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Issues and Countermeasures in Energy Measurement Management of Thermal Power Enterprises

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Abstract: To promote energy conservation, emission reduction, and sustainable development in thermal power enterprises, this study conducted a detailed analysis of the problems existing in measurement management in these enterprises and explored targeted solutions. The analysis found that, faced with increasingly stringent environmental protection requirements and urgent needs to improve energy efficiency, thermal power enterprises must address the current issues in energy measurement management. They should actively respond to the national call for energy conservation and emission reduction, continuously optimize energy measurement management processes, improve energy utilization efficiency, reduce unnecessary energy consumption and emissions, and lay a solid foundation for the green transformation and sustainable development of the industry.

Keywords: Thermal power generation; Enterprise; Energy; Measurement management

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1. Introduction

Thermal power enterprises occupy an important position in China's energy supply system. However, their high energy consumption and high emission characteristics also make them a key area for energy conservation and emission reduction. As an essential component of enterprise management, energy measurement management is significant for improving production efficiency, optimizing energy structure, reducing production costs, and enhancing market competitiveness. By adopting scientific measurement methods, reasonably setting up energy measurement devices, and equipping qualified energy measurement instruments, thermal power enterprises can effectively monitor, record, and analyze energy consumption data, providing intuitive and scientific evidence for energy conservation and consumption reduction. However, there are still some problems in energy measurement management in thermal power enterprises, which not only affect the energy utilization efficiency of enterprises but also restrict their sustainable development. Therefore, it is of great significance to deeply explore the

problems existing in energy measurement management in thermal power enterprises and propose corresponding countermeasures to promote energy conservation, emission reduction, and sustainable development in these enterprises.

2. Problems in energy measurement management in thermal power enterprises

2.1. Inadequate and aging measurement instruments

Thermal power enterprises often face issues of inadequate and aging measurement instruments due to historical reasons or financial constraints. This leads to a situation where the number of measurement instruments is not sufficient to meet the demand for comprehensive and precise measurement of various energy media (such as coal, oil, gas, water, electricity, and others). This not only limits the enterprise's ability to accurately grasp its energy consumption situation but also affects the effectiveness of energy conservation, emission reduction, and cost control [1]. At the same time, some of the equipped measurement instruments have aged due to long-term operation, resulting in a gradual decline in measurement accuracy and stability, and even possible malfunctions. This can lead to distortions or missing data in energy measurement, increasing maintenance and replacement costs and potentially misleading the enterprise's energy management decisions due to inaccurate measurement data [2].

2.2. Incomplete management system

Another urgent problem to be solved is the incomplete management system. Thermal power enterprises often lack effective system construction and process standardization in energy measurement management [3]. This includes a lack of unified standards and a clear division of responsibilities in various aspects such as the collection, recording, processing, analysis, and application of measurement data. This leads to chaotic management of measurement data, difficulty in ensuring data quality, and even risks of data loss or tampering. Additionally, enterprises lack systematic management and supervision mechanisms in the full lifecycle management of measurement instruments, including selection, procurement, installation, verification, maintenance, and disposal. This not only affects the reliability and service life of the measurement instruments but also increases the enterprise's operating costs and safety risks.

2.3. Low data accuracy

Thermal power enterprises face many challenges in terms of low data accuracy in the collection, processing, and application of energy measurement data. Firstly, the accuracy of measurement data can be affected by factors such as the precision limitations of the measurement instruments themselves, aging or improper maintenance, and environmental factors (such as temperature, humidity, and electromagnetic interference, among others). Secondly, during the transmission and recording of measurement data, issues such as human operational errors, system failures, or network delays may occur, leading to data loss, tampering, or incorrect recording, further reducing data accuracy. Additionally, enterprises lack scientific methods and tools in the processing and analysis of energy measurement data, leading to inaccurate data interpretation and difficulty in identifying problems and optimization spaces in energy consumption. These issues affect the enterprise's ability to accurately grasp its energy consumption situation and limit the effective implementation of energy conservation and emission reduction measures.

2.4. Low level of informationization

The low level of informationization is another key factor restricting the improvement of energy measurement management in thermal power enterprises. Currently, many thermal power enterprises still rely on manual recording and simple data analysis in energy measurement management, lacking advanced information technology and system support. This results in inefficient collection, processing, and analysis of measurement data, severe data islanding, and difficulty achieving data sharing and integrated applications. Simultaneously, enterprises lack intelligent and automated tools and methods in energy measurement management, such as the Internet of Things technology, big data analysis, artificial intelligence, etc. The absence of these technologies limits the deep mining and utilization of energy measurement data, making it difficult to achieve real-time monitoring, early warning, and optimization of energy consumption. Furthermore, the low level of informationization also hinders effective information exchange and collaboration between enterprises and external environments (such as power grids, suppliers, customers, etc.), affecting their market competitiveness and sustainable development capabilities.

