Application of Advanced Power Electronic Technology in Smart Grid

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Abstract. With the continuous development of society, in the power system, the smart grid is also moving in the direction of digitization, automation and information. In the smart grid, the application of advanced power electronics technology is of great significance and can greatly improve the operational safety and operational efficiency of the smart grid. This article first analyzes the demand for power electronics technology in the development of smart grids, and then studies the application of advanced power electronics technology in smart grids.

1. Introduction
In the new era, with the development of our country's economy, due to the constant development and renewal of computer technology, the power system has paid more and more attention to the development of power electronics technology. The development goals of the intelligent power grid are set in information, digital, and interactive. The use of advanced power electronic technologies in smart grids is mainly reflected in the entire process of power generation, power transmission, power generation, power distribution and other power generation, power generation, and power generation. The power electronics technology promotes the development of smart grids. Therefore, advanced power electronics technologies are studied. The application in smart grids is particularly important. This article combines the author's own work experience, mainly to analyze the application of power electronics technology in different aspects of the power system, thus looking forward to the future development of power electronics technology.

2. The meaning and current status of advanced power electronics
As an emerging electronic technology in the field of electric power, advanced power electronics technology is mainly used for the exchange of electricity. Specifically, it is the technology for the effective control and conversion of electric energy through power electronic devices. At present, China's advanced power electronics technology has been widely used in many fields. It can enable the utilization of electricity to reach a reasonable state, optimize the use of electricity, and play a role in the transformation of traditional industries and the development of mechanics construction. The vital role. At the same time, the intelligent development of power electronics technology has brought new integration methods for power processing and information processing. Therefore, it is necessary to apply advanced power electronics technology in smart grids [1].
3. The role of advanced power electronics in smart grids

3.1. Safeguarding the safety of smart grid
China has a long history and a vast territory. At the same time, natural disasters occur more frequently than other countries. These natural disasters will adversely affect the normal operation of smart grids to varying degrees. How we can make smart grids more efficient and safe for people, which ultimately depends on the support of advanced power electronics technology [2]. Therefore, in order to strengthen the safety and reliability of the smart grid, the use of advanced power electronics technology in the smart grid is a matter of no delay.

3.2. Guaranteed stable transmission of smart grid
With the rapid development of technology, the country and the people have new requirements for the power quality of the smart grid. Once the power grid quality of the smart grid is unstable, it will bring huge economic losses to the country and the people to a great extent [3]. Therefore, the use of advanced power electronics in smart grids is of great significance to the stable output of smart grids. At the same time, it will also satisfy the ordinary people's daily electricity needs.

3.3. Guaranteed resource optimization for smart grid
Because China has a large demand for energy, and the existing energy use efficiency and per capita share are relatively low, this has led the country to pay more and more attention to the development of the power sector. In the smart grid, extensive use of advanced power electronics technology and the construction of a scientific and rational power system can effectively alleviate the current situation of energy shortage in China, so as to ensure long-distance and large-scale safe transportation of power, and ultimately achieve energy efficiency. The purpose of sustainable development.

4. Advanced Power Electronics Technology Meets Smart Grid Demand

4.1. Optimize Power Grids in China's Power Facilities
Building a smart grid can be more convenient for management and application. As an interactive system, the smart grid can timely adjust according to the real-time changes in the network system, user needs, environmental changes and other issues, with the characteristics of rapid response, at the same time, advanced and mature power electronics technology can ensure the power grid Real-time adjustment of important technical support quickly. So far, the application of advanced power electronic technology in China's power grid has been continuously innovated to meet the needs and characteristics of China's power grid construction [4]. Among them, transmission and distribution capabilities, quality of electrical energy, fault losses, and fault recovery technologies are certain. The degree has achieved remarkable results. In the development of smart grid construction, the further development of advanced power electronic technology must be consistent with the characteristics and needs of the industrial and residential life in the new era of the 21st century.

