Research on Operation and Maintenance Technology of Electrical Equipment in Hydropower Station Based on Data Mining of Internet of Things

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Abstract: Data mining technology in the Internet of Things has played a greater role in the development of various industries. This paper will introduce the technology of Internet of Things, and discuss the application of data mining technology of Internet of Things in the operation and maintenance of electrical equipment of hydropower station.

1. Introduction of Data Mining Technology in Internet of Things

The application of Internet of Things in smart grid is the inevitable result of the development of information and communication technology to a certain stage. It will effectively integrate communication infrastructure resources and power system infrastructure resources, make information and communication services for power system operation, improve the level of power system informatization, and improve the utilization efficiency of existing power system infrastructure. The application of Internet of Things (IOT) technology in smart grid will effectively provide important technical support for power generation, transmission, substation, distribution and power consumption, and contribute to national energy saving and emission reduction goals. The research of Internet of Things for smart grid application will rely on the advanced and mature technology in the field of information and communication. According to the characteristics and actual needs of power grid operation, as well as the construction and development direction of smart grid, the technology system of Internet of Things will be established. While realizing the functions of cooperative perception, real-time monitoring, information collection, fault diagnosis and auxiliary operation, it will be reliable, stable and economical. Effectiveness, standard and friendly interaction are the four basic characteristics.

Reliability and stability is the necessary prerequisite for the application of the Internet of Things in China's smart grid. Reliable, stable, safe and accurate acquisition, sensing, communication, transmission, processing and decision-making links are the basis of resisting multiple faults, external damage, information attack, disaster prevention and disaster relief. Economy and efficiency is the basic requirement for the large-scale application of Internet of Things technology in power generation, transmission, substation, distribution and power consumption of smart grid in China. Information integration and sharing through the Internet of Things can provide technical means for safe production and efficient operation of power grid. The use of Internet of Things technology can realize the whole network resources and assets life cycle management, improve the utilization rate of assets and investment, and enhance the lean management level of power enterprises. Standard is the development concept of Internet of Things technology for smart grid applications in China. The standards and norms of the Internet of Things should be able to provide long-term and extensive advanced technical support for the development of power grid, make full use of power grid resources to provide additional value-added services to society, and adapt to technological progress and changes in demand.

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2. Application of Internet of Things Data Mining Technology in Operation and Maintenance of Electrical Equipment of Hydropower Station

2.1 System Design

An on-line monitoring and fault diagnosis system for small hydropower stations is developed based on the layout of powerhouse, equipment location and operation requirements of the hydropower station by using the Internet of Things technology. The main monitoring objects and information of the system include two aspects: first, vibration of the upper and lower racks and volutes, shaft swing, partial discharge, unit oil pressure, unit grounding, unit, cable head temperature and excitation system, governor, protection automation, equipment failure state of public system, water level of dams, forebays, tailracks and catchment wells, ecological flow of rivers, rainfall. Main transformer temperature, partial discharge of switch cabinet, temperature of switch cabinet contact, bus bar, cable head, gate opening, position, displacement, pressure deformation and other equipment on-line monitoring and fault diagnosis alarm; Second, dam seepage pressure, joints, strain and settlement, small hydropower station important environmental temperature, humidity, immersion, fission and smoke, flame, sound and light, odor and other environmental aspects.

The system configures intelligent sensors of monitoring signals, intelligent gateway of Internet of Things, on-line monitoring device, monitoring host, data server, Web server, on-line monitoring and fault diagnosis host, remote centralized control center and mobile terminal, etc. The system communication network is based on the layout of field equipment, minimizes the hard wiring mode, adopts wireless ad hoc network communication, mainly adopts the wireless communication mode of intelligent sensor and intelligent gateway, and the wired direct connection mode of intelligent sensor and online monitoring device.

