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Optimization of Microgrid Operation Control Strategy under New Energy Integration

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Abstract: With the direct rise of the social demand for renewable energy, as a new type of energy supply model in the new era, the operation control and optimization of microgrid play an important role in solving the problem of resource sharing. Microgrid can realize the flexibility of distributed power supply and the application of high efficiency, solving the problem of a large number and variety of forms of the power grid. Based on this, this paper will discuss the operation control strategy of microgrid based on a new energy grid connection, and provide constructive ideas for high-quality operation of microgrid.

Keywords: Power system; New energy grid-connected; Microgrid; Renewable energy; Sustainable

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1. Introduction

In the context of contemporary society, the increasingly prominent environmental problems and the growing demand for energy make various countries begin to seek ways to solve energy problems. On this basis, the development and utilization of new energy has been widely concerned. Microgrid can better integrate and unify distributed energy resources, such as wind, solar, and other renewable energy, improve the utilization rate of resources, and realize an efficient, environmentally friendly, and sustainable energy supply. The new energy grid can connect some renewable energy generation systems such as solar energy and wind energy into the grid. Under the transmission and distribution of the grid, it can promote the effective integration of renewable energy and power system, and finally realize the stability and efficiency of power supply. Under the new energy integration, the operation and control of the microgrid can maintain the stability of the power system, maintain the quality of power, promote the effective use and conversion of new energy, so as to achieve sustainable development.

2. Related overview and advantage analysis of microgrid

2.1. Related overview

Microgrid is mainly composed of distributed energy, an energy storage system, a load, a conversion device,

and a control system. Among them, distributed power is one of the energy sources of microgrid, including solar power generation system, wind power generation system, biomass energy generation device, etc. [1]. Solar power generation system needs to use photovoltaic cells to convert solar energy into direct current, and then convert it into alternating current through power electronic devices, so as to provide power for the microgrid to ensure power quality. Wind power generation system needs to use the wind speed to drive the windmill to drive the generator to generate electricity. These distributed power sources have certain decentralized attributes, which can effectively reduce the energy loss in the transmission process. The energy storage device is mainly used to balance the supply and demand of power, which can give priority to storing power when the distributed power generation is excessive, to maintain the balance of power generation [2].

2.2. Optimization advantages of microgrid operation control strategy under new energy integration

First, based on the new energy grid, the optimization and control of the microgrid can help to monitor the supply and demand of energy in the microgrid in real time, and adjust it comprehensively and systematically as soon as the problem is found, so as to maximize the balance of the volatility and instability of new energy generation week. The excess, for example, in new energy power generation, the power grid in an energy storage device to store the surplus electricity, then at the time of electricity shortage, can use the energy storage device to release energy, in order to maintain the stability of the microgrid operation [3]. Again, optimization of micro power grid operation mode can also to a certain extent, the problems of fast reaction, when the micro power grid failure, can in a short period of time of fault zone in isolation. So as to further restore the power supply demand of non-fault areas, so that the microgrid can maintain stable operation.

Second, the optimization of the micro grid operation path can help to achieve the optimal allocation of new energy, reduce the cost of energy consumption, in particular, after detail grid in new energy power generation system, micro power grid will be according to the new energy supply and demand situation, the power output of distributed power supply, energy storage device optimized electrical energy storage and release, consolidating and choose the cheapest way of energy supply [4]. In addition, under the coordination and control of the grid, the microgrid can also realize the complementarity and mutual utilization of energy, and reduce the operating cost.

Thirdly, the optimization of microgrid based on new energy grid-connected can maximize the acceptance capacity of microgrid for new energy generation, so that new energy can be connected to the grid on a large scale and a wide range. With the continuous improvement of science and technology, intelligent operation strategy has become an important form to promote the stable and safe operation of microgrid [5]. Under the support of information technology, the intelligent prediction and scheduling algorithm is a very important means to accurate prediction of the new energy power, on the basis of this, can be more scientific and reasonable arrangement plan and load distribution, improve the utilization of new energy power generation, also can use pluripotent complementary control strategy, to achieve the optimal allocation of energy between different and complementary use of, to further increase the proportion of new energy in the microgrid.

