Preliminary Research of Electric Power Planning System Based on "Regional Multi-Energy Body"

Fei Fei 1, Mingxing Guo 1, Jianlin Yang 1, Ruanqing Mo 1, Ming Zeng 2, Weicheng Chen 2, Wei Liu 2,*

1Economic and Technology Research Institute of State Grid Shanghai Electric Power Company, Shanghai 200000, China
2School of Electrical and Electronic Engineering, North China Electric Power University, Beijing 102206, China

Abstract "Regional Multi-Energy Body" refers to an entity which is made up of the main body of energy supply, energy transmission and energy consumption. And "Regional Multi-Energy Body" is a concrete way to realize the optimized configuration of power supply, power grid and load. Influenced by many factors, the situation of electric power planning in China shows a trend of out of control and ineffective. This paper attempts to introduce "Regional Multi-Energy Body" into the electric power planning, aiming at improving the power planning work system.

1. Introduction

Power planning is a complicated system engineering. Its complexity is reflected in the characteristics of large scale, uncertain and delicate factors, wide range of departments and fields of expertise. So far, China's electric power planning has been adhering to a planning concept and planning method which has been laid in the planning economy and focused on the deterministic goals [1]. Electric power planning requires a lot of data and the analysis involving social and economic development, further investigation on the power supply and demand situation [2].

Literature [3] discusses the necessity of applying integrated resource planning method in China's power industry, and gives some suggestions on how to apply it. Literature [4] attempts to establish a unified planning optimization model of sustainable development of power industry, considering the coordination of national energy policy and energy exploitation and transportation constraints, environmental problems, reasonable installed capacity, power supply structure optimization, system load, power supply, power grid layout optimization and so on. Although some countries have more than 30 years of integrated resource planning experience, but in China is still a need to continue in-depth research field.

For a long time to come, China will be in the crucial period of promoting the revolution of energy production and consumption. As an industry with large energy consumption and pollutant emissions, the power industry will face increasing pressure on energy conservation and emission reduction, and macro-control will lead the power growth slow. Therefore, the general tone of power planning is to meet the needs of the national economy and social development for energy conservation. Under the background of energy revolution and electric power system reform, power planning should take full...
account of the transformation of the energy supply system, that is, the traditional fossil energy supply system changes to the clean energy supply system. This energy supply system transition needs to go through a long period of "Mixed Energy Era".

2. Power Planning Needs to Change Its Thinking
The situation of electric power planning in China shows a trend of out of control and ineffective in the reason of many factors. As a part of energy planning, electric power planning should change many special power planning, fragmentation of regional power grid planning, and strengthen the overall settlement mechanism. Specifically, the whole power industry needs to focus on three problems: first, strengthen planning, simplify approval; second, further optimize the power distribution; third, power structure adjustment.

In the mixed energy era background, to co-ordinate the work of power planning, on the one hand, the corresponding solutions should realize the coordination of development and utilization of clean energy development and utilization of traditional fossil energy, the coordination of power grid planning and construction, the coordination of clean energy and fossil energy complementary advantages. And the solutions should unify power, power grid, the user, and implement integrated resource planning, which embodied in the concept of "Regional Multi-Energy Body". On the other hand, to achieve optimal allocation of resources between power supply and power grid, power grid and users, power supply and users, namely "Generation-Grid-Load-Energy Storage" coordination optimization model, this overall solution needs to be supported by intelligent electric grid technology, advanced transmission technology, demand side response technology and related energy storage technologies.

3. "Regional Multi-Energy Body" Is the Inevitable Choice to Accelerate the Transformation of Energy Reform
"Regional Multi-Energy Body" refers to an entity which is made up of the main body of energy supply, energy transmission and energy consumption. And "Regional Multi-Energy Body" is a concrete way to realize the overall coordination of power supply, power grid and load.

