

The new situation and optimization strategy of China's power grid management system

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Abstract. The system mechanism of power grid management is an important institutional basis to support the development of electric power industry, and has always been an important controversial issue in China's electric power system reform. Based on the current situation of China's power grid management system, this paper analyzes the new situation, analyzes the main problems, and finally, based on the background of new power system construction, systematically puts forward the overall thinking and specific strategies of China's power grid management system optimization.

Keywords: Power grid management system; the situation; optimize.

1. Introduction

The power grid management system is an important institutional basis to support the development of electric power industry. At present, China's power grid management system and mechanism maintain the core characteristics of "integrated transmission and distribution" as a whole, and explore the adjustment methods of management system and mechanism through incremental distribution reform and mixed ownership reform [1]. In 2023, the Central government issued the Guiding Opinions on Deepening the Reform of the Electric Power System and Accelerating the Construction of a New Electric Power System to accelerate the reform of the electric power system with the goal of building a new electric power system. In November 2023, the third meeting of the Central Deep Reform Commission reviewed and adopted the Implementation Opinions on Improving the Regulatory System and Mechanism of Natural Monopoly Links, requiring further improvement of the regulatory system and mechanism of natural monopoly links. Under the background of new power system construction, how to promote the optimization of power grid management system and mechanism in the future, and what is the ideal model, is a key issue concerning the sustainable development of energy and power industry. This paper systematically analyzes the new situation and existing problems faced by the current power grid management system in our country, and puts forward optimization ideas and reform suggestions.

2. The new situation and new requirements we are facing

The power industry mainly includes four links: power generation, transmission, distribution and sales, among which transmission and distribution belong to the power grid business with natural monopoly properties. In 2015, Zhongfa No. 9 opened a new round of power system reform, clarified the institutional structure of "controlling the middle and letting go of both ends", and laid the foundation for the status quo of China's power grid management system. At present, the new situation of China's power grid management is mainly as follows.

(1) Accelerating the construction of new power systems requires optimizing grid management to adapt to changes in productivity

Compared with the traditional power system, the development pattern and operation mechanism of energy and power under the new power system will undergo profound changes: first, the power production structure has undergone major changes, and the structure of "conventional energy to ensure power supply and new energy to regulate electricity" is taking shape; Second, the scale and form of the power grid have undergone major changes, and the pattern of large power grid dominance and the coexistence of multiple power grid forms has gradually taken shape; Third, major changes

have taken place in the structure of the power market, with the rapid development of new flexible power sources such as extraction and storage, and the emergence of emerging market players such as the integration of source and network load and storage, multi-energy complementarity, distributed power sources, microgrids, and virtual power plants. Fourth, the power balance mode has undergone major changes, which will gradually change from "provincial and regional balance" to "province-based and unified balance of the whole network", and shift from the real-time balance of "source with load" relying on traditional stable power to the non-complete real-time balance of charge and storage coordination and interaction of the source network; When the penetration rate of new energy power exceeds 10% to 15%, the system cost will enter the critical point of rapid growth, and the future cost reduction of new energy stations is difficult to completely offset the rise in system costs paid by new energy, which needs to be scientifically channeling.

(2)The issue of energy and power security is becoming increasingly prominent, requiring continued consolidation of the power grid security management foundation

The Party's 20th National Congress put forward policy requirements to ensure energy security, and the Central Economic Work Conference further emphasized the requirements. On the one hand, with the large-scale and rapid development of new energy and grid-connected consumption, due to its randomness, volatility and other characteristics, the power system's "relying on the weather" characteristics are strengthened, resulting in insufficient overall regulation capacity of the power system, a declining trend of power supply safety margin, and a significant increase in grid security challenges. It is required that the power grid management must simultaneously and even in advance consider the security of the power grid while promoting the development of new energy. On the other hand, under climate change, more frequent extreme weather events in recent years continue to challenge power security. For example, in 2021, due to hydropower reduction, power coal shortage and other reasons, orderly electricity consumption will be implemented in many parts of the country. In 2022, Sichuan and Chongqing areas will face power shortage due to drought and hydropower reduction. This requires strengthening the ability of national power resource coordination and cross-provincial and cross-regional mutual relief.

(3)The construction of a national unified market requires the strengthening of the grid pattern of "one national network"

Large scale single market is a prominent advantage of our economy, in order to make full use of this advantage, China is accelerating the construction of a national unified large market. In the field of energy and power, the construction of a national unified power market is an inevitable requirement for the construction of a national unified large market. As the physical carrier and basic platform for the marketization of power resources, the construction of a national unified power market will inevitably require the basic structure of the power grid "a national network", and solve the system drawbacks in the power grid management such as "inter-network barriers" and separate governance. In terms of physical facilities, it is required to further strengthen the construction of the power grid and the national networking, consolidate and strengthen the grid pattern of "national one network", meet the needs of the construction of the national unified power market, and effectively support the implementation and realization of power trading; In terms of management mechanism, it is required to accelerate the reform, optimization and adjustment of power grid management in accordance with the requirements of fair and open national unified power market construction with orderly competition, so as to ensure market efficiency and fair competition [2].

3. The existing problems

(1) Interconnection between large-scale power grids needs to be enhanced to better meet the needs of allocating resources in a wider range

From the perspective of Mengxi Power Grid and State Grid, limited by the management system, there is already a problem of "inter-network barriers" affecting the cross-network allocation of clean resources. Inner Mongolia Autonomous Region is one of the main energy bases in China, at present,

in the first two batches of large-scale wind power photovoltaic base plan issued by the state, Inner Mongolia has been approved a total of 32.08 million kilowatts. In the future, promoting the large-scale development and utilization of clean energy in Inner Mongolia Autonomous Region will inevitably require cross-network configuration to form a joint force for the development, transmission and utilization of energy resources. From the perspective of the Southern Power Grid and the State Grid, there are only two transmission channels and a small amount of power transactions between them at present, but because the heterogeneity of resources is not strong, this configuration has no substantive problems. However, from the perspective of the future, as the penetration rate of renewable energy continues to increase, the resource complementarity between the State grid and the southern Grid operating areas will continue to strengthen, and the security mutual benefit between the two and the realistic demand for market transactions will continue to improve, and the existing networking pattern and interaction relationship cannot meet this development needs.

