Research on Field Personnel Regulation Method Based on Intelligent Scheduling Technology of Power Grid

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Abstract. The conventional field personnel control method mainly uses DTS distributed collaborative simulation technology for personnel control interconnection, which is easily affected by the deviation of control trend, resulting in poor personnel control effect. Therefore, it is necessary to design a brand-new field personnel control method based on power grid intelligent scheduling technology. That is, the carrying capacity model of field personnel regulation is constructed, and the field personnel regulation algorithm is designed by using the intelligent scheduling technology of power grid, thus completing the field personnel regulation. The experimental results show that the control method of field personnel based on intelligent scheduling technology of power grid has good control effect, reliability and certain application value, and has made certain contributions to improving the control efficiency of field personnel.

Keywords: Power grid intelligence; Scheduling; On site; Personnel; Regulation; Methods; study.

1 Introduction

Power grid intelligent scheduling technology is an optimization technology of power system operation based on artificial intelligence algorithm. By analyzing historical data, real-time operation status and forecast information [1-3] , it provides the optimal scheduling scheme for power grid operation, so as to realize the safe, stable and economical operation of power system. The intelligent scheduling technology of power grid mainly considers the load forecasting, equipment status, personnel allocation and other factors of power grid, and obtains the completion of parallel calculation [4-6] through the optimization algorithm, which lays the foundation for formulating a reasonable power grid operation scheme. It is of great significance that the field personnel of the power grid can only regulate and control. First, it can ensure the safe and stable operation of the power system, which is a complex energy supply system, including power generation, transmission and distribution. The main goal of power regulation operation is to ensure the safe and stable operation of power system [7-10] and ensure the continuity and stability of power supply. Only by ensuring the balance between supply and demand, frequency stability and reasonable voltage control can we prevent the occurrence of power grid overload, power failure and other problems. Secondly, it can improve the economy of the power system, and the power regulation operation can achieve the balance between supply and demand by reasonably scheduling and optimizing the use of power resources [11-13] , so as to maximize the economy and energy utilization efficiency of

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the power system. Through the reasonable planning and dispatching of power load, the short-term mismatch between supply and demand can be reduced, the peak-valley difference of load can be reduced, the load rate and utilization rate of power system can be improved, and then the power cost and energy waste can be reduced. Finally, it can enhance the power grid's ability to resist disasters and deal with emergencies [14-15] . When faced with natural disasters, accidents and other emergencies, the field personnel control of the power grid can quickly respond and recover, reducing losses and impacts.

The regulation of intelligent personnel in power grid mainly includes several different steps. First, data collection and analysis, including historical data of power grid operation, real-time operation status and forecast information, are collected and analyzed. These data include power grid load forecasting, equipment status, staffing and other information. Through the analysis of these data, we can get the operation characteristics and laws of the power grid, and provide the basis for the subsequent scheduling scheme; Secondly, to formulate the scheduling scheme, it is necessary to consider the load forecast, equipment status, staffing and other factors of the power grid, and make adjustments according to the actual situation. At the same time, it is also necessary to consider the skills and experience level of field personnel and make reasonable personnel control; Thirdly, the optimization algorithm is introduced to automatically adjust the parameters in the scheduling scheme to achieve better scheduling effect. According to the above steps, this paper designs a brand-new field personnel regulation method based on the intelligent scheduling technology of power grid.

2 Design of field personnel regulation method based on intelligent scheduling technology of power grid

2.1 Construction of on-site personnel control bearing capacity model

Different personnel control areas have different business volume, different personnel abilities and different work contents. Therefore, in order to improve the reliability of field personnel control, it is necessary to build an effective field personnel control bearing capacity model. Firstly, it is necessary to analyze the post business volume and determine the time required to complete different businesses in a certain period. Secondly, it is necessary to measure the business ability of personnel and record the processing efficiency of different personnel in the same post. Finally, the personnel business volume is allocated, the bearing capacity coefficient is calculated, the relationship between the post business volume and the personnel in different periods is counted, and the quantitative judgment is made. Based on this, the on-site personnel regulation bearing capacity model is constructed as shown in Figure 1 below.

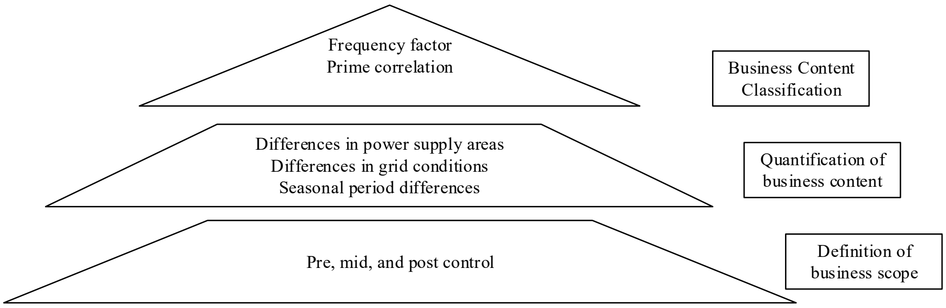

Fig. 1. Field Personnel Regulation Bearing Capacity Model.

