Research on Energy Storage Technology in New Energy Power System Based on Computer Processing System

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Abstract. Promoting the development and utilization of new energy is the essential goal of China's energy revolution, and energy interconnection is the key means to achieve this goal. This paper first analyzes the role of computer processing system in promoting energy revolution in energy interconnection, especially the development of energy storage technology in new energy power system. The compatibility between energy interconnection and new energy power system is analyzed. Secondly, the energy storage technology considering the energy storage optimization in each link of the new energy power system under the background of energy interconnection is proposed. Finally, the key technologies of energy interconnection and new energy power system integration are studied, and Suggestions for future research are put forward.

Keywords: New Energy Power System, Energy Interconnection, Energy Storage Optimization, Energy Storage Technology, Computer Processing System

1. Introduction

Currently, China is in the critical transformation stage of the energy industry. With the depletion of fossil energy and the continuous deterioration of the environment, the traditional energy production and consumption system with fossil energy as the core has been unsustainable. Therefore, it has become an essential development in the field of energy in China to build the energy supply and demand system with wind energy, solar energy and other new energy as the core and guide the development direction in the transformation and upgrading of the energy industry\textsuperscript{[1-2]}. As the focus of secondary energy, electric power can transform new energy into directly available energy. Therefore, guiding the
transformation of the traditional power system to the new energy power system is the crucial way to achieve the above energy transformation, which is also an essential goal of China's energy revolution\cite{3,4}. The energy interconnection will play an important role in the realization of the above energy revolution goals. The concept of energy interconnection was first put forward by Jeremy Rifkin in his book “the third industrial revolution”. It is a new energy supply system that takes renewable energy as the primary energy unit, uses Internet technology to realize the real-time flow of energy flow and information flow, and all kinds of energy networks and transportation networks are highly coupled\cite{5-6}.

In summary, energy interconnection will be an essential means to promote the energy revolution, so it will further improve the energy storage and development of the new energy power system. In this aspect, there have been relevant studies at home and abroad. At present, the research on energy interconnection and new energy power mainly focuses on physical technology, information technology and other aspects, while the research on energy interconnection and new energy power system collaborative energy storage is less. As power is the core of secondary energy and can convert renewable energy such as wind energy, solar energy and traditional fossil energy such as oil and natural gas into available energy, the power system will be the core of the whole energy interconnection, and the main research goal of this paper is to promote the improvement and development of new energy power system through energy interconnection technology. Therefore, based on the analysis of the compatibility between the energy interconnection and the new energy power system, this paper proposes the energy interconnection and the new energy power system to optimize the energy storage technology, analyzes the key technologies that make the two connect, and puts forward the corresponding policy suggestions and prospects.

2. Analysis of compatibility between energy interconnection and new energy power system

The integration and transmission of energy flow and information flow is one of the fundamental features of energy interconnection. According to the flow direction of energy flow and information flow, from the perspective of information flow conduction, based on the traditional energy supply network, the energy interconnection will realize the real-time sharing of information resources in the energy development and utilization link through Internet technology. This resource sharing mechanism has the features of the two-way transmission. Users and information control systems, energy supply module, multiple intelligent transmission module There are two-way information transmission capabilities between users, and users can also share energy consumption information. In this highly shared and open information network architecture, the publishers of energy supply and demand information will become more diversified in the future, and the amount of information sharing will increase geometrically.

The energy storage variable is denoted as symbol $I, I_{ij}(p_{ij})$ indicates that the energy storage variable of the $i$th mobile device depends on all energy storage variables except the speed vector itself

$$g_y = \begin{cases} h, i = j \\ h, c_{ij}, i \neq j \end{cases} \quad (1)$$

When the speed of the principal eigenvalue is constant, if equation (1) needs to be satisfied, the following equation is obtained.
\[ \sum_{i,j} g_{ij} p_j \leq T \]  

Equation (2) can be further expressed as follows

\[ p_i \leq \left( T - \sum_{j \in \text{set}} g_{ij} p_j \right) / g_{dd} \]  

From energy flow transmission, the energy interconnection expands the traditional relatively single energy transmission network into a multi-intelligent transmission network. The network has a universal energy access port, and both distributed and centralized energy supply modules can realize plug and play. At the same time, the integration degree of energy flow and information flow is improved, and the capacity to carry information of energy is improved, thereby further improving the capacity to optimize the allocation of energy resources in the broad area.

3. New energy power system collaborative optimization energy storage technology under the background of energy interconnection

In the environment of energy interconnection, the model of energy development, utilization and management will change essentially. The energy supply system will take the form of combining decentralized and centralized energy modules. Based on self-balance and self-optimization of each decentralized energy module, the energy storage of decentralized module and centralized module will complement each other, and then the energy supply end itself and both sides of energy supply and demand will achieve cooperation. With the optimization, the above ideas will be an improvement of the energy storage ideas of the new energy power system.

