Research on Energy Management System of Iron and Steel Industry under the Background of Cloud Environment

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Abstract: With the introduction and implementation of sustainable concept, the construction of energy management system has become a consensus for the further development of China's iron and steel industry. The continuous development of cloud computing technology and Internet of Things technology will help to upgrade and optimize the energy management system. In this context, this paper combs the current situation of energy management in iron and steel industry, analyses the specific functions and requirements of this industry's energy management system, and combines the characteristics of Internet of Things and cloud computing technology in the cloud environment, constructs an energy management system for iron and steel industry. The system is composed of data center, energy branch and energy center. The system architecture is mainly divided into data layer, application layer and management layer. On this basis, this paper points out the specific functions and implementation steps of each layer in order to provide reference for the development of energy management in China's iron and steel industry.

1. Background of the study

1.1 Literature review

Energy management system refers to a set of systems based on energy and information technology and energy data to monitor, analyze and control energy consumption of water, electricity and gas (Chen et al, 2011). Promoting the application concept of energy management system and upgrading the traditional energy management mode is the only way for the development of enterprise modernization process, and has become the consensus of the industry (Chen, 2013). Especially for the steel industry with high energy consumption and low efficiency, energy management is very important. Sun Huayun and Li Mingjing pointed out that in the past five years, energy management in China's iron and steel industry as a whole is in the stage of continuous improvement, but the improvement of management system still needs to be improved, and cannot achieve the goal of economic balance, high quality and environmental protection. Zhang Menghao and Long Ruyin believe that the current iron and steel industry is facing the dual effects of overcapacity and excessive energy consumption. It is pointed out that domestic iron and steel enterprises need to adjust the internal factors to improve the effect of energy management before the development of energy management. In the process of developing energy management, we should learn the advanced and open nature of Western energy management system, and pay attention to recycling and structural innovation(Zhang and Long, 2015).

In the iron and steel industry, energy management is the focus of production management. The effect of energy management directly affects the survival and development of enterprises (Liu, 2015). Establishing an information and intelligent energy management and control center is an effective measure to solve the energy problem. It can not only control energy saving objectively and subjectively, help enterprises reduce costs and improve production efficiency, but also help enterprises improve operational efficiency (Feng, 2009). Li Xuelong et al. discussed the specific reform measures of energy management system in iron and steel industry in winter, including improving energy index, tapping the potential of energy-saving facilities, reducing investment risk

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of energy-saving projects, and further pointed out the importance of energy management system in iron and steel industry (Li et al, 2017).

1.2 Purpose of the study

At present, the energy consumption of China's iron and steel industry accounts for about 15% of the total energy consumption. However, the effective utilization rate of energy is only 30%. Compared with the European and American countries, the gap is obvious, which restricts China's economic development to a certain extent. Contradictions in the long-term development of iron and steel industry can not be fundamentally resolved, and some enterprises lack systematic energy management. In order to further improve the energy management level of iron and steel enterprises, it is necessary to establish an efficient energy management system. Energy management integrates energy scheduling, energy management and process monitoring. It has the characteristics of huge scale and complex technology. The emergence of cloud computing technology and Internet of Things technology has become an opportunity to solve this contradiction. Therefore, it is of great practical significance to explore the establishment and implementation of energy management system in iron and steel industry under cloud environment.

2. Energy management system function and demand analysis of iron and steel industry

2.1 Functions of energy management system

The particularity of energy management system requires that it can provide continuous service for 365 days, 24 hours a day throughout the year. In the process of restarting operation, it is not only necessary to provide information resources retrieval, information exchange and other tools, but also to enable users to query the required reports at any time (Geng, 2018). Specifically, the energy management system of iron and steel industry needs to have the following functions. First, data acquisition function, timely incorporation of energy data generated by enterprises, as data analysis, monitoring and early warning, data statistics of basic materials. The second is the comprehensive monitoring function, which monitors the power, water, gas and other system equipments responsible for the energy management system in real time, analyses the suspicious environment and alarms the faults. As the command center of energy production, the energy management system must ensure the orderly production of the main line of work, and be able to complete the emergency dispatch of energy during emergencies. The third is to integrate the functions of integrated protection devices in substations to complete the remote monitoring of substations. Fourth, information exchange function, energy management system and enterprise information system need to exchange information in real time, to ensure that new production management can be delivered in time. Fifth, energy management function, as a supplement to online energy management, energy management system needs to complete energy planning management, energy quality management and so on.

