Research on the Difference Between New Power System and Traditional Power System

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Abstract. Under the background of the "carbon peaking and carbon neutrality" goal, it is urgent to build a clean, low-carbon, safe and efficient energy system. In order to achieve the transformation from the traditional power system to the new power system, the overall requirements of the power enterprise have also changed. If they want to accelerate the transformation process and quickly adapt to the new power system after the successful transformation, it requires the enterprise to understand the existing problems and gradually develop to the level required by the new power system. Based on the differences between the new power system and the traditional power system, this paper explores the challenges faced by the electric power enterprises in the construction of the new power system. In addition, we gives suggestions on the construction of the new power system.

Keywords: new power system, carbon peaking and carbon neutrality.

1 Introduction

Under the background of the "carbon peaking and carbon neutrality" goal, it is urgent to build a clean, low-carbon, safe and efficient energy system.The new power system takes new energy as the main body, and constructs a "four-in-one" framework system with safe and efficient, clean and low-carbon, flexible and low-carbon core, which is an important component of the new energy system and a key carrier to achieve the "carbon peaking and carbon neutrality" goal. With the strategic deployment of the electric power enterprise of China, the enterprise's business is gradually undergoing digital and intelligent transformation. As the overall requirements for power enter-

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prises have changed, enterprises need to gradually improve and develop on the basis of understanding existing problems.

2 The difference between the new power system and the traditional power system

2.1 The power supply is relied on new energy

The traditional power system in China is dominated by coal-fired power generation and coal-fired power installation, which will cause environmental pollution and does not meet the "carbon peaking and carbon neutrality" goal. However, in recent years, the focus on the development of new energy and renewable energy has gradually changed the supply of the power side to the green and clean direction, and has developed into a power supply model dominated by new energy and supplemented by coal-fired power generation. Coal power will still be an important support for China's power supply security for a long time in the future. It is necessary to accelerate the clean and low-carbon development of coal power and improve the flexible regulation capacity, and promote the gradual transformation of fossil energy power generation to basic security and system regulatory power supply. The new power system will take new energy as the main body of new power supply and occupy a dominant position in the power supply structure[1]. The National Energy Administration issued the "Guidance on the establishment of a sound long-term mechanism for the consumption of clean energy", in order to ensure the energy demand of users, but also to ensure the interests of renewable energy generators. It is foreseeable that the renewable energy side of the proportion will steadily increase in future, traditional thermal power, hydroelectric generation and wind power, photovoltaic and other common participation in the market[2].

2.2 Intelligent collaborative regulation of power networks

The traditional power system in China is mainly based on one-way step by step transmission. However, in the process of achieving the "hydroelectric generation" goal, energy is the key, and electricity is the foundation. The new power system requires a cross-industry and cross-field collaborative transformation, and the energy use of various industries is transformed into a comprehensive low-carbon transformation, so as to support economic growth with power supply and achieve economic, efficient and low-carbon development. The integration of large-scale renewable energy power into the grid not only requires sufficient backup in the power system, but also requires strong support from grid technology. In this context, the concept of ubiquitous electric IoT(Internet of Things) has been developed. Through the power grid technical support, renewable energy and thermal power bundle trading can be achieved, while ensuring the overall income, increase the proportion of renewable energy, including AC and DC power grid, micro grid, local DC power grid and adjustable load energy Internet[3]. At the same time, grid-end coordination will weaken

the instability of renewable energy output, making it adjustable and controllable, thereby improving the grid's ability to absorb renewable energy, and improving the competitiveness of renewable energy. The flexible interconnection form and digital regulation technology of "cross-provincial backbone power grid + small and medium-sized regional power grid + distribution network and micro-network" will make the power grid more flexible and controllable[4]..

2.3 User load flexibility, consumption and production

The load of the client side of traditional power system is rigid and pure consumption, and one of its characteristics is "source changes with load". However, with the development of power grid technology, more and more users' load side participate in demand response. The new power system is based on flexibility, both consumption and production. Users can change their power consumption behavior according to the market price signal or incentive mode, so that the load curve gradually approaches the power generation curve, from less to more, and finally manifests as peak-load shifting. It can reduce the energy consumption expenditure while reducing the peak-valley difference, break through the traditional way of source and load movement, and truly realize the interaction of source and load[5]. At present, foreign demand response projects have been extremely mature, and domestic demand response pilots are also running in an orderly manner. Load-side resource participation in the market can not only reduce the backup demand in the power system, but also improve the flexibility of the power system.