3. Countermeasures for energy measurement management in thermal power enterprises

3.1. Strengthening measurement instrument management

Strengthening measurement instrument management is a key countermeasure to address the problems in energy measurement management in thermal power enterprises. Firstly, updating and upgrading measurement instruments is fundamental to improving energy measurement accuracy. Thermal power enterprises should regularly evaluate the performance and accuracy of existing measurement instruments. For instruments that are severely aged, have decreased accuracy, or cannot meet current energy measurement needs, timely updates or upgrades should be carried out. This includes adopting higher-precision, more stable measurement sensors and integrating smart communication functions into metering equipment to improve the accuracy and real-time performance of data collection [4]. Simultaneously, enterprises should also focus on the compatibility and scalability of measurement instruments, ensuring that new equipment can be seamlessly integrated into existing energy management systems to achieve seamless data transmission and integrated analysis.

Secondly, regular calibration and maintenance are necessary measures to ensure the long-term stable operation of measurement instruments. Thermal power enterprises should establish a comprehensive calibration and maintenance system for measurement instruments, clarifying the calibration cycles and maintenance requirements for various types of instruments. Through regular calibration, deviations in measurement instruments can be timely identified and corrected, ensuring the accuracy of their measurement results. Regular maintenance includes cleaning, inspecting, debugging, and replacing wearable parts of measurement instruments to extend equipment lifespan and reduce failure rates [5]. Enterprises should also strengthen training for personnel using measurement instruments, improving their ability to correctly operate and maintain the instruments and avoiding equipment damage or measurement errors due to improper operation.

Finally, introducing advanced measurement technology is an effective way to enhance energy measurement management. With the rapid development of technologies such as the Internet of Things, big data, and artificial intelligence, thermal power enterprises should actively explore and apply these advanced technologies to improve the collection, processing, and analysis capabilities of energy measurement data. For example, by introducing Internet of Things technology, remote monitoring and intelligent diagnosis of measurement instruments can be achieved, improving the timeliness of equipment failure warnings and handling. Through big data analysis,

deep mining and correlation analysis of energy measurement data can be conducted to discover patterns and trends in energy consumption, providing a scientific basis for energy conservation, emission reduction, and optimized operations. Through artificial intelligence technology, intelligent identification and learning of energy measurement data can be realized, enhancing the automation and intelligence level of data processing.

3.2. Improving the management system

To address the problems in energy measurement management in thermal power enterprises, it is essential to improve the management system. Firstly, a strict measurement management system must be established and implemented. Thermal power enterprises should develop a comprehensive, detailed, and operable measurement management system based on their actual situations. This system should clarify the requirements for the full lifecycle management of measurement instruments, including selection, procurement, installation, verification, use, maintenance, and disposal, as well as standardize processes such as the collection, recording, processing, analysis, and application of measurement data [6]. Simultaneously, enterprises should establish a responsibility system for measurement management, clarifying the duties and authorities of management personnel and measurement personnel at all levels to ensure the effective implementation of the measurement management system [7]. Furthermore, enterprises should regularly review and update the measurement management system to adapt to the latest requirements and changes in energy measurement management.

Secondly, a measurement data management mechanism should be established. Thermal power enterprises should establish a comprehensive measurement data management system that includes data collection, storage, processing, analysis, and application. By adopting advanced information technology tools such as database management systems and data analysis software, automated data collection, intelligent processing, and visual presentation can be achieved, improving the efficiency and accuracy of data processing. Concurrently, enterprises should establish a measurement data review and verification mechanism to ensure data authenticity and reliability. Furthermore, enterprises should strengthen the analysis and application of measurement data, providing a scientific basis for energy conservation, emission reduction, cost control, and operational optimization by exploring patterns and trends in the data.

Finally, enhancing the training and assessment of measurement personnel is key to improving measurement management capabilities. Thermal power enterprises should prioritize the training and development of measurement personnel, regularly organizing training sessions on measurement knowledge, skills, and regulations to enhance their professional qualities and business capabilities. Simultaneously, enterprises should establish an assessment mechanism for measurement personnel, incorporating indicators such as the implementation of the measurement management system, the accuracy and reliability of measurement data, and other relevant criteria into the assessment scope. This will motivate measurement personnel to actively fulfill their duties and improve work quality and efficiency. Furthermore, enterprises should encourage measurement personnel to participate in measurement-related scientific research projects and technical exchange activities, enhancing their innovation capabilities and competitiveness in the field of measurement.