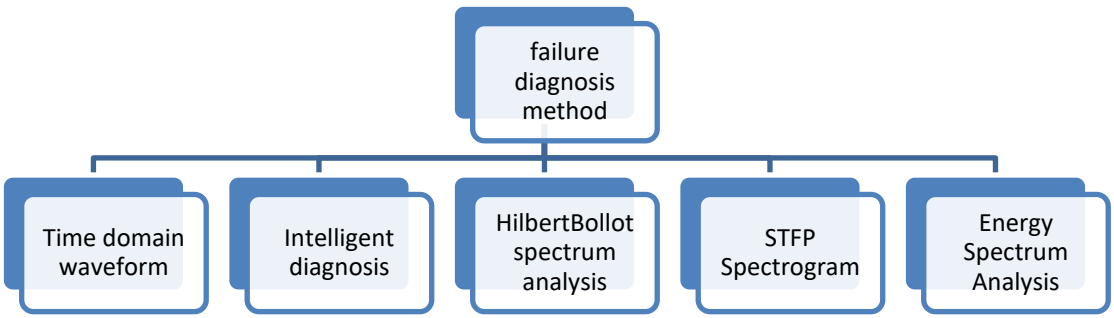

Figure 1 Fault Diagnosis Module Diagram

2.2 System Function

(1) Safety monitoring and fault alarm. Implementing Pair Forward with Internet of Things Technology to monitor information of water valves, turbines, generators, transformers, switch cabinets, excitation, governors and other equipment and alarm information monitoring of auxiliary system such as partial discharge, temperature, oil level, water level, pressure, etc. can automatically carry out information analysis, provide time and frequency domain aided analysis tools for various charts analysis and comprehensive display; can be used for security, fire control, water and rain monitoring of small hydropower stations. Real-time alarm events are generated by threshold comparison method and comparative analysis of similar data for safety monitoring of conditions, dam gates, hydraulic channels and rivers.

(2) Data statistics and trend analysis. The data information of field equipment status is collected, and the related parameters of SCADA monitoring system are fused to carry out automatic statistical analysis of real-time data. Compared with the design parameters and historical data, the historical data are analyzed by comprehensive analysis method, and the statistical analysis report is formed. The trend analysis curve of equipment operation status is generated to guide the operation and

management of small hydropower stations.

(3) Fault diagnosis and optimal operation. With fault diagnosis methods, such as parameter comparison method, threshold comparison method, wavelet packet energy analysis method, Hilbert envelope analysis method, harmonic wavelet analysis method, SVM model diagnosis method and correlation parameter comprehensive analysis method, are used to analyze and analyze all kinds of data on-line monitoring. Meanwhile, the time-domain waveform graph, spectrum graph and historical trend graph are used to analyze the data. The fault situation and the trend of equipment operation status are displayed, so that the optimal operation scheme of equipment can be put forward based on the analysis of fault diagnosis results.

(4) Equipment information and assistant decision-making. Using Internet of Thingstechnology, the coding, performance parameter recording and management of IOT tags for main equipments of small hydropower stations are realized. Data acquisition and diagnosis of equipment status are automatically completed. Auxiliary management information including equipment identification of power stations can be obtained. The information management of power plant equipment can be realized, which provides safe operation, planned maintenance, active maintenance and technical management of equipment.

(5) Telecommunication and Mobile Management. The system passes through a private network or the Internet such as GPS, 4G and other communication modes which centralized control center, cloud service platform and mobile terminal of hydropower station for data, image and event information, realizing remote monitoring and mobile office of on-line monitoring and fault diagnosis system, and improve the safety management level and efficiency of equipment operation of small hydropower station.

2.3 System Operation

During one year of trial operation, the monitoring data of the system is accurate and reliable, the fault analysis and diagnosis report is complete, and the operation is stable. On the one hand, it makes the staff on duty.

The number and intensity of work have been greatly reduced, and the mechanism of fault diagnosis, evaluation and early warning has been implemented, so that no major production accidents have occurred. On the other hand, equipment condition monitoring, information technology and mobile management of mobile APP have improved the safety management efficiency of power plants, increased the normal operation time of generating units, reduced the number of shutdowns, and improved the economic benefits of generating. It can be seen that the application of on-line monitoring and fault diagnosis system in small hydropower stations has brought better economic benefits for small hydropower stations and improved the management level of power stations while saving operation and maintenance costs.

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