(2) Some local power grids are "small", "scattered" and "weak", and the coordinated development of the grid pattern of "national one network" needs to be enhanced

Power grid is a natural monopoly business, and its scale advantages are reflected in multiple levels such as assets, coverage space, load, access subjects, etc. High-quality development needs to be established on the premise of having a considerable scale. Affected by the historical evolution, there are still some scattered local power grids in Sichuan, Chongqing, Xinjiang, Hunan and other places in China. These power grids are generally small in scale, low in voltage level and closed development, resulting in many problems such as poor asset quality, low reliability of power supply, insufficient profitability, and repetitive construction. It is urgent to implement the transformation and development in a scientific way [3].

(3) Emerging entities have emerged at a faster pace and put forward relevant demands such as participation in the power market and participation in demand-side response

With the construction of new power systems, there will be more and more new formats in the distribution network in the future, such as micro-grid, load storage integration of source network, user-side energy storage, virtual power plant, etc. The latter is of great significance in promoting the development of distributed renewable energy and ensuring grid security [4]. On the one hand, emerging entities have proposed clear positioning of market entities, nearby "wall sales", "special lines" or construction of low-voltage power lines, and participation in demand-side response. On the other hand, because the emerging subject has new characteristics that are different from the traditional power supply and load, the current subject status, technical standards, dispatching control mode, electricity price mechanism of the emerging subject is still unclear and imperfect. For example, the current electricity pricing mechanism related to the development of microgrids, such as access fees, transmission reserve capacity fees, and transaction network fees, does not reflect the "equality of rights, responsibilities and interests", and there are contradictions and disputes.

4. The optimize ideas and strategies

Throughout the world's power industry management practices, generally according to their own national characteristics to choose a suitable grid management mode, country differences are large, there is no unified management mode, and there is no so-called perfect management mode. Facing the future, under the background of adapting to the "dual carbon" goal, the construction of new energy systems and the construction of new power systems, China's centralized power grid management system should be further consolidated and strengthened, and it can continue to adhere to the integrated management system of transmission and distribution, and adhere to the unified planning, unified scheduling and unified management of the power grid. Strengthen interconnection and power trading between power grids, promote the coordinated development of local power grids and large power grids, and accelerate the development of emerging entities on the distribution network side.

First, we will continue to adhere to the integrated management system of transmission and distribution. Under the new situation, the cooperation relationship between transmission and

distribution is becoming closer, and the system arrangement of transmission and distribution is more advantageous, which is a power grid management mode in line with China's national network situation. First, the integrated management of transmission and distribution conforms to the law of power grid interconnection, which is conducive to the coordinated operation of all links and the security of power supply. Second, the integrated management of transmission and distribution is conducive to better implementation of major national decisions and plans and social responsibilities. Third, the integration of transmission and distribution is more conducive to promoting clean and low-carbon energy transformation. Fourth, the integrated management of transmission and distribution is conducive to better serving the development of new business forms at the end of the grid.

Second, we will promote the coordinated development of local power grids and major power grids. From the perspective of development, due to the natural disadvantages of local power grids in terms of economies of scale, in the long run, it is necessary to accelerate the integration into the "national one network" power grid development pattern. First, for the relevant stakeholders with the same cooperation intention, mutual benefit and no realistic obstacles, it indicates that the conditions for local power grid restructuring are relatively mature, and it can be integrated into the large power grid through asset transfer, equity acquisition and other ways. Second, for those that still have heavy historical protection, or still have certain concerns, the integration of local power grids and large power grids can be promoted through joint-stock cooperation on the basis of equality and reciprocity. Third, for local power grids that still have certain differences and difficulties in restructuring, it is necessary to accelerate the establishment of cooperation mechanisms, strengthen power grid interconnection, power trading and information exchange, promote the considerable, controllable and adjustable equipment and resources related to local power grids, and work together to ensure the security of the power system.

Third, we will accelerate the development of emerging entities such as microgrids. First, better play the role of integrated transmission and distribution grid platform. Second, a unified definition of microgrids should be introduced at the national level. Third, promote the transformation and upgrading of the distribution network, and constantly improve the level of intelligence. Fourth, improve the electricity price mechanism and subsidy mechanism of microgrid development.

5. The main conclusions

The power grid management system is the institutional basis for the development of a country's electric power industry, but there is reform analysis at present. This paper analyzes the situation of China's power grid management system, which mainly comes from three aspects: the construction of new power system, the prominent problem of energy security, and the construction of national unified power market. Under the new situation, China's power grid management system has exposed three problems, mainly the interconnection between large power grids needs to be enhanced, some local power grids are "small", "scattered" and "weak", and the main demands of emerging markets are more.

On this basis, this paper puts forward the optimization strategy of China's power grid management system, in short, that is: China's centralized power grid management system should be further consolidated and strengthened, can be in the "control of the middle, let go of both ends" institutional structure, continue to adhere to the integration of transmission and distribution management system, adhere to unified grid planning, unified dispatch, unified management, strengthen the interconnection between power grids and power trading, promote the coordinated development of local power grids and large power grids. We will accelerate the development of emerging entities in the distribution network.

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