To improve the connection features between the energy interconnection and the new energy power system, the optimized energy storage technology and key technologies proposed in this section are shown in Figure 1 as follows.
Energy storage technology of energy module

Decentralized module self-balancing mode

Energy resource storage technology

Bilateral stochastic problem

Storage problem

System feasibility analysis

Energy supply and demand storage planning

Collaborative optimization model of energy supply and demand

**Figure 1.** Relationship of existing problems, energy storage technologies and key technologies

The decentralized energy module mainly consists of three essential components: energy production and supply, energy transmission and energy utilization. It is the primary energy supply module of the whole energy interconnection framework. Each energy module is closely connected, with its self-balancing capacity and unique features. Therefore, interaction and cooperation should be implemented based on self-balancing.

In the process of planning, design and energy storage of energy interconnection, the self-balance of energy supply and demand of each decentralized energy module is the basis for optimizing the energy storage in the whole system. Distributed generation follows the energy supply mode of “spontaneous self-use, surplus online”. In the decentralized energy module, users are both “producers” and “consumers” of energy, and the boundary between them becomes blurred. In the process of system energy storage, distributed photovoltaic power generation, small wind power and other power generation resources with high randomness of power generation output and small diesel power generation units with substantial flexibility are used to store energy. Meanwhile, with the orderly charging and discharging of energy storage equipment, the energy storage of the internal power generation side of the distributed module is controllable. This relative controllability is used to deal with the randomness of power consumption on the user side, to achieve the goal of self-balancing energy supply and demand in the decentralized module at present. The self-balance mode of the distributed module is shown in Figure 2 as follows.
Supply side optimization and coordination

Small fuel generator
Other
Flexible generator set

Photovoltaic power generation
Wind power

Electric vehicle
Energy storage equipment

Figure 2. Internal self-balance mode of the distributed module

Because the distributed energy is mainly clean energy, which is affected by the intermittence, randomness and other problems, in some cases, the self-balance mode is not necessarily the optimal operation mode, and each module may achieve the balance of energy supply and demand with high economic cost and pollution emission cost to achieve self-balance. Therefore, in the framework of energy interconnection, there is also an interactive cooperation mode among various modules. When a decentralized energy module cannot achieve self-balance or pays a hefty price for self-balance, it can carry out interactive cooperation, energy exchange and complementary energy storage among several energy modules, to reduce the cost of achieving global optimization.

4. Key technologies linking energy interconnection to new energy power system

To further strengthen the role of energy interconnection technology in promoting new energy grid connection and building new energy power system, we should nest more advanced Internet technology based on existing smart grid technology, energy information connection bridge between energy storage Internet and new energy power system, and cooperate with wide-area energy planning technology and energy storage technology to implement the overall optimization of the energy system at present.

Following the optimization planning mode of energy supply and demand and energy storage, multiple system planning schemes can be obtained by solving the optimization model. The operation effect of each planning scheme is simulated by big data cognitive technology and Simulation simulation technology. The evaluation index system is designed to evaluate each simulation result and select the optimal system planning scheme. Hence, how to improve the simulation accuracy, narrow the gap
between simulation results and analytical values, or further expand the scope of the analytical method, apply it to the analysis and calculation of large-scale systems through big data processing technology, is the technical difficulty in the future.

On the energy supply side, through machine learning, pattern recognition, big data analysis, trend prediction and modeling technology, the correlation analysis model between new energy power generation output and surrounding environmental factors is established. Based on the clustering analysis results, the variable features of new energy can be better managed to form an optimized unit output combination. On the energy demand side, the macro energy consumption data and regional energy consumption data are predicted and analyzed using the big data technology to identify the relationship between energy consumption data and other information data and a differentiated big data analysis model can be established. The big data technology is used to simulate the dynamic response process of the user's demand side, analyze the load response rate and response load of different users in layers, predict the implementation effect of various response measures on the demand side, and provide data support for the design of dynamic demand-side response plan in the process of system operation. In the process of scheduling scheme design and implementation, the system energy storage providers of decentralized and centralized modules can be used to formulate and implement the scheduling plan based on the analysis results of cloud and big data technologies, integrate the advanced technology of energy supply-side and demand-side, and guide the user load to actively track the generation output of clean energy source.

5. Conclusions

It is the primary goal of China's energy industry reform to promoting the development and utilization of new energy and increase the proportion of new energy in China's end-user energy consumption. As the core of secondary energy, the electric power will play an essential role in the reform of the energy industry. Energy storage and development of a new energy power system will be the key means to achieve the reform goals. The energy storage of the energy interconnection can drive the industrial technology upgrading and structural adjustment of China’s energy industry. Through the fundamental transformation of the energy supply and demand structure, the penetration of new energy can be improved at both levels of decentralization and concentration. Hence, both the energy interconnection is closely related to the new energy power system at the design and implementation levels. The energy interconnection can promote the energy storage development of the new energy power system.

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