3. Influence of new energy grid connection on microgrid operation

3.1. It affects the stability of microgrid operation

In today's energy field, new energy has been widely researched by various countries. However, the intermittency and volatility of new energy have become the most important reasons affecting its power generation. When these

problems are difficult to solve, the electricity power of the new energy will not be able to maintain the stability of continuous power, and further lead to an imbalance between the power grid [6]. When a large amount of new energy is connected to the grid, it is first necessary to ensure the stability of power generation. Once the power generation is affected by other external factors, there will be a grid failure, resulting in a power failure. With solar and wind, for example, in particular, solar and wind power will be affected by uncontrollable factors, such as weather and season on the one hand, when the output power of wind power will be affected by wind speed, when the wind speed is not stable, electricity power output will be reduced greatly, the stability of the supply of electricity has brought some challenges; On the other hand, solar energy depends on light power generation, which has certain limitations, because only when there is light in the day to output power, and the power generation in different time periods will have large differences [7]. The volatility of new energy has a certain relationship with the voltage and power stability of the grid, which has a certain impact on the stable operation of the microgrid.

3.2. It will increase the difficulty of microgrid dispatch

New energy generation has a certain degree of randomness and volatility, which increases the difficulty of making microgrid dispatching plans to a certain extent. Specifically, conventional energy (coal, oil, natural gas, etc.) power generation has certain controllability and adjustability. However, when doing power dispatch analysis based on new energy, it is necessary to accurately predict and adjust the fluctuation of new energy generation, otherwise it will cause problems of low power dispatch efficiency [8]. In this process, the microgrid dispatching system has a certain flexibility and adaptability, so it is extremely important to control and optimize the microgrid operation. Moreover, in the process of new energy power generation systems to the grid, the dispatching operation and control of the microgrid will become more complex. In the area of large-scale new energy generation, the microgrid dispatching needs to accurately control the ability of new energy generation to meet the changes in power demand.

3.3. The power quality of the microgrid is affected

Power electronic devices are an important part of the new energy power generation system, which will generate harmonics in the operation process. After being connected to the microgrid, it will have a certain impact on the power quality of the microgrid. For example, the appearance of harmonics will make other equipment in the grid heat up, thereby reducing the operation efficiency, and eventually may cause equipment failure [9]. In addition, after the new energy power generation system is connected to the grid, it will have an impact on the voltage, causing voltage deviation and frequency deviation beyond the specified range, thus further affecting the power quality. Under the grid system, the power quality is related to the voltage deviation and the increase of new energy power. New energy needs to meet the specified standards to ensure the safe operation of the microgrid.

4. Operation control strategy of microgrid under new energy grid connection

4.1. Establish an information-sharing platform to control the balanced operation of the microgrid

In order to realize the information sharing and real-time communication between the microgrid and the large grid, the establishment of an information sharing platform is essential. Under the information sharing platform, the microgrid can maximize the load demand of the large grid, the dispatch plan, and the rise and fall of the electricity price, so as to stabilize the load of the grid. The large grid can understand the generation power, energy storage

effect, and load situation of the microgrid, so as to develop a more scientific regulation strategy to improve the operation quality and overall coordination of the microgrid and the large grid [10]. In addition, the operation mode of the microgrid is more flexible and independent, usually relying on internal distributed power supply and energy storage devices to meet the demand for electricity, which makes it stable in the face of bad weather or other natural disasters, while the large grid relies on large-scale dispatch and has strong stability. When the new energy power generation system is unstable, Micro power grid and power transmission power grid can rely on the information sharing platform, realize the complementary and optimize the utilization of the energy, reduce operating costs, and improve energy utilization. Moreover, when the new energy power generation system is connected to the microgrid, the microgrid will have an inaccurate dispatching plan due to external factors. At this time, the large grid can give instructions to the microgrid to comprehensively regulate its power consumption. When the microgrid receives the dispatch instructions, it will control the distributed power and the storage and discharge power of the energy storage device according to the exchange power value issued by the dispatch, so as to ensure the stable operation of the microgrid [11].