As can be seen from Figure 1, the above-mentioned on-site personnel regulation bearing capacity model focuses on the classification relationship between personnel regulation and business execution, and the total time of regulation business can be calculated according to different business characteristics and the correlation degree of personnel regulation, as shown in the following (1).

$$T_Z = \sum T_i \quad . \tag{1}$$

In the formula (1), T_i represents different classified sub-traffic. At this time, the execution of each category of traffic takes an average time t is shown in the following (2).

$$t = \sum_{i=1}^{m} T_i N_j M_j \quad . \tag{2}$$

In the formula (2), N_j represents the number of times the business is conducted during working hours, M_j represents the number of people who need to participate in this task item. Different working areas of field personnel have different basic businesses. Therefore, the parameters of field personnel regulation can be adjusted based on the business consumption time, and the total time T_S of personnel regulation in different areas at this time is shown in the following (3).

$$T_S = T_i \bullet k_a \bullet k_n \bullet k_t \quad . \tag{3}$$

In the formula (3), k_a represents adjustment coefficient of personnel regulation area, k_n represents the business regulation coefficient, k_t represents the time control parameters, according to the above-mentioned on-site personnel control model, different personnel control links can be effectively determined, and the business ability of personnel can be matched with the actual control requirements, so as to ensure the final control reliability to the greatest extent.

2.2 Based on the intelligent scheduling technology of power grid, the field personnel control algorithm is designed

Power grid intelligent scheduling technology is a new intelligent technology, which can effectively reduce the risk of field personnel regulation, solve the problems of personnel regulation in different links and improve the rationality of field personnel regulation. Therefore, this paper designs an algorithm for field personnel regulation based on power grid intelligent scheduling technology. First of all, it is necessary to assume the number of basic services, and the field personnel control function $f(P_a)$ at this time is shown in the following (4).

$$f(P_a) = f_1(p) + f_2(p) \ . \tag{4}$$

In the formula (4), $f_1(p)$ represents a random variable, $f_2(p)$ represents the optimization variable, combining the efficiency of personnel business completion, considering the personnel density and regulation requirements, the calculated personnel regulation probability density $f(x)$ is shown in the following (5).

$$f(x) = \frac{1}{nh}\sum_{i=1}^{n} K(\frac{x}{h}) \ . \tag{5}$$

In the formula (5), n represents personnel regulate the number of samples, h represents the width of the window function, K represents a kernel function, x represents the minimum loss constant. At this time, we can assume the scope of personnel control, and generate the field personnel control algorithm OPT according to the relationship between planned tasks, teams and groups and field operations, is shown in the following (6).

$$OPT = \min(a \bullet T_{\max} + b * C) \ . \tag{6}$$

In the formula (6), a represents the initial personnel control coefficient, $T_{\max}$ represents the time required for the representative to perform all tasks, b represents the final personnel control coefficient, C represents the loss cost caused by the delayed execution of planned tasks. In the process of personnel control, firstly, it is necessary to obtain the number of control personnel in the control area, including the position of personnel, their working status, task progress, etc. After the data collection is completed, the working status of personnel can be classified and evaluated, and the data can be converted into a unified analysis format. Secondly, it is necessary to analyze the field tasks, judge the relationship between the task difficulty, task type and the number of personnel, match the personnel's regulation information with the tasks, and assign relatively urgent tasks to those who are in good working condition. Finally, the field personnel control algorithm generated above is used for optimization, the working state of field personnel is determined in real time, and the control data is fed back. Using the field personnel regulation method based on power grid intelligent scheduling technology designed above can effectively determine the matching state between personnel and tasks, effectively allocate the completion time of operations, and effectively improve the efficiency of personnel regulation.

3 Experiment

In order to verify the control effect of the designed field personnel control method based on power grid intelligent scheduling technology, this paper configures a basic experimental platform, and compares it with the conventional field personnel control method considering cross risks and the field personnel control method based on artificial intelligence, and carries out experiments as follows.

