Construction and Application of Distributed Power Storage System

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Abstract—In today's society, with the continuous development of China's economy, the power industry is also growing rapidly. As an important part of the logistics distribution system, the warehousing system plays an important role in the production and operation of the entire enterprise. Therefore, effective utilization of distributed generation is of great significance for improving energy supply efficiency and reducing operating costs. This paper mainly introduces the background and application status of distributed generation technology, analyzes and discusses the research and simulation of power supply network scheduling optimization methods based on DGS structure model and DGs topology mode, and gives the corresponding solutions. After the design of the system, this paper conducts a performance test on the system to determine whether the system can operate normally. The test results show that the performance of the distributed power storage system is basically stable at more than 80% under different power storage capacities, and the power utilization efficiency is also more than 90%. This shows that the performance of the power storage system can meet the needs of users.

1. Introduction

With the development of the electric power industry, the demand for gas storage is also growing, but China is currently in the situation of coexistence of power generation side and transmission and distribution side. In the traditional mode, the storage capacity is insufficient. Therefore, it is necessary to optimize the design of distributed storage[1-2] For large loads, centralized control can be used to improve their efficiency to maximize benefits. Distributed energy system is characterized by high efficiency, energy conservation, environmental protection and green sustainable utilization. Therefore, it is of practical significance and long-term value to apply this technology to the power industry[3-4].

In foreign countries, the research and application of distributed generation technology started earlier, and its development mainly focused on distributed power generation, including photovoltaic power plants and energy storage devices[5-6]. With the rapid progress of information technology, such as large-scale integrated circuits, computer network communication equipment, and the rapid growth of power electronic device industry. China also has a certain degree of understanding of the photovoltaic power generation system. It has grasped the first key advantage. It uses solar energy as the energy source for power supply. It directly radiates the sun to semiconductor silicon wafers to achieve electrochemical conversion into electrical energy. In addition to adding a large number of electrode plates to the battery pack, some scholars described the distributed energy power generation technology. He pointed out that the access capacity and load characteristics required by different types of power plants are quite different, and proposed how to improve the decentralized power storage to achieve the goal of energy conservation and environmental protection, solve the impact of large-scale power supply access on the traditional power system, and reduce the cost of power network construction and operation and maintenance costs to improve the operation quality and efficiency of power supply networks in large cities in China[7-8]. Therefore, this paper builds the power storage system based on distributed.

With the development of information technology, people's demand for power resources is also increasing. At the same time, energy consumption and environmental pollution are becoming increasingly serious. In order to effectively reduce the air pollution, water and soil loss and other ecological hazards caused by fossil fuels. Based on the distributed generation technology, the efficient storage management mode can be realized to solve various problems and challenges that currently exist in the process of distribution network construction in China. This paper will introduce a simple and easy method that meets the actual needs, can provide users with quality services, has certain economic benefits and environmental protection value, and also has strong applicability and feasibility.

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2. Discussion on Distributed Power Storage System

2.1 Construction of Power Storage System

During the construction of the power storage system, the actual situation shall be taken into consideration to ensure the layout of the selected distributed generation device and load center[9-10]. The power supply, transformer and other related equipment and facilities in the whole area shall be fully understood. At the same time, the scheme with advanced technology, good economy, reliable, stable operation, convenient maintenance and low cost shall be selected as far as possible. Figure 1 is the basic diagram of the power storage system.

