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Design and Improvement of Transmission Line Online Monitoring Communication Network

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Abstract: transmission line is an important part of smart grid construction, which has many factors, such as wide distribution, long distance, complex working environment, difficult maintenance and easy to be damaged by natural external forces, etc. Among them, the construction of transmission line online monitoring network plays an important role in ensuring the stability and safe operation of online monitoring technology. In this paper, through the analysis of the transmission line and on-line monitoring transmission data demand and the existing problems of the current communication network, the communication network and data transmission system for transmission line monitoring is designed, which provides some reference for the construction of stable operation of the transmission line on-line monitoring network.

1. Introduction

Long distance power transmission is the main way to solve the contradiction between power demand and energy distribution in China. It is also an important part to promote the process of urbanization, accelerate the transformation of national economic development, and promote China's national strength. But we need to pay attention to the fact that long-distance transportation is to meet the power demand, and the places with large power demand are often more developed cities. The environment of power supply lines is relatively bad. How to effectively, stably and reliably supply power for a long time is still a problem to be solved. Since 2000, the development of a variety of sensors, such as photovoltaic power generation technology and other transmission line on-line monitoring technology, can complete the real-time monitoring of transmission line operation, in which real-time monitoring, accident diagnosis, assessment and prediction, risk warning and other functions have become an important technical means to realize the state operation and maintenance of transmission line^[1].

2. Problems in the construction of transmission line online monitoring network

At present, most of the domestic transmission lines are in a relatively bad environment. The extremely high temperature in summer will affect the quality of communication data transmission, and the too cold weather in winter will also affect the data transmission of base stations. Secondly, high altitude areas such as Xinjiang and Tibet belong to high altitude areas. The bad natural environment and the influence of external electromagnetic interference easily lead to the communication base station crash and network paralysis.

Secondly, the power consumption of communication network is too high. At present, most large-scale intelligent communication networks in China are powered by solar energy and battery. The power and power consumption of power supply are relatively fixed. In the face of high or low temperature environment, the efficiency of power supply will be greatly reduced. Among them, the



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power supply for the communication network occupies a large part, which may lead to the power shortage of the state extension. Therefore, the problem to be solved is the energy supply of communication network^[2].

Finally, the supply of transmission line communication network is unreasonable. The construction of transmission network generally uses optical fiber communication and WiFi mode to transmit data after the transmission line is built, which has the problem of high installation cost.

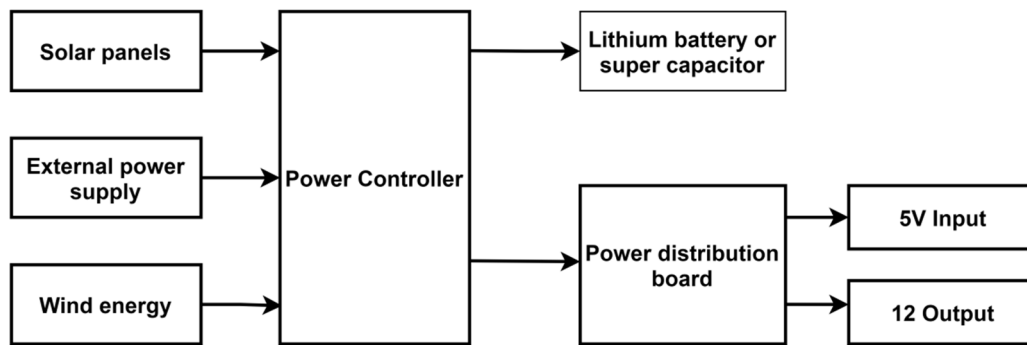


Figure 1: Tower communication power supply system diagram

3. Design principle and improvement of transmission line online monitoring network

3.1. Optical communication replaces cable communication

After updating the communication mode of intelligent substation, the secondary cable can be saved. Using optical fiber communication instead of traditional cable communication can provide excellent conditions for substation communication and transmission. In optical fiber communication, it has excellent effect of preventing radio interference in the operation process, excellent confidentiality, excellent communication transmission quality and high transmission speed. In this communication mode, the information is converted into a signal to complete the transmission operation. The signal is applied to the laser beam emitted by the laser at the transmitting end, and the secondary transmission is completed according to the frequency and reception of the signal. The signal is transformed to recover the original content of the information. Therefore, in the process of optical fiber communication, because of its light weight, fast transmission speed and high reliability, it is suitable for the construction of substation^[3].