3.1 Experimental preparation

According to the requirements of on-site personnel regulation experiment, this paper selects RG-CT550 cloud terminal platform as the experimental platform, which has good performance and mainly uses distributed storage technology to process on-site personnel scheduling information. During the experiment, different types of control instructions may be generated, which may affect the final experimental results. In order to solve this problem, RG-CT550 cloud terminal experimental platform uses ATML embedded memory chip to process experimental instructions. The parameters of this ATML embedded memory chip are shown in the following Table 1.

Table 1. Parameters of ATML Embedded Memory Chip.

Index	Numerical value
package	Small Outline Package
RoHS	correct
Minimum power supply voltage	2.5V
Maximum power supply voltage	6.5V
model	7.1mm*7mm*1mm

It can be seen from Table 1 that the performance of the ATML embedded memory chip is good, which meets the experimental requirements. In the process of personnel regulation experiment, it is necessary to continuously obtain the scheduling effect parameters of field personnel and optimize the experimental process. Therefore, the RG-CT550 cloud terminal experimental platform configured in this paper uses STM processor to process the experimental instructions in real time, and the structure of the processor is shown in Figure 2 below.

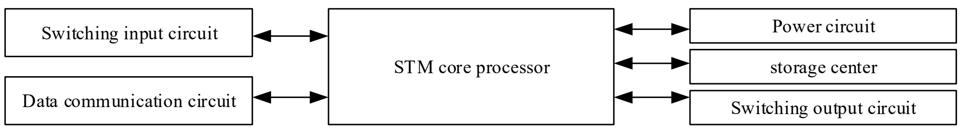

Fig. 2. STM processor structure.

As can be seen from Figure 2, there are many operating levels of the experimental platform. In this paper, VPS experimental virtual machine is used to ensure that different personnel scheduling lines are always in an independent state. In addition, OpenStack cloud computing management tool and Fuel tool are selected for optimization and correction. The schematic diagram of test deployment is shown in Figure 3 below.

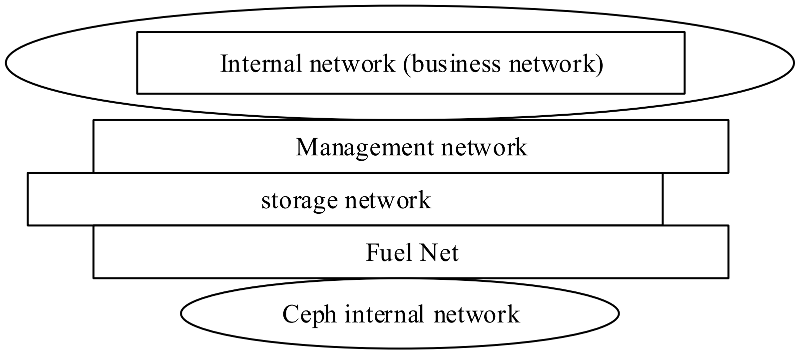

Fig. 3. Schematic diagram of test deployment.

As can be seen from Figure 3, after the above-mentioned test deployment is completed, the service relationship of the virtual machine can be adjusted, different personnel control tasks can be planned, and the final experimental results can be output according to the Keystone\Horizon service relationship.

3.2 Experimental results and discussion

According to the above experimental preparation, an example of field personnel regulation can be analyzed, that is, the field personnel regulation method designed in this paper based on power grid intelligent scheduling technology, the conventional field personnel regulation method considering cross risks, and the field personnel regulation method based on artificial intelligence can be used to regulate X smart grid. The regulation effects of different methods are shown in Table 2 below.

Table 2. Experimental results.

Date	Regulatory personnel number	Control time	Regulatory instructions	Implementation of personnel regulation
The on-site personnel control method designed in this article based on intelligent scheduling technology of the power grid				
2022-08-06	ZS02158866	9:00~10:00	Increase the output of Unit 2 by 10%	Successfully completed personnel control and correctly executed control instructions
2022-05-07	LS15552369	8:00~9:00	Adjust the frequency of Unit 5 to 59.5Hz	Successfully completed personnel control and correctly executed control instructions
2022-06-09	WW5742238	10:00~11:00	Distribute the load of Unit 4 to other units	Successfully completed personnel control and correctly executed control instructions
2022-07-11	SH1482369	11:00~12:00	Reduce the output of Unit 3 by 5%	Successfully completed personnel control and correctly executed control instructions
2022-	XA5841253	12:00~13:00	Adjust the frequency	Successfully completed personnel