4.2. Develop intelligent operation strategies with the help of artificial intelligence

With the development of artificial intelligence, intelligent operation control of microgrid has gradually become a hot topic of social attention. Artificial intelligence algorithms are added to the intelligent scheduling and optimization control of microgrid, such as deep learning, reinforcement learning, etc. Based on the real-time operation data and historical data of the microgrid, the intelligent operation of the microgrid can predict the energy demand and supply in the next period of time, formulate the corresponding scheduling scheme, and perform self-learning and optimization according to the operation state of the microgrid to improve the operation efficiency and stability of the microgrid. In addition, an intelligent decision support system can be established to collect and analyze the historical operation data, current operation data and external data of the microgrid, use machine learning, deep learning and other methods to carry out intelligent analysis and prediction, and use the obtained decision-making information as the basis for decision-making, so as to make the microgrid more stable operation [12].

4.3. Establish a safety monitoring system to achieve rapid response to the fault

With the increasing capacity and complexity of the microgrid, protection and recovery are very important. In order to maintain the stability of the microgrid, it is necessary to make a quick response and timely repair for the failure of the equipment in the microgrid, and to maintain the normal and stable operation of the system according to the various emergency states after the system meets the failure [13].

On the one hand, the use of advanced technical means such as big data analysis, cloud computing, etc., to establish a real-time security monitoring system to achieve real-time monitoring and early warning of each device and line in the microgrid, and to timely find potential security risks and faults. , on the other hand, aiming at all kinds of fault conditions in micro power grid, the establishment of a flexible failure recovery strategy, including automatic isolation failure area, fast recovery of the failed area of the power supply, ensures the grid remains in stable operation under fault conditions.

4.4. Optimize and coordinate energy storage devices to improve energy utilization and system stability

Energy storage system plays an important role in microgrid, which is of great significance for balancing supply

and demand and improving system stability. Future research will pay more attention to the optimal configuration and operation strategy of energy storage systems to achieve more efficient energy utilization and system stability.

Firstly, the charging and discharging behavior of the energy storage system is determined according to the energy demand of the microgrid and the working condition of the energy storage system. When the new energy generation is excessive, the energy storage system enters the charging mode and stores the excess energy in the energy storage system. When the new energy generation is insufficient or a load peaks, the energy storage system releases energy to the microgrid [14]. In addition, the remaining power of the energy storage system should be considered. If the battery's state of charge is too low or too high, it cannot be commanded. Let the power output of the energy storage system be damaged; otherwise, the problems of overcharge and overdischarge will occur, and the life of the energy storage system will be shortened. Secondly, the energy management system is scheduled according to the energy supply and demand situation of the microgrid, and the energy flow is adjusted in time after getting the most accurate output, load, and energy storage system information at the current time. For example, if the current new energy power generation is large and the load demand is small, the load demand will be met first, and the surplus will be stored in the energy storage system. When the new energy power generation is not enough and the load is high, the energy storage system discharges energy supply, and then takes power from the large grid or starts the backup power supply to supply energy [15]. In addition, the optimal control method of combining different energy storage devices can also be used to realize the application of microgrid in many aspects, that is, different energy storage systems can be used to complete various functions such as smooth power, stable voltage, emergency backup power, and so on. For example, you can type energy storage device and power type energy storage device to combine, which can maximize the stable electricity, keep the balance of the micro power grid.

To sum up, with the rapid development of the new energy industry, new energy power generation systems are gradually being widely applied in the microgrid. However, due to the instability and volatility of the new energy power generation system itself, it is extremely important to discuss the operation and control strategy of the microgrid based on the new energy grid connection. By establishing an information sharing platform, formulating an intelligent operation strategy, establishing a security monitoring system, optimizing and coordinating energy storage devices, and other ways, we can ensure the stable operation of the microgrid and realize the balance of electric energy, so as to reduce the operating cost.

Disclosure statement

The author declares no conflict of interest.

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