2.2 Requirements for energy management systems

In order to achieve an integrated management and control of energy management system, we need to meet the following four needs. First, data acquisition requirements, according to energy management requirements, to determine the level of coverage of acquisition, acquisition scale also needs to be appropriate, usually 10 million tons per year output of enterprises, acquisition volume of about 30,000 (Wei et al, 2017).

The second aspect is the requirement of field equipment operation. Specifically, the first is to establish a centralized management and control model to enhance the system's ability to deal with anomalies and effectively play the potential of energy saving. Second, the field automation system should be able to implement remote monitoring to ensure the sTable operation of major power facilities. Third, electrical instruments and equipment should have the ability to transmit all kinds of signals. Fourth, the transmitted information needs to be reliable and sTable to ensure the integrity of information. Fifth, fully consider the characteristics of the site and equipment to ensure that information can be transmitted to the information system through monitoring points (Zhang, 2013).

The third is the requirement of the energy management and control center. The first is the requirement of power supply, which guarantees two independent power supply from different substations. Secondly, UPS in the control center computer room needs continuous power supply for 2 hours. Thirdly, the telephone system must have at least two sets of independent switches. Fourthly, the control center should arrange all kinds of cables reasonably. Fifth, the net height of the control room should be no less than 5 meters in accordance with international standards.

The fourth aspect is the basic requirement of hardware and software environment. First, we must adopt high-quality hardware products from mainstream manufacturers, and eliminate miscellaneous hardware for key components. Secondly, the switch used should be industrial level. Finally, the best monitoring software is independent software vendor products, try to use SCADA.

3. Technical foundation of energy management system in iron and steel industry under cloud environment

3.1 Cloud computing technology

Configurable shared resource pool is the core component of cloud computing, which can provide a variety of hardware and software resources including servers, storage, network, etc. Cloud computing has five key features: extensive network access, fast flexibility, on-demand self-service, resource pooling, and on-demand billing. Wide network access means that users can work through the network in all areas covered by the network, with the help of a variety of devices including mobile notebooks, telephones and so on. Fast elasticity refers to the fact that physical or virtual resources can be automatically supplied to achieve rapid growth or decrease. On-demand self-service means that there is no need for service providers to participate. Cloud computing technology can provide users with self-service and help users deploy resources. Resource pooling refers to the integration of resources used to facilitate customer service. Volume-based billing mainly refers to cloud computing can be billed according to the use of the situation, users only need to pay for the resources used, this feature emphasizes the high utilization of resources.

3.2 Internet of things technology

At this stage, there are three typical cloud computing service modes. The first is infrastructure services, the second is platform services, and the third is software services. As for the specific mode of cloud deployment, there are mainly four kinds: public cloud, private cloud, community cloud and hybrid cloud. Public cloud applications are mostly large industrial alliances, and organizations that own them usually provide cloud services. Private cloud infrastructure ownership belongs to a single organization, and its services are divided into on-site services and off-site services. The day-to-day operations of private clouds can be managed by the owner or outsourced to third parties. Like private cloud, community cloud has two service modes: on-site service and off-site service. The difference is that the infrastructure of community cloud is shared by multiple organizations to provide services for specific communities. The last hybrid cloud is a combination of the above types of clouds, whose constituent units are independent individuals. Through standardization technology, data can be transplanted between cloud-free units.

4. Solution of energy management system for iron and steel industry in cloud environment

4.1 Spatial layout of energy management system

The physical architecture of the traditional energy management system in iron and steel plants has great limitations on the scalability, scalability and maintainability of the system. The continuous upgrading of cloud computing technology has become an opportunity to change this situation. With extensive network access, fast flexibility, on-demand self-service, resource pooling, billing by volume and other characteristics, cloud computing can provide unified services in the form of unlimited resource pools. The combination of cloud computing and energy management is helpful to promote the innovation of management mode and enhance enterprise profits.

The spatial layout of energy management system in iron and steel industry under cloud environment is mainly divided into three levels. First of all, the data center, the main function of this level is to store massive data, and do data mining, analysis and other work to provide cloud services for users. Large iron and steel groups need to configure corresponding data centers. The users of data centers are mainly enterprise decision makers.