3.3. Improving data accuracy

Addressing the issue of low data accuracy in energy measurement management for thermal power enterprises, it is essential to improve data accuracy. Specifically, this can be achieved through three aspects: optimizing measurement data collection and transmission processes, reducing the impact of environmental factors on

measurement data, and implementing measurement data review and verification mechanisms.

Firstly, optimizing measurement data collection and transmission processes is fundamental to improving data accuracy. Thermal power enterprises should review their existing measurement data collection and transmission processes, identify bottlenecks and vulnerabilities, and take corresponding optimization measures. For example, advanced sensor technology and the Internet of Things technology can be adopted to achieve real-time and accurate collection of measurement data. This data can then be transmitted to a central database for unified management and analysis through a stable communication network [8]. Simultaneously, enterprises should establish standardized processes for data collection and transmission, clarifying the responsible personnel and operating norms for each link to ensure data accuracy and completeness. Furthermore, enterprises should strengthen the maintenance and care of data collection and transmission equipment to avoid data loss or errors caused by equipment failures [9].

Secondly, reducing the impact of environmental factors on measurement data is key to improving data accuracy. Thermal power enterprises should deeply analyze the influence mechanism of environmental factors (such as temperature, humidity, electromagnetic interference, etc.) on measurement data and take corresponding measures for control and compensation. For example, temperature compensation technology can be applied to measurement instruments susceptible to temperature influences, improving the accuracy of measurement results. For measurement equipment susceptible to electromagnetic interference, measures such as shielding and filtering can be taken to reduce the impact of interference on measurement results. Simultaneously, enterprises should strengthen the monitoring and control of the measurement environment to ensure that measurement instruments operate under suitable environmental conditions, enhancing data accuracy and reliability.

Finally, implementing a measurement data review and verification mechanism is a guarantee for improving data accuracy. Thermal power enterprises should establish a comprehensive measurement data review and verification system, clarifying the review and verification cycle, methods, and standards. By regularly reviewing and verifying measurement data, errors and deviations in the data can be promptly identified and corrected, ensuring data accuracy and reliability. Simultaneously, enterprises should establish a traceability mechanism for measurement data quality, tracing and recording the data's source, collection, processing, and application. This allows for quick identification of the cause and corrective measures when data issues arise. Furthermore, enterprises should encourage employees to actively participate in the review and verification of measurement data, raising awareness and emphasis on data accuracy among all staff.

3.4. Promoting information construction

Enhancing the automation level of metering systems is fundamental to advancing information construction. Thermal power generation enterprises should increase investment in metering systems, adopting advanced automation technologies and equipment to achieve remote monitoring, intelligent diagnosis, and automatic calibration of metering instruments [10]. Through the application of automation technology, manual intervention can be significantly reduced, improving the accuracy and real-time performance of data collection while lowering operation and maintenance costs. Furthermore, enterprises should strengthen the maintenance and servicing of metering systems to ensure stable system operation and avoid data loss or errors caused by system failures.

Establishing an integrated metering data platform for analysis is the core of promoting information construction. Thermal power generation enterprises should integrate existing metering data resources, establishing a unified data warehouse and data management platform to achieve centralized storage, unified management, and

efficient utilization of metering data. Through the data integration and analysis platform, enterprises can conduct deep mining and correlation analysis of metering data, discovering patterns and trends in energy consumption to provide a scientific basis for energy conservation, emission reduction, cost control, and operational optimization. Additionally, the platform should support visual data presentation, intuitively displaying data analysis results to facilitate quick decision-making by management.

Introducing intelligent metering management tools and methods is an innovative aspect of promoting information construction. Thermal power generation enterprises should actively explore and apply intelligent metering management tools such as big data analytics, artificial intelligence, and machine learning to improve the efficiency and accuracy of metering data processing. Through the application of intelligent tools, enterprises can achieve intelligent identification, automatic classification, and smart warning of metering data, enhancing the automation and intelligence level of data processing. Simultaneously, enterprises should strengthen learning and training on intelligent tools, improving the entire team's understanding and application ability of intelligent technology and pushing metering management towards intelligent and refined development.

4. Conclusion

In summary, the problems existing in energy metering management of thermal power generation enterprises cannot be ignored. These problems not only affect the energy conservation and emission reduction effects of enterprises but also restrict their sustainable development. To improve the level of energy metering management, thermal power generation enterprises need to take a series of measures. In the future, with the continuous progress of technology and increasingly strict environmental protection policies, thermal power generation enterprises need to pay more attention to energy metering management and achieve efficient energy utilization and environmentally sustainable development through scientific methods and means. Simultaneously, the government and all sectors of society should strengthen their supervision and support for energy metering management in thermal power generation enterprises, jointly promoting the green development of the thermal power generation industry.

Disclosure statement

The author declares no conflict of interest.

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