2.4 Flexible adjustment of energy storage system

In the traditional power system, the energy storage system has not been flexibly applied, because the current energy storage methods and technologies are not mature enough, in the process of energy storage re-output will cause high energy consumption, so the energy storage technology still needs to be improved. In the new power system, the characteristics of energy storage resources are two-way regulation, and its accurate, stable and controllable charge-discharge characteristics make it a highly controllable and flexible resource in the power system, which can provide a variety of services for the power grid such as peak regulation, frequency modulation, backup and demand response[6]. The large-scale application of energy storage not only can play a role in regulating the power load, but also can reverse power supply to the grid to achieve peak-load shifting. The development of energy storage technology will greatly enhance the competitiveness of energy storage resources, through the interaction between energy storage and resources, improve the safety and economy of the energy Internet, new energy add energy storage, new energy + load + energy storage and other diversified coordinated development of new models continue to emerge.

3 Challenges about building new power systems

3.1 Instability of new energy power generation

With the shortage of global coal resources, the complex and volatile international situation, the sharp rise in energy prices, the supply of traditional power generation resources such as coal and natural gas in China is tight, and the operation of thermal power enterprises has encountered difficulties. At the same time, as the global ecology is affected by human activities, the frequency of extreme severe weather has increased significantly, resulting in a sharp rise in domestic power load, and it is difficult to guarantee the sustainable supply of power in some regions. In the process of transformation to the new power system, it is planned to increase the proportion of new energy installed power generation and rapidly consume the power system to flexibly adjust resources, but because of the intermittent, random, volatility and other characteristics of new energy power generation, it is more difficult to adjust the system, and there is a large gap compared with conventional power supply, failing to form a reliable alternative capability, and system balance and security problems are more prominent. Some large new energy bases with weak grids and lack of synchronous power support have insufficient system support capacity, and the safe and reliable delivery of new energy is affected. Although the domestic has begun to vigorously develop new energy, the new energy consumption foundation is not firm enough, and the risk of using new energy increases, which restricts the development of new energy power generation to a certain extent.

3.2 Defects of power system regulation and management system

The controllable objects of the power system have expanded from the source to all aspects of the load and storage of the source network, and the control scale has increased exponentially, and the regulation technology and network security protection need to be upgraded urgently. With the access of a large number of new energy sources, distributed power supplies, new energy storage, electric vehicles, etc., the power system's information perception ability is insufficient, the existing regulation technology means cannot be comprehensively observable, measurable and controllable, and the regulation system management system is insufficient to meet the development requirements of the new situation. It is necessary to continuously deepen the reform of the power system and the construction of the power market. We will improve the capacity of new energy consumption and the ability to flexibly adjust the load and storage of source and network. The power grid control function is moving forward from the control center to the distribution, load control and third-party platforms, the attack exposure of the power grid has increased significantly, the power system has become an important target of network attacks, the network security protection situation has become more complex and severe, and the network security protection ability of key links of the power system needs to be improved[7].

3.3 Insufficient innovation potential of electric power technology

The key core technology and equipment of electric power still have shortcomings, and the driving efficiency of scientific and technological innovation of electric power system needs to be continuously improved. China's energy and power industry has formed a complete industrial chain, supply chain and value chain with strong international competitiveness, and the overall level of power science and technology has realized a strategic transformation from running parallel to leading, but there is still a gap between individual technology fields and the world's energy and power technology powers. Advanced nuclear power, carbon capture utilization and storage (CCUS), high-efficiency and low-cost renewable energy generation equipment, high-power flexible power transmission and transformation equipment, long-term energy storage, fuel cells, large gas turbines, high-temperature materials, high-end electrical materials, key components and other technologies, equipment and materials supporting the construction of new power systems need to be breakthroughs. We need to strengthen the policy guidance to unleash the potential of innovation[8].

3.4 Market mechanism and price system need to be improved

With the transformation and development of the power system, the reform of the power system has entered the "deep", and deep-seated contradictions have been highlighted. The problem of uncoordination and imbalance in the power market is more prominent, the market mechanism and price system that meet the flexible, efficient and convenient interaction of the new power system need to be improved, the market design that ADAPTS to the low marginal cost, high system cost and large-scale and high proportion development of new energy needs to be innovated, and the cost facilitation mechanism of various regulatory and supporting resources needs to be improved. The reform of transmission and distribution pricing, on-grid pricing, and sales pricing needs to be further deepened. Under the new situation, the management system of the power industry still needs to be improved and optimized, the design, planning and operation methods of power to adapt to the high proportion of new energy and the interaction of charge and storage of the source network need to be adjusted and improved, the power supervision mechanism needs to be innovated and reformed, and the governance efficiency of power enterprises needs to be continuously improved.

4 Suggestions for the construction of new power systems

4.1 Digital transformation to realize information sharing

The goal of the new power system is to form a smart grid and energy Internet model in the future, and strengthening the digital transformation of power enterprises is the basis for realizing the intelligent and friendly new power system, which can power the Internet of things, realize the deployment and transaction of renewable energy and thermal power, and weaken the clean energy and instability of new energy.

