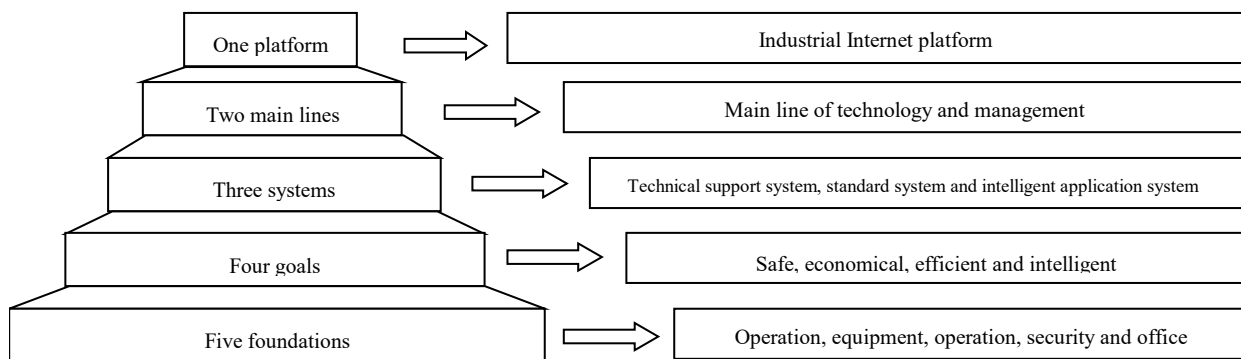
Fig. 1. Strategic framework of intelligent construction of Hydropower Enterprises

4 Overall scheme design for intelligent construction of Hydropower Enterprises

The intelligent construction of hydropower enterprises is to realize the automation and standardization of power generation process. Based on the digital and information technology, the intelligent acquisition and transmission, intelligent control and implementation, intelligent configuration and optimization, intelligent management and decision-making technology are integrated on the basis of digitization and informatization, and relying on

the network information platforms such as management and control integration, big data, Internet of things and cloud computing, etc., to form a technology with "self collection, self-control and implementation, intelligent configuration and optimization, intelligent management and decision-making" The ability of analysis, self diagnosis, self-learning, self-management, self correction, self optimization, self-organization and self promotion, namely intelligent perception, intelligent computing, intelligent management, information integration, intelligent decision-making, management and control integration and life cycle management, to

achieve the goal of more security, economy, efficiency and intelligence.

13In this chapter, the solution of intelligent construction of hydropower enterprises will be introduced. The production and management data of hydropower enterprises will be transformed into information by using new technologies such as Internet of things, cloud computing and big data. The information will be transformed into knowledge through intelligent mining, and centralized monitoring can be realized through 3D modeling and virtual reality The comprehensive situation display of operation analysis, fault warning, operation analysis and safety prevention and control can help hydropower enterprises realize

intelligent operation[5], intelligent security, intelligent maintenance, intelligent management decision, etc.

The intelligent planning and design of hydropower enterprises is divided into two main lines: management and technology. Management and technology complement each other.

This paper mainly introduces the technical solutions in the intelligent construction of hydropower enterprises, which are mainly divided into five levels, namely, intelligent equipment and control system layer, network communication layer, storage and calculation resource layer, data and service layer and intelligent application layer, as shown in Figure 2.
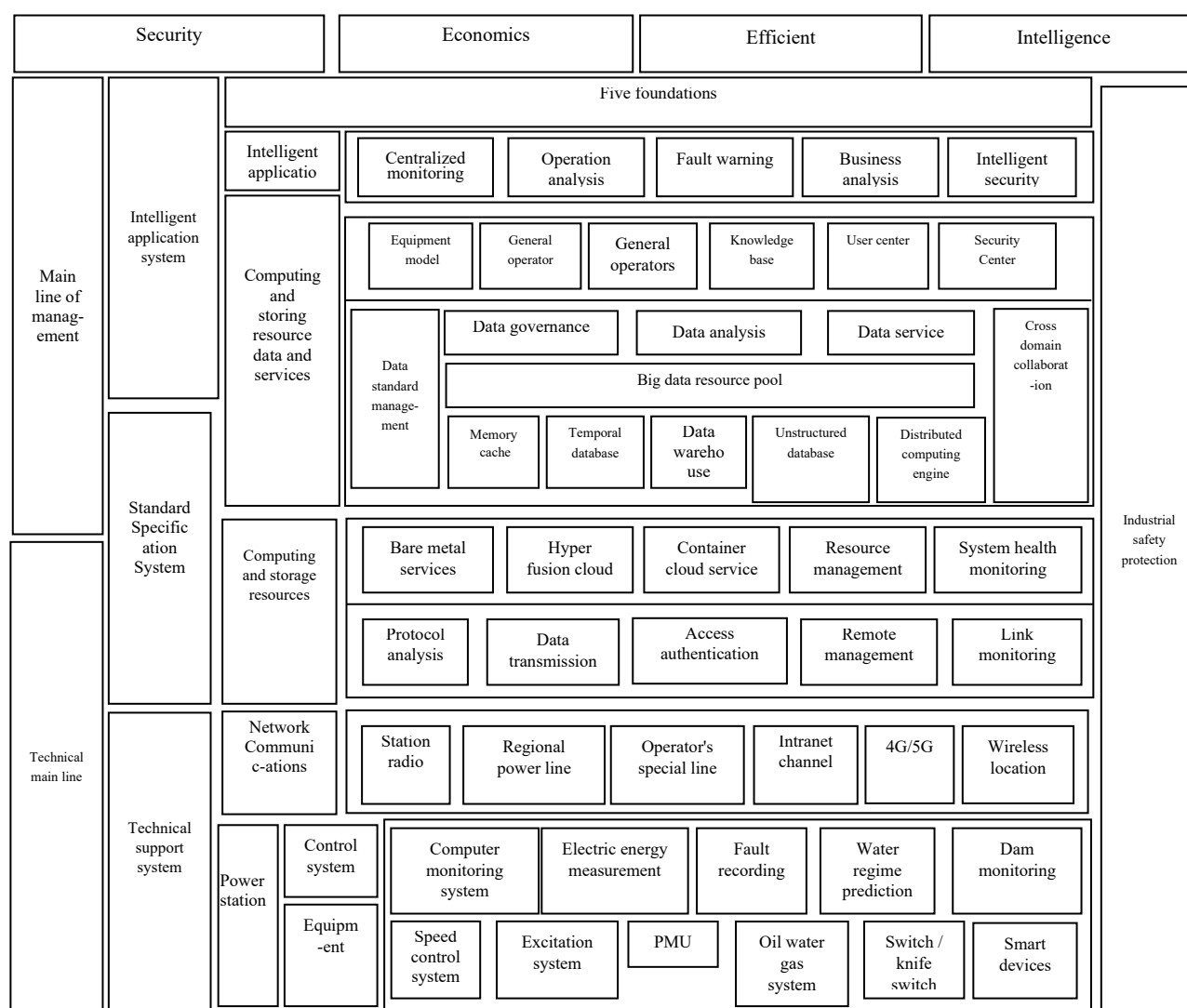
Fig. 2. The overall solution of intelligent construction of Hydropower Enterprises

