Design of Flexible Interactive Platform System between Self-owned Power Plant and Power Grid

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Abstract. In response to the call of the state to deepen power system reform, strengthen and standardize the supervision and management of coal-fired captive power plants, and implement regulation from the load side to effectively ensure the power supply and demand balance of the power grid, a flexible interactive platform system between captive power plants and the power grid is developed. The platform software has the functions of self owned power plant file management, resource adjustable potential analysis, operation state detection, energy consumption analysis, transaction management, etc., and the response time to power grid interactive instructions is less than 10 seconds.

1. Introduction

The province's power supply continues to be tight and the balance between supply and demand is uncertain. The traditional power supply and demand balance is to regulate power generation to meet the load demand of power users. With the shortage of power coal supply, the uncertainty of call support outside the province, the increase of temporary fault repair and output reduction of thermal power units in the province, and the improvement of new energy penetration, it is urgent to implement relevant regulation from the load side to effectively ensure the balance of power supply and demand of the power grid[1]. Enterprise owned power plant is an important part of China's power generation industry. It will also become a member of the power market reform and participate in the market competition[2]. The self owned power plant has both power generation resources and a large number of loads, but it has been in the state of spontaneous self use for a long time. Its potential as an available resource for the balance of power supply and demand has not been tapped[3]. The promulgation of the guiding opinions on strengthening and standardizing the supervision and management of coal-fired captive power plants is conducive to scientifically guiding and standardizing the development of captive power plants, promoting the equal management of captive power plants and public power plants, realizing fair competition, giving better play to the role of captive power plants, earnestly maintaining the order of power market and steadily promoting power reform[4].

The development direction of supply-demand interaction between captive power plants and power market is clear. However, through investigation, it is found that due to the flexible interaction between captive power plants and market-oriented supply-demand regulation, the method system of design and operation optimization is not perfect, and the actual operation effect of most demonstration projects has not reached the expected goal[5]. The reasons are mainly reflected in several aspects: the theoretical research on the behavior characteristics and flexibility evaluation methods of self owned power plants is still insufficient, and there is a lack of fine operation technical characteristic model of multi type self owned power plants, resulting in the lack of planning means; Lack of evaluation and Analysis on the characteristics of power generation and consumption behavior of self owned power plants, lack of analysis on on-line monitoring technology and external relevant data, resulting in unclear objectives for flexibility improvement; The research on the coordinated optimization operation method of market mechanism is not enough; Insufficient policy guidance and low willingness of users of self owned power plants to participate in market-oriented supply and demand interactive services. The platform built in this paper studies the operation characteristics, evaluation and market mechanism of self owned power plants, and improves the results of theoretical and technical research in combination with demonstration projects, in order to form an operable and popularized evaluation system and market mechanism.

2. Technical research content supported by the platform

The platform is developed on the basis of relevant theoretical research of captive power plants. The theoretical basis is as follows: from the perspective of energy interaction and auxiliary service interaction, study the interactive regulation strategy of multiple types of captive power plants in different application scenarios; Study the security protection strategies of boundary

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operation environment of self owned power plants, the interaction mode of auxiliary services and power interactive regulation strategy between various types of self owned power plants and power grid in peak shaving scenario, frequency modulation scenario and other scenarios are studied. Research on flexible interactive security protection strategy between captive power plant and power grid boundary security protection measures at three levels of terminal credibility, transmission reliability and boundary controllability under the access of public network and power private network; Research the terminal security protection measures of terminal and master station based on digital certificate authentication technology; Research on network security protection measures based on encryption algorithm, identity authentication and other technologies. Research on the standardization technology of technical supervision of self owned power plants in the form and specific content of technical supervision of self owned power plants, as well as supporting technical policies and management specifications related to power reform; This paper studies the specifications for operation monitoring of self owned power plants based on the architecture of on-line monitoring system.

3. Overall system architecture design

The platform software has the functions of self owned power plant file management, resource adjustable potential analysis, operation state detection, energy consumption analysis, transaction management, etc. the response time to power grid interactive instructions is less than 10 seconds.

The distribution map of self owned power plants of Shandong direct dispatching on the homepage of the platform includes the distribution of self owned power plants of cities in Shandong Province. The main adjustment parameters are displayed after hovering the mouse; The real-time statistical function displays the power generation and consumption data of current operating units, active power, load rate, thermal power ratio and energy consumption power of self owned power plants in Shandong Province in real time; The main indicators of the whole network show the power generation of the whole network yesterday, the power generation of the whole network today and the active power of the whole network at present; The comparison of the regulatory potential of each group shows that each group has the maximum daily upward potential and the maximum daily downward potential; The adjustable potential of the whole network in the current month shows the adjustable potential of the whole network in the current month.

The condition monitoring can monitor the relevant performance of the direct dispatching self owned power plant and its relevant production units in Shandong Province. The relevant parameters of steam turbine include main steam system, double reduction system, feedwater thermal control system, steam turbine safety monitoring thermal control system, etc; Relevant
parameters of energy consumption system display the actual power generation and power consumption relationship diagram of the power plant.

Energy consumption analysis shows the coal consumption deviation of each unit through histogram and radar chart, and analyzes the influence of boiler efficiency related parameters, steam consumption rate related parameters and plant utilization rate related parameters of each unit on coal consumption level by level.

Adjustable potential analysis mainly includes the display of power generation potential calculation indicators, power consumption potential calculation indicators, power generation Statistics (day, month and year), consumption statistics (day, month and year), adjustable potential parameter configuration, etc.

The transaction management module mainly realizes the identification of comprehensive utilization of self-owned power plants and the display of medium and long-term transaction information. Among them, the comprehensive utilization identification function is the real-time monitoring of comprehensive utilization fuel blending of each unit in the self-owned power plant, monthly fuel blending and display of important indicators of the unit. Medium and long-term transaction management includes declaration information module and transaction information module.

File management mainly includes the boiler equipment account, steam turbine equipment account, boiler and steam turbine alarm parameters and data upload and download of each unit (operation procedures, thermal calculation instructions, etc).

The overall directory structure of the platform is shown in Figure 1.

4. Conclusion

This paper introduces a flexible interactive platform system between self-owned power plant and power grid. The system has the functions of self-owned power plant file management, resource adjustable potential analysis, operation state detection, energy consumption analysis, transaction management and so on. The flexible interactive technology of self-owned power plants for market-oriented supply and demand regulation is the key to promote the future development of power reform. Through the research and development of the operation method of self-owned power plants, the analysis method of power generation and consumption regulation potential of self-owned power plants, the interactive market mechanism between self-owned power plants and power grids and the flexible interactive platform between self-owned power plants and power grids, it will help to master the key technologies of flexible interactive application of self-owned power plants for market-oriented supply and demand regulation, and continue to maintain and consolidate its leading position in the field of power reform.
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References