Information sharing brought about by digital transformation can increase the predictability of new energy generation. The output of new energy power generation is very unstable, but through accurate weather prediction and intelligent calculation, it is possible to achieve accurate short-term and ultra-short-term output prediction and more accurate medium-term prediction within 5 days. At present, due to the wide geographical area and complex natural ecological environment in China, the accuracy of the prediction still has great room for improvement and needs further development. Through more accurate prediction, the standby demand of the power supply side can be reduced and the power generation cost can be controlled. Use the power side to know the future power gap in advance and make preparations or load reduction measures to reduce production losses caused by temporary load reduction.

In the new power system, all kinds of energy equipment, smart meters, sensors, etc., can share and exchange data through the Internet and communication technology, which enables the data of each link to be accurately collected, transmitted and analyzed, so as to better understand the operating status and needs of the energy system. "Open Interaction" encourages different participants to join the power system, including energy suppliers, energy consumers, energy trading platforms, technology providers, etc. These participants can share information, collaborate to develop new energy solutions, and jointly create a smarter and more efficient energy ecosystem.

4.2 Improve the market mechanism and price system

Most of the existing domestic electricity prices are fixed, while the ideal price in the new power system is dynamic. The openness of energy trading markets. Participants in the energy market can freely trade energy, not only limited to traditional energy suppliers and consumers, but also can include distributed energy producers, storage system operators, etc. This kind of open trading environment can promote more efficient use and distribution of energy resources.

4.3 Personnel training mechanism to provide guarantee

The new power system is an intelligent power system based on digital transformation, which relies on high-quality talents within the enterprise who can support and promote the high-quality development of the enterprise[9]. Building a strong internal training system is an important part of quickly realizing a high-quality talent team. Optimize the staff training system of power grid enterprises from the aspects of improving the training course system, clarifying the training focus of employees at all levels and innovating multiple training methods, and create a new type of talent team through effective training work, so as to provide strong talent support for the rapid development of the construction of a new type of power system[10].

4.4 Promote power grid technology innovation

The supply and demand matching of high proportion new energy power system should consider the uncertainty of both sides of supply and demand, and play the role

of market mechanism in regulating supply and demand relationship. In addition, the bilateral uncertainty of supply and demand under a high proportion of new energy has decision dependence. Based on the research of new energy power generation prediction technology, it is also necessary to study the uncertainty assessment method of new energy power generation considering decision dependence, so as to support the safe operation of a high proportion of new energy power system.

5 Conclusions

As the latest goal of the electric power industry in the new era, the construction of new power system has made innovation in four aspects: source network load and storage. This requires power generation enterprises to make changes in smart grid, digital transformation, electricity price market regulation, talent training, technological innovation, etc., to lay a solid foundation for the construction and operation of new power systems.

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References

1. Zhang Q, Li M, Tang Y.P. et al. (2023) Construction of county new power system to serve high-quality development of new energy [J]. Agricultural Electricity Management, 11, 21-24.
2. Guo F, Wang Y, Lu X et al. (2023) Economic operation and energy storage configuration of new power system with high proportion of wind power [J]. Smart Electric Power, 51, 11, 76-82.
3. Zhang Y H. (2023) Characteristics analysis of new power systems under dual-carbon background [J]. Instrument Users, 30, 11,103-105+86.
4. Wang G Q, Song Y B, Guan L Y, et al. (2023) Architecture and evolution route of distributed sources-charged and storage-resource secure interactive communication network [J]. Electric Power Information and Communication Technology, 21, 10, 10-18.
5. Li D Y. (2023) Distribution network planning method based on source load in the context of new power systems [J]. Electrical Technology and Economics, 8, 313-315.
6. Li G F, Sun S H, Be C H, et al.(2023) Research review on optimal allocation and flexible scheduling of energy storage for new power systems with improved elasticity [J]. High Voltage Technology, 49, 10, 4084-4095.
7. Wang C H, Gao H J, Zhou W Y, et al.(2023) Scheduling optimization of high-proportion new energy power systems considering linear demand response [J/OL]. Grid Technology, 1-10.

8. Zheng Y P, Lv P F, Li B, et al.(2023) Problems faced by relay protection of new power systems and solutions [J]. Automation of Electric Power Systems,47, 22, 3-15.
9. (2023) Construction of new power system for Training Network Security talent echelon Escort of Digital Department [J]. North China Electric Power Industry, 10, 11.
10. Gao B, Gao X Y. (2023) Promoting the good development of Young people through the overall situation: Exploration and research on young talent training based on the development trend of new electric power system [J]. Agricultural Electricity Management, 11, 71-72.