The mode of energy development and utilization is closely related to the national economic and social development, scientific and technological level, and the endowment of energy resources. Under the circumstance that traditional solution cannot solve the problems of clean energy development and utilization, "Regional Multi-Energy Body" is the inevitable choice to accelerate China's energy transformation and coordinate the reform of various energy fields. Necessity is mainly reflected in the following three aspects: first, the "Regional Multi-energy Body" is an important means to realize the effective utilization of clean energy, coordination of multi-energy; second, the "Regional Multi-Energy Body" is a sally port to optimize the overall layout of China's energy and promote the integration of energy development and utilization; third, the "Regional Multi-Energy Body" is the key point to realize the national balance of energy supply and demand and the organic coordination of energy transportation system.

To make better use of the concept of "Regional Multi-Energy Body" and the coordination mode and technology of "Generation-Grid-Load-Energy Storage", we put forward the following suggestions:

Firstly, the power grid enterprises are gradually positioned as public utility enterprises, which exercise the overall planning function of the power system and implement integrated resource planning model. The key to solving the problem is to understand the essential characteristics of clean energy, and find complementary ways.

However, the planning and decision-making of power system in China are too scattered, and the degree of specialization is not enough, which leads to the uncoordinated construction of power supply and power supply, the uncoordinated construction of power supply and power grid and so on. Therefore, in order to realize the coordination between the development and utilization of clean energy and the development and utilization of traditional fossil fuels, the coordination between power supply construction and power grid planning, and realize the complementary advantages between the clean
energy and fossil energy, we suggest that power grid should gradually position for utilities, implement integrated resource planning, and make an overall power system plan including power supply and power grid.

At the same time, to avoid power grid enterprises to seize monopoly interests, Chinese government should change traditional assessment and supervision mechanism. In this way, power grid enterprises will be able to get rid of the current uncertain position embarrassment, and make its operation more open, more efficient.

Secondly, through the market means to promote the development and consumption of clean energy, and then establish a multi-level diversified electricity market. At present, the Direct Power-Purchase for the Large User in China has been carried out in several regions. The bilateral contract transaction mode, which need both sides of the supply and demand meet directly, is in line with China's actual situation, and is a workable mode of power market reform. However, from the current pilot situation, the clean energy is not competitive in the market, and some provinces even explicitly deal only with thermal large consumer direct power exchange, which is clearly not conducive to the future development of clean energy. Therefore, we propose that in the process of power market reform, all peaking resources, including power supply side and grid side and load side, should be through the establishment and operation of ancillary service market to support clean energy, and to achieve coordination among various power supply.

Thirdly, to make a bilateral random fluctuation system into a more stable and controllable system, the power system needs to accelerate the development of demand side response resources, and establish a coordination mechanism of fossil energy and clean energy.

4. Introduce Integrated Resource Planning Concepts and Methods

From the current situation in China, we cannot ignore the important transitional period of the mixed energy era. At this stage, the current work that needs to be carried out and the focus of future energy-saving and energy-saving emission reduction work is to introduce the concept and method of comprehensive resource planning in the specific work of electric power planning, and vigorously carry out the demand side management and demand side response work, and make full use of the "Regional Multi - Energy Body" concept and "Generation-Grid-Load-Energy Storage" coordination mode and technology.

It should be noted that the current system in China is not conducive to the implementation of integrated resource planning model. In electric power planning, the concept of integrated resource planning needs the top-level to design relevant supporting policy, and the existing institutional mechanisms also need to make a big change, such as the reform of energy-saving emission reduction regulatory model, modification of regulatory system, restructuring of regulatory bodies, etc. At the same time, all departments should be optimized, instead of each act in his own way, so as to better promote the transformation of Chinese power planning, ensuring continuity and persistence of power planning.

5. Conclusion

As part of the energy planning, electric power planning should change its thinking, strengthen the overall planning mechanism, optimize the power distribution, and adjust the power structure. China should set up "regional energy" to accelerate the transformation of energy, and coordinate reforms in various energy fields. Specifically, we should gradually locate the power grid enterprises as public utility enterprises, establish a multi-level and diversified power market, and accelerate the development of demand side response resources. Finally, electric power planning should introduce the concept and method of integrated resource planning, make top-level design, and reform the existing energy system and mechanism.
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