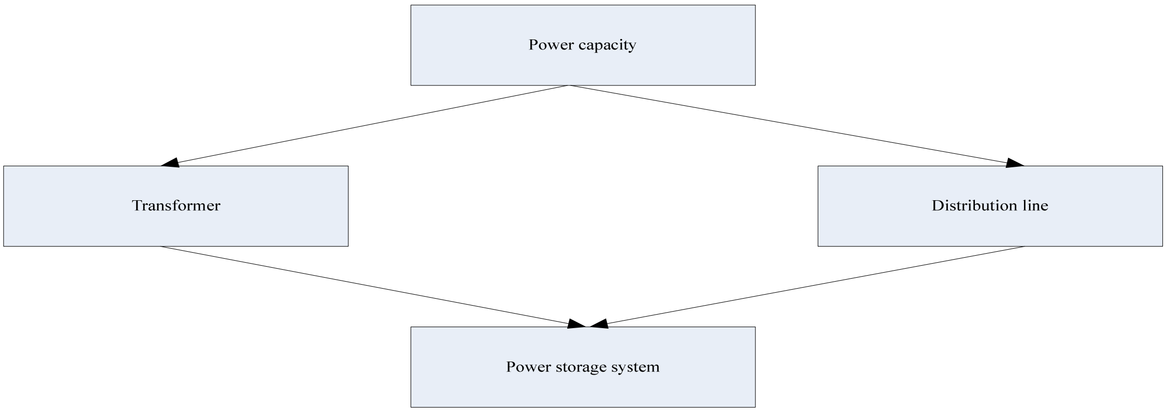

Figure1. Actual situation of electric power storage system

The power supply LAN is composed of power grids, substations, etc., which connects power plants and power companies for load transmission through satellite positioning equipment[11-12].

2.2 Distributed Technology

Distributed technology refers to the division of decentralized and decentralized production scale, so that each department has corresponding functions and effectively controls these businesses. Centralized management is to share information through the use of computer network systems. The distributed warehousing management system can reduce the mutual interference and resource waste between various links under the traditional warehousing mode to a certain extent, and can also improve the accuracy and reliability of load forecasting at all levels in the distribution network, thus reducing energy consumption, protecting the environment from damage, and can also bring considerable benefits for power enterprises. Figure 2 shows the data transmission structure of the distributed system.

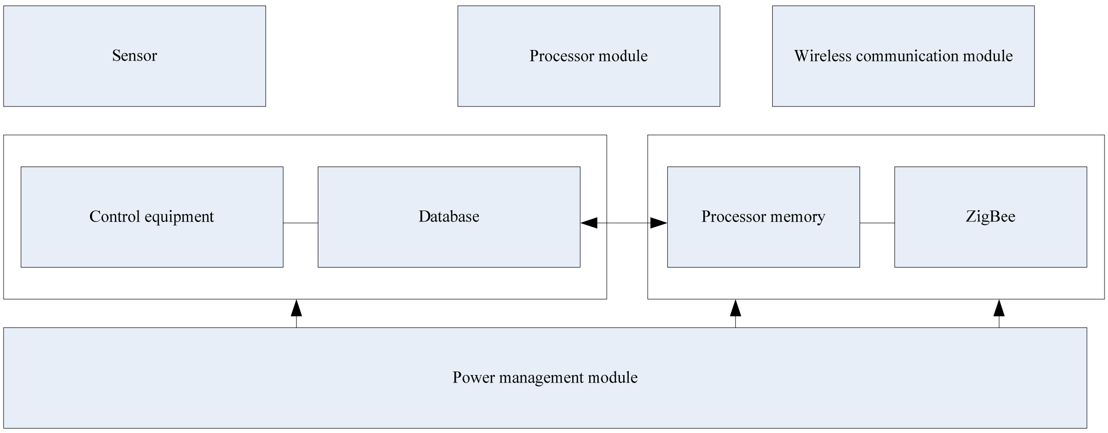

Figure2. Distributed system data processing structure

It takes electric energy as the main energy, and the power module provides energy to the load, and then transmits or transmits the electric energy to the storage unit (such as transformer) and stores it. Finally, the inverter obtains the corresponding voltage value and distributes it to each distribution network, so as to realize the power supply demand of the whole system and the matching and coordination relationship between power supply and user demand. In order to simplify processing, the power storage can be regarded as a regular sphere, so a=b=R, e=0. This formula can be simplified as:

$$\begin{cases} x = a \times \theta \\ y = a \times \ln \tan\left(\dfrac{\pi}{4} + \dfrac{\varepsilon}{2}\right) \end{cases} \tag{1}$$

According to the pyramid model, there are 2n tiles in each row and column of the nth layer. Combined with the above formula, we can get the conversion formula of longitude and latitude coordinates and tile coordinates in the pyramid as follows:

$$\begin{cases} x = \dfrac{\pi + \theta}{2\pi} \times 2^n \\ y = \left[\dfrac{\ln \tan\left(\dfrac{\pi}{4} - \dfrac{\varphi}{2} \right)}{2\pi} + 0.5 \right] \times 2^n \end{cases} \tag{2}$$

