

Research on Standardized Management Measures of Electric Power Metering in Power Supply Enterprises

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ABSTRACT With the continuous development and progress of society, China's electric power industry is advancing at a high speed, and with it, metering technology has been improving rapidly. Many staff are not well-versed in the details of electric power metering operations and thus mistakenly believe that the existing standards for implementation and application are easy to follow. Execution of electric power metering work is relatively difficult in practice. This problem stems from the fact that the equipment used to measure electricity at all stages of production directly affects the accuracy of the measurement results through standardisation and operation. Given the rapid changes in current society and the growing need for electric power metering, under the new circumstances, continuous optimisation and strengthening of standardised management methods are required to implement stricter management measures and promote the development of electric power metering standards in China.

INDEX TERMS Power Supply Enterprise; Electric Power Metering; Standardized Management; Management Measures

I. INTRODUCTION

As China's development accelerates and electricity consumption steadily rises, the operational efficiency and quality requirements for power supply enterprises have been continuously elevated, particularly with regard to electric power metering and its associated management responsibilities. Primarily, the electric power metering responsibilities of a power company are closely linked to the users, as they directly reflect the company's operational performance and management capabilities. Moreover, by implementing a comprehensive and scientific set of standardized management strategies for electric power metering, power companies can greatly improve their management standards and, to some extent, enhance their competitiveness in the market. The research framework of this study is presented in Figure 1.

II. OVERVIEW OF ELECTRIC POWER METERING AND STANDARDIZED MANAGEMENT

A. OVERVIEW OF ELECTRIC POWER MEASUREMENT

1) OVERVIEW OF ELECTRIC POWER METERING

Given the various demands of all sectors of society, power companies have introduced diverse services and now use electricity meters to provide some of these services. At the same time, the electricity meter data will show how much power the users have used and help to protect their rights and interests. Therefore, a special meter data analysis system

should be built, and the staff's professional skills and service quality need to meet the requirements of this system. Only in this case will the normal operation of the metering statistical system be guaranteed, and the effective progress of electric power metering management will be achieved. However, many problems still exist in the current management of electric power metering, such as missing management rules at some power companies that do not provide effective guidance for electric power metering operations; employees often show a lack of responsibility awareness and lack the necessary knowledge and skills, resulting in frequent measurement errors; in addition, unclear role definitions and limited technical proficiency prevent them from carrying out their duties in the field of electric power metering efficiently. All of the above are serious issues.

2) THE CURRENT STATUS AND DEVELOPMENT TRENDS OF ELECTRIC POWER METERING TECHNOLOGY MANAGEMENT IN CHINA

In recent years, China's electric power facilities and enterprises have been developing steadily; however, some problems have still remained and can generally be divided into two categories.

Firstly, the main problems in China's electric power metering operations at present originate from technological deficiencies and irrational management. As many power companies in China are state-owned enterprises, any tech-

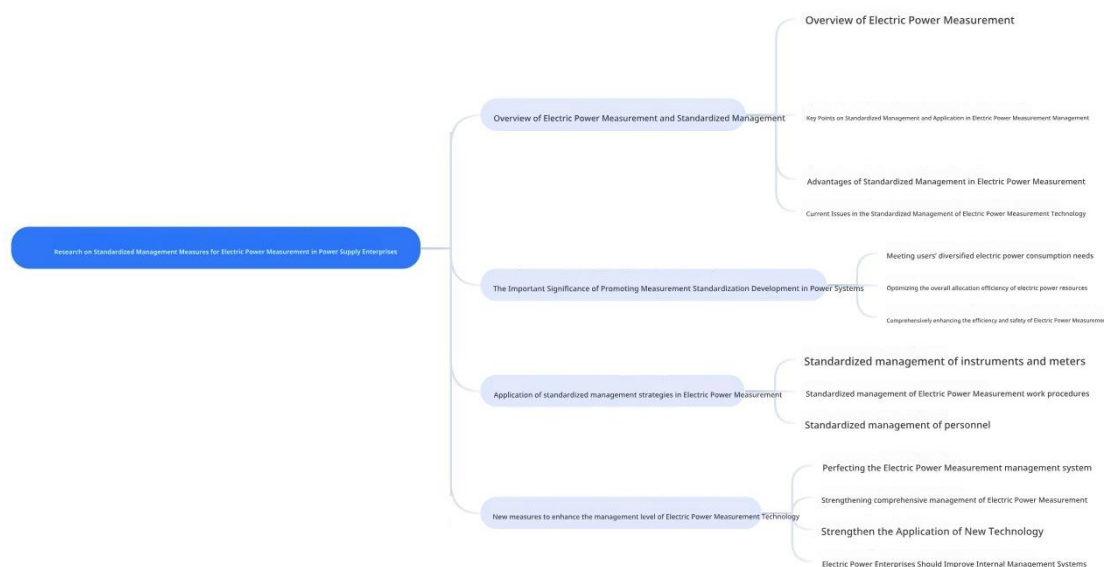


Fig. 1. Research Framework

nology or management problems in their metering work may lead to inaccurate data of electricity consumption for users, causing energy waste and a loss of state-owned assets. Therefore, the technical and managerial difficulties in the current electric power metering management constitute a basic problem. Secondly, there have been discrepancies between the electric power meter readings and the actual situation due to improper operation by some personnel in the metering office, thus affecting the impartiality and objectivity of the electric power metering work. Therefore, some management problems have arisen as a result.