Figure 1. Advanced Power Electronics Technology Development in Smart Grid
4.2. Guaranteeing Grid Security Grid

As the pillar of economic and social development, it occupies an indispensable position. As far as China's existing grid structure of the power grid is concerned, its structure is simple, and it is far inferior to the smart grid construction in developed countries, especially in terms of transmission and distribution. In recent years, due to rapid environmental changes, some regions in China have been deeply affected by extreme natural disasters. These external environmental factors have largely affected the safety and reliability of large power grids. From the perspective of the development history of power grids, large-scale power grid interconnection is the trend of its development, which will require China to strengthen its research and development efforts on advanced power electronic devices, in order to adjust the distribution of power distribution network distribution, optimize the existing network structure, prevent power grid failure, to avoid the spread of the failure, and this At the same time, it can improve the self-repairing ability of the power grid and enhance the stability and reliability of the power grid. Therefore, China should further increase investment in R&D of AC transmission devices and fundamentally strengthen the grid structure of China's power grids.

4.3. Promoting the Development of Renewable Resources

The electricity produced by the ground wind is mainly used for centralized use, and the photo voltaic energy generated by solar energy can be used for decentralized use. However, the large-scale and decentralized renewable energy itself has the characteristics of being intermittent and uncertain, which requires the use of similar power electronic technology as a technical means to build a smart grid. The smart grid has the accommodation and adaptability to renewable energy sources. In order to achieve predictable and controllable renewable energy generation dispatch and control, it will further lay the technical foundation for adapting to global climate change.

5. Application of Advanced Power Electronics Technology in Smart Grid

5.1. Application of FACTS Technology in Smart Grid

FACTS technology aims to improve the stability and reliability of transmission and distribution lines in the power grid. It uses existing power electronic equipment and combines modern control technology to quickly respond to existing AC transmission system parameters and network structures. Regulation. With the development and continuous innovation of power electronics technology, the FACTS technology, which is a static overcompensate (SVC) and history-controlled series compensate (TCSC), has become mature. The device includes static synchronous compressor (STATCOM) and unified power flow controller (UPFC) technologies. The compatibility and rapid regulation of FACTS technology can largely balance the current state of China's energy resources and demand, increase the transmission capacity of power transmission and distribution lines, and solve the problem of voltage instability.
5.2. Application of SVC Technology in Smart Grid

SVC technology is a flexible AC transmission device advanced technology imported from abroad around 1980. At that time, there were six sets of SVC equipment power grids imported. Afterwards, further innovations and developments were made in China, which effectively solved the problem of power transmission and achieved significant results. This technology can not only timely adjust and maintain the system voltage stability, stability of the power grid system, improve transmission capacity, and increase the resistance. Usually, we will choose copper wire or flat steel for line assembly, and use grounded current box enclosures to connect with underground leads. Because substations are relatively easy to be affected by voltage, we need to set certain voltage protection requirements. We must set up a unified and appropriate grounding system to ensure the safety of related equipment and related personnel [5].

5.3. Application in Power Generation of Smart Grid

How can we effectively realize the sustainable use of energy in the stage of rapid development this is a major problem we face at this stage. In the smart grid, advanced power electronics technology should be widely applied. This can effectively alleviate energy shortages, save energy, and protect the environment. In the process of power generation in the smart grid, the application of advanced power electronics technology means the use of advanced technologies and some renewable resources such as wind energy, water, and energy to generate electricity. In the process of using wind energy to generate electricity, it is necessary to integrate the electronics of the electric machine group into the electric grid with advanced technology, so that the variable-speed operation can be performed better.

Figure 2. Basic wiring method of FACTS power technology
5.4. Wind Energy, Photoelectric Energy, Storage Mixing Applications
Wind energy and photo voltaic energy are renewable energy sources and are the cleanest energy. They are crucial in the process of green construction. This is also the main direction of development of resource utilization in the later period and can effectively meet the needs of the society. However, because wind energy and photo voltaic energy are not particularly stable, it is necessary to pay attention to coordinating the relationship between the production power and the load during the actual application process. In practice, during the application process, high-power converters must be used to connect the power system so that energy conversion can be effectively achieved.