Power system	4G	Optical communication	Beidou/SkyNet		Ad hoc network	
	Encrypted authentication					
	Data exchange					
	WLAN	NB-IoT	Lora	FE	RS232	RS485

Figure 2: communication gateway structure

3.2. Application of intelligent network communication terminal management platform

The intelligent terminal has the ability to record goose instructions, complete the monitoring task through the tripping and closing instructions, and execute the corresponding protection tasks. After receiving the trip command, the intelligent equipment must send the command message through goose network to simplify the control equipment in the main control room. In order to complete the functions of information management, measurement and control tasks and related network data transmission, it is necessary to better process the software system of intelligent substation, as well as highly integrated

wave recording and measuring units. It needs to be improved. The information collection of software component technology in intelligent substation is completed, which has a strong auxiliary effect on the transformation of substation system and equipment system. Information based data transmission platform plays an important role in the system. Finally, the data from multiple integrated sensors can be effectively transmitted through specific network terminals, so that the system can be monitored in real time^[4].

4. Transmission line online monitoring troubleshooting and network security design

4.1. Introduce synchronous timing and high-precision positioning technology

At present, according to the global positioning system or Beidou system, synchronous sampling technology is applied, such as GPS. When the synchronous signal is obtained, the analog quantity is converted and modulated to realize the analog-to-digital conversion. At this time, GPS provides the trigger signal to the analog-to-digital conversion equipment, which is processed by CPLD to obtain the synchronous trigger pulse signal. When all devices convert trigger pulse to realize synchronous sampling operation, the fault data can get accurate label through GPS to form synchronous phase angle data. Put forward requirements for the punctuality of the system. In order to achieve this requirement, the system selects a high precision constant temperature crystal oscillator as the time tracking source. At the same time, high-precision positioning technology is needed. One of the key functions of fault recording monitoring system is ranging. Single terminal fault location is the main method for fault location when the terminal data cannot be obtained. However, its accuracy is easily disturbed by such factors as aperiodic decaying DC component and transition resistance at fault point. In the calculation of single terminal ranging, not only the aperiodic decaying DC component is filtered, but also the filtering resistance is systematically grasped, and the compensation technology is scientifically applied to reduce the interference of distributed capacitance and improve the accuracy of single terminal ranging. Therefore, accurate positioning of high-voltage line fault is conducive to ensure the quality of maintenance and control the outage time. Smart use of optical communication on the effectiveness of data transmission, the complexity of the current high-voltage transmission network, only actively optimize the fault location method, can improve the level of intelligent fault location^[5].

4.2. Introduce artificial intelligence technology to complete the construction of communication network

For power system, it is very necessary to develop transmission line on-line monitoring expert system. Its purpose is to infer the possible fault points and causes of transmission line faults by analyzing the data collected by the monitoring system. It includes five parts: knowledge base, database interpretation mechanism, inference engine and human-computer interface. The main means to obtain data signal of monitoring system are remote visualization, safe operation of line, lightning arrester, etc. When the artificial intelligence system can run normally and stably, it can transform the field situation into visual message signal. The lightning arrester, safety mode and corresponding protection module in the system will start, and the system will make intelligent decisions according to the output signal of each module. For the corresponding mechanical structure, the results can be used as an important basis for early fault diagnosis of transmission lines, and provide a certain reference significance. With the continuous development of wireless communication technology, signal coverage can be achieved in a large range, and the sensor can effectively monitor and collect data in the detection point of power transmission system,

Based on the infinite communication network, the system realizes the transmission of relevant data, completes the synchronous transmission of the monitoring system, and constructs an integrated information monitoring platform with AI fault diagnosis technology to intelligently monitor the safe operation of the transmission line.

4.3 Ensure the safe operation of the network

Different communication methods have different design of communication network security. The way of each design is as follows:

(1) For wireless APN private network, based on VPDN technology, using two-layer tunnel protocol to build virtual private network for users in dial-up network technology, to realize the extension of enterprise private network to wide area wireless side. Using the APN platform of mobile operators, the monitoring extension can access the secure access platform through APN to ensure the security of data transmission.

(2) For optical communication network and optical communication + WiFi communication network, industrial grade optical fiber switch and industrial grade wireless AP are needed. In the setting of industrial grade optical fiber switch, MAC address is filtered and bound with IP address. Industrial wireless AP adopts MAC address filtering, MAC address and IP address binding and WPA2 protocol encryption mechanism to hide SSID to ensure communication security.

(3) For wireless private network, set Mac and IP address binding on private network terminal and RRU to prevent illegal users from accessing private network terminal and RRU; In the substation or converter station management computer for further strict authentication of user identity, to prevent the invasion of illegal users.

5. Conclusion

Transmission line online monitoring communication network is an important part of transmission line online monitoring technology. This paper analyzes the problems in the transmission line online monitoring communication network in China, and puts forward the corresponding transmission line security problems, online monitoring communication network information security problems and the corresponding protection scheme. It provides a reference for the design of transmission line online monitoring communication network.

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