It can solve the problems studied without any prior knowledge and necessary conditions. It can only be transformed into simple, intuitive, fast and accurate data processing software to complete the operation task. For large capacity power transmission and distribution networks, it is not necessary to consider this algorithm at all, but to realize the calculation and simulation of various complex models through computer technology.

$$\begin{cases} x = a \times \theta \\ y = a \times \left[\ln \tan\left(\dfrac{\pi}{4} + \dfrac{\varphi}{2} \right) + \dfrac{e}{2} \ln\left(\dfrac{1 - e \times \sin\varphi}{1 + e \times \sin\varphi} \right) \right] \end{cases} \tag{3}$$

The value range of sample number is determined according to certain criteria and constraints. Because the system has strong fault tolerance and nonlinear eigenvalues are unavoidable distributed problems, the random vector method can also be used when linear algebraic equations are not involved.

3. Experimental Process of Distributed Power Storage System

3.1 Design of Distributed Power Storage System

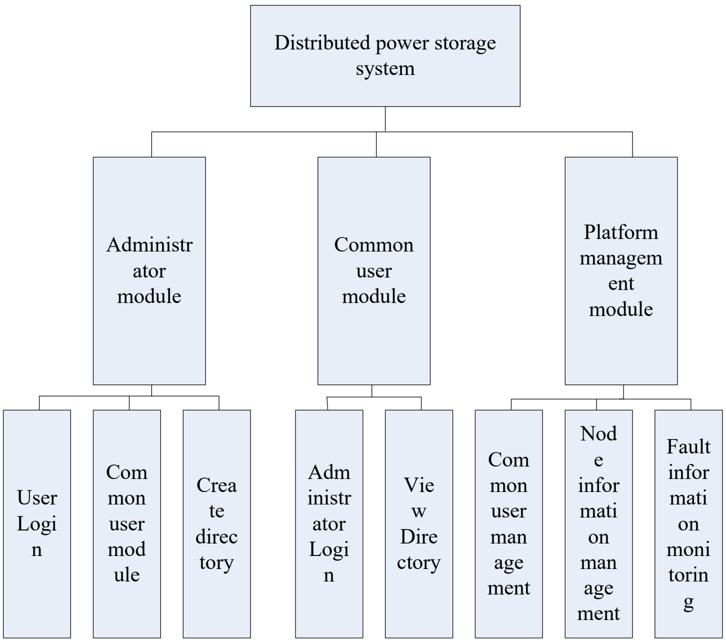

Figure3. Based on the distributed electric power storage system design

The system (as shown in Figure 3) is composed of distributed generation system and power transmission and distribution network, and is mainly used to supply power to large and medium-sized power plants and substations.

(1) Distributed power supply access. When the power grid fails, it can provide power to the power grid. In case of short circuit or overload operation, it can directly put the electric energy into the power grid in nearby areas for standby or dispatching operations, and then restore the power to users for use. It is an economical, safe and reliable switching mode.

(2) The power transmission and distribution network is composed of photovoltaic power generation and wind turbine generator units. Formulate corresponding strategies according to different users' electricity consumption and usage. Through real-time monitoring of grid voltage, frequency and other parameters, the required power capacity and whether it is a standby generator set can be determined. At the same time, the power dispatching center can also be used to collect data and feed back these information to the distribution system. Under the power network operation mode, through the load characteristics, network topology and future load forecasting, the mathematical modeling method is used to establish the model and adjust according to different needs.

3.2 Test Process of Distributed Power Dtorage System

During the design and operation of the power storage system, it is necessary to consider some problems that may occur in the whole project, such as the distributed power supply access mode. When selecting different types of power generation equipment, it is necessary to fully consider their actual conditions. (1) After determining the transmission power size and direction required by each unit node, the overall task target can be built; (2) According to the functional requirements of the system, the whole simulation process is simulated and compared with the actual operation. If the fixed mode access mode is used, it will lead to resource waste and high cost. On the contrary, distributed power can be used to save energy and reduce investment costs or improve efficiency, reduce maintenance and other effects. Therefore, according to the specific project content and demand conditions, in order to verify the actual operation of the distributed power storage system, it is necessary to conduct simulation experiments. In the whole simulation process, all equipment and devices are assembled first. Then test whether there is a good connection relationship between different types of equipment, and achieve the final goal by changing the number of transmission lines on the lines between various parts.