5.5. Application in Smart Grid
In the current stage, the competition in the market is mainly the interaction between users. This is also the main goal of the power supply in the smart grid. In this link, the advanced power electronics technology can effectively meet the power supply needs. With the information needs of electricity users, it is more effective to ensure users' needs for electricity. Especially in recent years, substations have been rapidly developing from traditional models toward digitization and information. This has mainly played a role in the extensive application of power electronic technologies. The future direction of development of substations is to effectively implement them through an exchange platform. Sharing of information.

The continuous improvement of digitization of substations can effectively realize the intelligence and information of substation power grids. Therefore, the late smart grid is not only the collection of numbers, but also uses advanced power electronics technology to analyze the digital depth. In the application of smart grid power distribution, we must ensure the actual needs of users for power quality, integrate advanced power electronics technology and automated technology, and strictly monitor the process of power distribution for users who need it. Provide basic technical support to ensure the user's actual demand for electricity. When problems arise in the distribution process, it must be handled in a timely manner.
6. The role and significance of advanced power electronics technology in smart electricity

6.1. Maximizing overall grid resources
The flexible distribution technologies that were once familiar to people no longer require a large-scale change of existing transmission equipment, that is, they can clearly express the distribution function of the power grid, and can complete the long-distance distribution of hydro power or nuclear power and various renewable cleanliness. Energy, scientifically and reasonably balance the phenomenon of China's energy distribution is not balanced. In addition, all relevant power departments can also use the smart grid as a carrier to optimize the allocation of power resources.

6.2. Enhancing the Safety Performance of Power Grid Operation
Compared with traditional transmission technologies, the current flexible AC technology and DC technology have faster response rates and more powerful control capabilities, which can further improve the actual efficiency of smart grid transmission construction. In addition, some of the more advanced power electronics technologies can provide personalized services to different power users. Operation can reduce energy consumption, thereby effectively reducing losses and improving the overall quality and level of service of the power grid.

6.3. It is conducive to the construction and planning of the city
In terms of electricity use, modern cities have more stringent requirements. The past high altitude power grids are now unable to meet the daily needs of ordinary users, and as losses increase, and they are directly exposed to the air, they increase. The frequency of accidents. However, the cables used in the flexible DC and AC transmissions are buried deep in the ground. This will not only have no negative impact on the urban environment, but at the same time it will not affect the electromagnetic influence of the cable, so it is appropriate to increase the long-distance transmission of electricity. The intensity can provide more scientific and effective design methods for the city's future planning and construction.

6.4. Mixture of Photo voltaic Energy and Wind Energy Storage Applications
Photo voltaic energy and wind energy are a series of renewable clean energy. They are increasingly favored in the application of green and environmental energy, and are also the general trend of the development of high-quality energy in the future. They can meet the growing social needs as much as possible. However, in view of the unstable factors in these kinds of energy sources, it is necessary to pay attention to the coordination between the power production and the power load in the practical application process. High-power converters should be used to connect the power system, effectively converting energy, and helping to achieve a reasonable connection between storage devices and high-power voltage sources in the power system. This will not only result in a large amount of energy storage, but also improve the power energy. The quality of.

6.5. It is conducive to the practical application of smart grid distribution
The power distribution of the smart grid needs to ensure the quality requirements of the users on the electrical energy. In conjunction with advanced power electronics and automation, it closely monitors all aspects of the distribution process and provides users with supply technologies that meet actual needs. In the distribution chain, the information collected by the sensory measurement technology should be integrated through the network, and the control coordination should be strengthened to ensure the quality of the electrical energy in the distribution process.

7. Conclusion
All in all, the application of advanced power electronics technology in smart grids is not only in order to comply with the trend of smart grid development, but also to ensure the safe and stable operation of smart grids, thereby meeting the needs of socioeconomic development for electricity, and protecting
the natural ecological environment. The quality of transmission has also been improved. Therefore, it is necessary to strengthen the application of advanced power electronics in smart grids.

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