The first layer is the intelligent equipment and control system layer[6], which provides the ability of intelligent perception of hydropower station power generation, water regime, fault, status and other basic conditions. Through various data acquisition equipment, sensors, intelligent measurement and control equipment, intelligent instruments, intelligent security equipment, intelligent inspection machine, UAV, intelligent helmet and so on, the data acquisition and identification related

to hydropower station production can be realized And monitoring.

The intelligent control system is the core of intelligent power generation, which realizes the centralized analysis, processing, optimization and intelligent control of production process data. After the optimization of big data technology, the intelligent control system can not only calculate the economic performance index of each intelligent equipment in real time, but also grasp the healthy operation state of water

turbine unit at any time, and give alarm to the equipment in bad state, providing the main cause of failure Judgment and accident handling advice, provide technical support for maintenance personnel, and ensure the safe, stable, economic and efficient operation of hydropower enterprises.

The second layer is the network communication layer, including station wireless, regional power line, operator line, internal network channel, wireless positioning, etc. this layer is mainly responsible for information communication, and transmits the data collected by the underlying intelligent equipment and control system to the storage and computing resource layer through special line, internal network, etc.

The third layer is the storage and computing resource layer [7], which is also divided into access layer and resource layer. The access layer is responsible for data transmission, protocol analysis, identity authentication, authority management and link monitoring. It is the boundary between the bottom layer and the data platform, and is responsible for access identity authentication, which mainly authenticates the data access of equipment or system. The resource layer includes various software resources, computing resources and storage resources, which provide data storage and computing resources for the upper layer and guarantee the related requirements of the upper layer for data aggregation.

The fourth layer is the data and service layer [8], which is the data collection and exchange, modeling and analysis, governance and service center, providing the data source of core business systems and data applications. The data from the bottom layer is stored in the temporal database, data warehouse, unstructured database and distributed computing engine respectively. The data is cleaned, preprocessed, stored, analyzed, associated and integrated in this layer to support the relevant applications in the intelligent application layer and provide various services and shared resources needed by the application.

The fifth layer is the intelligent application layer[9], which provides comprehensive and multi-dimensional dynamic display of centralized monitoring, operation analysis, equipment status and fault diagnosis, repair and maintenance, load optimization, operation analysis, safety prevention and control for the operation and maintenance personnel, maintenance personnel and management personnel of hydropower enterprises through 3D modeling, virtual reality and other technologies, so as to realize the intelligent operation, maintenance and maintenance of hydropower enterprises Intelligent security, intelligent maintenance and intelligent management decision [10].

5 Overview

The research and application of intelligent construction of hydropower enterprises is a task that the information practitioners of hydropower industry need to consider, and also the subject that information managers of hydropower industry should actively consider and study [11].

The intelligent construction of hydropower enterprises must be considered in an overall way at the beginning of design. It is necessary to weigh and plan from the aspects of intelligent equipment [12], data classification [13], data desensitization and sharing [14], management automation [15], intelligent network security protection , etc., so as to fully meet the production safety, data security, network security and economic rationality in the whole construction and operation process. Only by the demand of the government can we carry out the intelligent construction of hydropower enterprises in an orderly manner, realize the goal of more safe, efficient, economic and intelligent operation, make them occupy the advantage in the fierce competition of the power market, and meet the higher standards and requirements of the ecological environment and social development of the hydropower enterprises in the new era.

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