4. Experimental Analysis of Distributed Power Storage System

In the actual operation of power storage system, distributed generation is a very common and indispensable power supply mode. This method mainly uses photovoltaic cells, power storage devices and solar modules to store electric energy. The energy generated when these devices are connected to the power grid is released to the earth or near the radiation source to improve the transmission efficiency of the entire network, achieve the goal of efficient and rational use of energy and resource saving society, and also meet the power demand of users in the power storage system, thus effectively improving the living standard of users. Table 1 shows the test data of the distributed power storage system.

Table1. Power storage system test data

Test times	Power storage capacity(Mwh)	Electricity transport efficiency(%)	Power utilization efficiency(%)
1	498	80	93
2	542	86	96
3	379	84	98
4	645	89	94
5	494	86	96

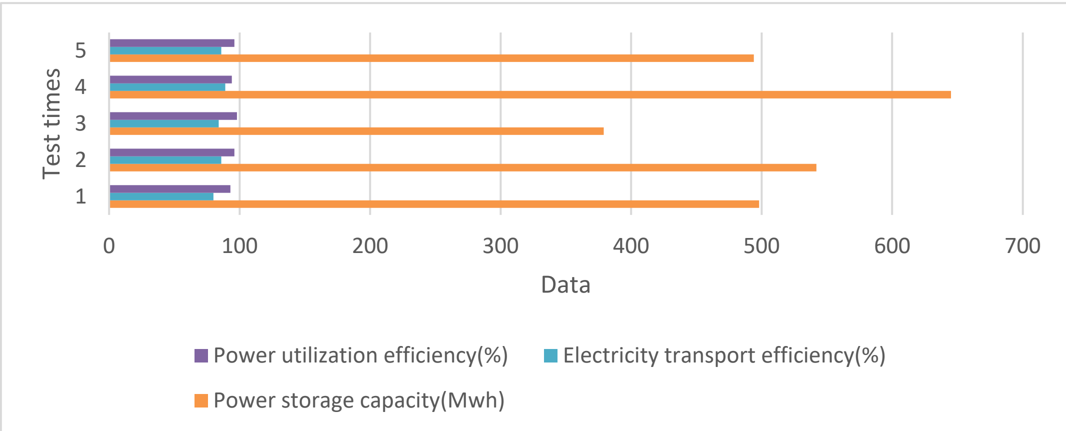

Figure4. Based on the distributed power storage system performance monitoring

The distributed power storage system is composed of many independent sub modules, each of which can detect itself and take corresponding management measures according to different situations. Its operation mode can be divided into decentralized, centralized control and remote monitoring. The dispatching center is set on the distribution side, which is responsible for the real-time monitoring and regulation of each bus and load in the whole system. The distributed power storage system is an integral structure and has many functional modules, so it requires multiple sub nodes to cooperate together to complete the task and execute the corresponding operation process. Verify whether the selected equipment meets the standards through simulation experiments. If the selected handling machinery, handling devices and other hardware facilities meet the specified conditions, the results can be obtained through tests. Otherwise, it is necessary to verify whether the performance and configuration scheme of the handling machinery are consistent with the actual needs. It can be seen from Figure 4 that the performance of the distributed power storage system is basically stable at more than 80% under different power storage capacities, and the power utilization efficiency is also more than 90%. This shows that the performance of the power storage system can meet the needs of users.

5. Conclusion

With the development of the power industry in China, the scale of the power grid is also expanding, and the storage system is one of the indispensable, indispensable and key links in the entire distribution network. However, there are many problems in the actual operation process. This paper will analyze and study the construction and

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scheduling optimization of photovoltaic power stations under the distributed generation mode, and establish a distributed generation model based on DDS (fuzzy control) using DDS technology. Through MATLAB simulation, the feasibility of this method for energy storage distribution management and safe and stable operation of the power grid is verified.

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