Research on the Structure of Smart Power Plant Based on In-depth Learning

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Abstract. The construction of intelligent power plant is not only a positive response to the corresponding policies of the country, but also more in line with the development trend of the modern information age, which is conducive to fully exploiting the potential of various resources of power enterprises and improving the actual operating efficiency and economic benefits of enterprises. Based on the analysis of the present situation of China's power generation enterprises and the exploration road of smart power generation, this paper explains the background and definition of the generation of intelligent power plants, discusses the structure system and functions of each level of smart power plants, and analyzes the structure of smart power plants. The smart power plant built on the basis of big data application is also introduced finally.

Keywords: Smart power plant; smart; In-depth Learning; structure.

1. Background
With the development of China's economy and society and the continuous improvement of science and technology, the competition between all walks of life is becoming more and more intense. With the arrival of cloud computing, Internet of things, artificial intelligence and so on, building an efficient and convenient intelligent power plant has gradually become the development goal of the new period of power enterprises. The Outline for Technological Development of Smart Power Plants points out that smart power plants are based on the extensive use of modern digital information processing and communication technologies, integrating smart sensing and implementation, intelligent control, and management decision-making technologies to achieve safe, efficient, and environmentally friendly operation, and coordinate with the smart grid.

2. Structure of Smart Power Plant
On the one hand, smart power plants must achieve safe and reliable unit operation, economic and environmental protection, and can better meet the needs of power grid operation and power users. On the other hand, they must improve efficiency, increase flexibility, and improve the level of intelligence. The smart power plant system structure mainly consists of four levels, from low to high, namely the smart device layer, the smart control layer, the smart real-time production supervision layer, and the smart management layer. The four-layer architecture has a division of labor and a high degree of
integration. Under the premise of satisfying security, the information flow and instruction flow are reasonably organized.[1]

![Structure of smart power plant.](image)

**Figure 1.** Structure of smart power plant.

2.1. **Smart Device Layer**  
The device layer mainly carries on the intelligent information management to the on-site measurement and control equipment through the comprehensive perception information, the information interaction and the effective execution instruction, the real-time monitoring equipment's running data and the state. It mainly includes field bus equipment, intelligent actuators and transmitters, intelligent inspection robots, wireless device networks, temperature field detection equipment in the furnace, and advanced detection technology and equipment.[2]

2.2. **Smart control layer**  
The control layer mainly realizes the intelligent control of the power production process in the factory, realizes the centralized processing and online optimization of the production process, and achieves safe and efficient production. It mainly includes intelligent diagnosis and optimized operation, such as self-starting control technology, decentralized control system, combustion online optimization technology, programmable logic controller, and fieldbus control system.

2.3. **Smart Production Regulatory Layer**  
The production supervision layer can realize the optimization function of the production process by assembling real-time and historical data and information of the whole production process. It mainly includes optimized scheduling, state analysis and real-time monitoring, namely, factor-level load optimization scheduling technology, digital coal field technology, real-time monitoring throughout the production area, and online simulation technology. For example, the operator operates the navigation system and the online simulation system.

2.4. **Smart management layer**  
Intelligent management mainly includes intelligent management and auxiliary decision-making to achieve the rational allocation and utilization of resources within the factory. They are the group safety production monitoring system, auxiliary decision-making and management, expert diagnosis, network information security, intelligent logistics, spare parts joint storage, and operational data depth mining.[3]
3. Features of Smart Power Plant

3.1. Smart power plants are smarter
It uses various types of perceptual devices and intelligent systems to identify, stereoscopic perceptual environment, state, location and other information changes, and integrates, analyzes, and processes perceptual data, and can be deeply integrated with business processes, providing basis for intelligent control and decision-making.

It adopts advanced and intelligent control technologies such as adaptive control, data mining, fuzzy control, and neural network control. According to changes in different conditions, it automatically adjusts control strategies and management methods, and adapts to various operating conditions of the unit. Make the power plant production process in a safe, economic and environmental protection operation state for a long time.

Based on comprehensive perception, Internet, large data, three-dimensional visualization and other technologies, multi-source data can be deeply integrated to achieve the calculation, analysis, and deep excavation of massive data, and the decision-making ability of power plants and power generation groups can be enhanced.

Intelligent power plants provide the basis for real-time interaction in power plants through the development of network(including wireless network) technology; Through the interaction and sharing of information in intelligent power grids and other systems, real-time analysis and forecasting of power market supply and demand, rational planning of production and management process, so that power products can better meet user safety and speed requirements.[4]

Figure 2. Process of smart power plant.

3.2. Smart power plants are safer.
In the future, smart power plants can quickly respond to the needs of the grid at any time, providing qualified electricity for the grid. Damage to physical or network attacks is smaller and can quickly recover from damage. In the future, intelligent power plants will use AR visual monitoring, data monitoring, and power plant robot operations on a large scale. Significantly reduce the number of high-risk operations! More human.

3.3. Smart power plants are more environmentally friendly
After upgrading to intelligent power plants, by scientifically and precisely controlling production costs and optimizing the operation level of environmental protection facilities, the declining traditional thermal power plants can be revitalized. The operation optimization system based on large data can keep the unit running optimally, and the operation of intelligent desulphurization and denitrification system can meet the needs of the unit's environmental protection.
3.4. Smart power plants are more efficient.
Smart power plants are more economical and efficient, and their operating costs are lower. They clearly master the production process and improve the controllability of the production process. We can collect data scientifically and make production plans scientifically. Planners and power plant engineers can guide the operation of power plants according to market needs and combined with power plant reserves.[5]

4. Partial application of smart power plants
Beijing Jingneng Gaoantun Gas Thermal Co. Ltd. is the first digital thermal power plant in China. Using big data technology to carry out production management and 3D simulation training, realize pre-Post training and pre-construction 3D simulation training.

Jingneng Shiyan Thermal Power Co., Ltd. will also carry out the construction of smart power plants and adopt the FCS system on two 350MW supercritical heating generating units to achieve the self-stop function of the unit; Through the use of large-scale data three-dimensional simulation technology and digital full-cycle life management technology, power plants achieve the goals of visualization, real-time, digital, interactive, simulation, and process flow during the entire project cycle, laying the foundation for the construction of smart power plants in the next step.

In August 2017, two units of Jiangyan Engine Thermal Power Co., Ltd. succeeded in "double investment" and became the first smart power plant in China. They achieved safe production management, three-dimensional visualization intelligent training, three-dimensional visualization fault diagnosis, and three-dimensional digital files. 5 functions.

In 2017, Shanxi Gemeng International Energy Co., Ltd. completed the construction of the 2 × 660 MW low-heat coal power generation project of Zhaozhuangxin. By integrating the large amount of data accumulated in the past and using Internet technology, the power plant quickly completed the work of establishing a data warehouse and a three-dimensional model, and realized all-weather three-dimensional information monitoring.

5. Conclusion
The smart power plant, benefits from its intelligent power generation process. It has the advantages of energy saving and emission reduction, increasing efficiency, real-time monitoring, safety maintenance, and fine management. In the future, with the continuous progress of three-dimensional technology and VR technology, the functions of smart power plants will become more and more abundant, and more advanced smart power plants will be popularized.

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