The second level of spatial layout is energy center, whose main function is to dynamically manage energy quality, energy planning and other matters. Usually, each independent steel plant needs to allocate energy center, while a steel group can allocate multiple energy centers at the same time. The main users at this level are operators and technicians.

Finally, the energy branch plant, the main function of this level is to collect and basically process energy data, monitor and adjust energy, manage and file relevant information and generate energy management reports. Each iron and steel plant involves a variety of energy sources, including water, electricity and so on, which need to be equipped with energy branch plants. Similar to energy centers, the main users at this level are operators and technicians.

4.2 Energy management system architecture

The Cloud Architecture of energy system in iron and steel industry in cloud environment needs to provide three types of services, namely infrastructure services, platform services and software services. To meet this demand, the energy management system architecture is divided into three levels: infrastructure, resource management and application management. Using Internet of Things technology and cloud computing technology, all levels will be integrated, according to cloud computing service model, steel industry information requirements, and key technology nodes to build.

For infrastructure layer, energy management system architecture integrates various hardware and software systems, integrates server system, storage system and other hardware facilities, achieves the goal of system sharing and meets different business workloads. Infrastructure platform solves the technical problem of mass data processing. Utilize virtualization management technology, share resource pool, improve resource utilization, and reduce operation and management expenditure. A business transaction can be distributed to thousands of servers at the same time to calculate and integrate the results. Through the infrastructure layer, the environment can be centralized and users' resource needs can be analyzed globally. Quick and accurate statistics of resource costs provide a basis for resource planning and co-ordination.

For the resource management layer, users need not care about the configuration and installation of the database. The platform provides Web 2.0 application runtime, Java runtime, various middleware and other resources. By equipping with a unified programmable interface, shield the underlying different architectures of the database. When developing new products, developers can reduce the initial cost of new business and further reduce the development cost. Using cloud computing PaaS platform, flexible allocation of resources.

Application management is mainly responsible for providing software services. Application service providers deploy software systems on servers. Users buy corresponding software services according to their own needs. The energy management system designed in the cloud environment provides energy monitoring, energy assets management, basic energy management and other services. Users don't need to buy software, they just need to pay for rental services.

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References

[1] Chen H., Liu X.T, Wu B.J. (2011). Applied Research of Energy Management System in Iron and Steel Enterprises. Automation and Information Engineering, 32 (4), 20-23.

[2] Chen J. (2013). Application of Energy Management Center in Iron and Steel Industry. Automation Applications, 4 (3), 14-15.

[3] Sun H.Y., Li M.J. (2017). Measures for Continuous Improvement of Energy Management System in Iron and Steel Enterprises. Shandong Metallurgy, 39 (3), 60-61.

[4] Zhang M.H, Long R.T. (2015). A comparative study of Chinese and Western cases of energy management in iron and steel enterprises. Journal of Henan Normal University (Philosophy and Social Sciences Edition), 33 (4), 67-72.

[5] Liu B.H. (2015). Application Analysis of Automation Equipment Technology in Energy Management System of Iron and Steel Enterprises. Mechanical and Electrical Engineering Technology, 44 (12), 123-125.

[6] Feng A.G(2009). Thoughts on the Establishment of Energy Management System in Iron and Steel Enterprises. Metallurgical Management, 22 (2), 51-52.

[7] Li X.L., Wang S.Q., Deng H. (2017). Energy Management Practice of Bagang in Cold Winter in Iron and Steel Industry. Xinjiang Iron and Steel, 24 (4), 12-12.

[8] Xu X.S., Yang S.G. (2017). Research on Energy Management and Control Path Optimization of China's Iron and Steel Production under the Background of Big Data. Industrial Technology Economy, 36 (1), 32-40.

[9] Geng J.J. (2018). Talking about the Construction and Application of Energy Management System in Iron and Steel Enterprises. Modern Information Technology, 2(5), 133-135.

[10] Wei Z.Q., Chen X.D, Wei J. (2017). Development Status and Prospect of Iron and Steel Energy Management System. Metallurgical Energy, 36 (s2), 8-9.

[11] Zhang D.Q. (2013). Design and Implementation of Energy Management System for Large Iron and Steel Enterprises. Chemical Automation and Instruments, 40 (3), 390-394.