03-12			of Unit 6 to 61.0Hz	control and correctly executed control instructions
2022-02-13	WC2695845	13:00~14:00	Distribute the load of Unit 3 to other units	Successfully completed personnel control and correctly executed control instructions
2022-09-15	ZW2452369	14:00~15:00	Increase the output of Unit 4 by 8%	Successfully completed personnel control and correctly executed control instructions
2022-10-26	XV8756854	15:00~16:00	Adjust the frequency of Unit 5 to 60.5Hz	Successfully completed personnel control and correctly executed control instructions
On site personnel control methods considering cross risks				
2022-08-06	ZS02158866	9:00~10:00	Increase the output of Unit 2 by 10%	Some regulatory instructions failed to execute
2022-05-07	LS15552369	8:00~9:00	Adjust the frequency of Unit 5 to 59.5Hz	Successfully completed personnel control and correctly executed control instructions
2022-06-09	WW5742238	10:00~11:00	Distribute the load of Unit 4 to other units	Some regulatory instructions failed to execute
2022-07-11	SH1482369	11:00~12:00	Reduce the output of Unit 3 by 5%	Successfully completed personnel control and correctly executed control instructions
2022-03-12	XA5841253	12:00~13:00	Adjust the frequency of Unit 6 to 61.0Hz	All personnel control instructions failed to execute
2022-02-13	WC2695845	13:00~14:00	Distribute the load of Unit 3 to other units	Some regulatory instructions failed to execute
2022-09-15	ZW2452369	14:00~15:00	Increase the output of Unit 4 by 8%	Successfully completed personnel control and correctly executed control instructions
2022-10-26	XV8756854	15:00~16:00	Adjust the frequency of Unit 5 to 60.5Hz	All personnel control instructions failed to execute
A method for on-site personnel control based on artificial intelligence				
2022-08-06	ZS02158866	9:00~10:00	Increase the output of Unit 2 by 10%	All personnel control instructions failed to execute
2022-05-07	LS15552369	8:00~9:00	Adjust the frequency of Unit 5 to 59.5Hz	Successfully completed personnel control and correctly executed control instructions
2022-06-09	WW5742238	10:00~11:00	Distribute the load of Unit 4 to other units	Some regulatory instructions failed to execute
2022-07-11	SH1482369	11:00~12:00	Reduce the output of Unit 3 by 5%	All personnel control instructions failed to execute
2022-03-12	XA5841253	12:00~13:00	Adjust the frequency of Unit 6 to 61.0Hz	Successfully completed personnel control and correctly executed control instructions
2022-02-13	WC2695845	13:00~14:00	Distribute the load of Unit 3 to other units	Some regulatory instructions failed to execute
2022-09-15	ZW2452369	14:00~15:00	Increase the output of Unit 4 by 8%	Successfully completed personnel control and correctly executed control instructions
2022-10-26	XV8756854	15:00~16:00	Adjust the frequency of Unit 5 to 60.5Hz	All personnel control instructions failed to execute

From Table 2, it can be seen that the field personnel control method designed in this paper based on power grid intelligent scheduling technology can effectively execute different personnel control instructions, while the conventional field personnel control method considering cross risks and the field personnel control method based on artificial intelligence are difficult to execute relatively complicated personnel control instructions, and in field operation, the two methods will rely on the technology and equipment and systems to support the transfer and execution of instructions, if the technology and equipment has limitation, fault, or accidents, such as communication interrupt, equipment failure, will cause the failure of instruction execution. The above experimental results prove that the field personnel intelligent control method designed in this paper has good control effect, reliability and certain application value. The regulation method based on intelligent grid scheduling technology is adaptive and flexible, and can adjust personnel scheduling in real time according to changes in site conditions. By real-time monitoring of power grid status, fault information and availability of personnel and equipment, it ensures that the system can maintain a good state of regulation at all times, and adapt to personnel scheduling under different needs and changing environments. Effectively solve the problem caused by the unbalanced utilization of human resources, and avoid the blindness and uncertainty of personnel scheduling.

4 Conclusion

Smart grid is a modern form of power system, which relies on advanced communication, sensing, measurement and equipment technology to realize real-time monitoring, intelligent dispatching and optimal management of power system. The development of smart grid is of great significance to ensure the safe and stable operation of power system, improve the economy and energy utilization efficiency of power system, enhance the resilience and emergency response capability of power grid, and promote the intelligent transformation of power industry. With the rapid development of China's economy and the transformation of energy structure, the demand for electricity is increasing. The traditional energy supply mode is not only inefficient, but also has a serious impact on the environment. At the same time, the composition of smart grid is becoming more and more complicated, and the conventional personnel control method is inefficient, which is difficult to meet the current requirements. Therefore, this paper designs a brand-new field personnel regulation method based on the intelligent scheduling technology of power grid. The example analysis shows that the designed field personnel control method has good control effect, reliability and certain application value, and has made certain contributions to promoting the development of smart grid.

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