In addition, due to the incomplete integration of equipment configuration, in some relatively remote areas or those lacking infrastructure, it has been difficult for electric power staff to carry out metering work efficiently because of the installation of electric energy meters and other electrical equipment. Therefore, it is necessary to address the serious problems that Chinese power supply enterprises are currently facing in electric power measurement and management promptly.

Our country has given attention to the problems in electricity metering technology during power generation. Relevant organisations have taken steps to offer support and thus provided a foundation for the development of electric energy metering technology across the country. Some electric power facilities have been renovated and improved; with the continuous progress of electric power technology, electric energy metering technology has advanced rapidly, and now a demand for its standardisation has emerged. However, the current technology of electric energy metering is still in a stage of continuous innovation and improvement in terms of equipment, and more research is needed to increase its intelligence and accuracy.

3) FUNDAMENTAL CHARACTERISTICS OF ELECTRIC POWER METERING

(1) Technical Aspect

Electricity provides power for many of our daily life and work; now, in the modern era, it is also essential for living. Suppliers and consumers have been the parties to an extent all the time. Most electric power meters are for measuring the amount of power consumption. This work requires people with special knowledge and the use of precise tools and equipment, so it is a relatively complicated electric-power metering system..

(2) Differential Characteristics

At present, many factors are affecting the process of electric power metering, such as the skill level of personnel, metering accuracy and enterprise management practices; at the same time, these factors are also to some extent influencing the process. Therefore, in the course of implementing electric energy metering under different scenarios, the resulting data are significantly different, showing considerable heterogeneity in electric energy metering and a problem of obtaining high-precision information in practice.

(3) Service Aspect

At present, electric energy is treated as a commodity in the commercial sector and is widely used; thus, both enterprises that provide this commodity (i.e., power supply companies) and consumers using it have been extensively developed. Therefore, in order to better use the entire market development, power companies need to have good service capabilities.

B. KEY POINTS OF STANDARDIZED MANAGEMENT AND APPLICATION IN ELECTRIC POWER MEASUREMENT MANAGEMENT

Electric power metering operations mainly involve three core aspects: technical, implementation, and personnel ser-

vice, as illustrated in Figure 2 below.

1) TECHNICAL ASPECTS OF STANDARDIZED MANAGEMENT

Given the high-technicality of the electric power metering management tasks, high-precision equipment needs to be used. Strictly supervise all operations in terms of equipment installation and calibration according to the engineering technical plan at any time. Do not make any short circuits due to improper connection; otherwise, there will be a danger of fire, and the quality of installation and operation for electric power metering cannot meet the required standards. To further strengthen investment in metering technology and human resources, and to advance the process of research and development, automation and intelligent technologies should be used to improve the high-end automated control capabilities of the metering system and optimize the efficiency of electric power metering management. In addition, a whole-system framework of metering equipment needs to be built to ensure that all supporting devices are in good working order continuously. At the same time, a full-coverage monitoring and management system should be built to strengthen supervision and regulation of the operation, maintenance and management of critical devices, such as energy meters, and related technical measures need to be taken to prevent frequent faults or malfunctions in all kinds of equipment. Periodically carry out inspections and strictly supervise the application of the relevant test rules at the Management Office.

2) STANDARDIZED MANAGEMENT IN IMPLEMENTATION

Effective implementation of the standardised Electric Power Measurement Management requires all-encompassing rules and regulations, so the leadership of electric power companies must fully understand the importance and development problems of these rules and regulations. Improve leaders' understanding of the management of electricity-power meters, build an all-encompassing management system in accordance with Chinese laws and industry technical standards, learn by doing, delve into the root causes of problems deeply, and develop effective countermeasures to ensure that all relevant management activities are carried out properly and in an orderly manner. With the numerous departments under the Electric Power Measurement Management section of the company, cooperation among them needs to be strengthened to optimise the use of resources, ensure timely transmission of information, and implement measurement management norms. Periodically have employees check the electricity-power measuring devices themselves. If it shows any signs of wear or malfunction, promptly arrange for repairs, and at the same time, the company will strictly regulate employees' conduct to ensure that all staff are competent in their work. All of this is to reduce Electric Power Measurement Error and show the positive effects of Electric Power Measurement Management Standardisation.

3) STANDARDIZED MANAGEMENT IN PERSONNEL AND SERVICES

At this time, customers have had increasing expectations of Power Supply Enterprises. If the power supply company fails to prioritise improving its power supply model and continues to serve customers based on outdated concepts, it will be impossible to enhance the quality of power supply for the Electric Power Company and thus fail to gain customers' trust and support. Employees are closer to the users, and a stronger sense of service can be displayed by these employees in their work. Strengthen training for employees to provide better services to the public. According to the positions of the staff, all of them should learn about new-era service ideas through organised courses. A Norm for Electricity and Energy Meters Needs to Be Established. At the same time, the company should be willing to change its business model proactively and closely listen to what customers require. Fulfill all the various requirements of the users and promptly deal with any feedback or problems they raise. Continuously overcome the problems that arise during the implementation of standardised management, adapt to changes in society, and keep adding value.

C. ADVANTAGES OF STANDARDIZED MANAGEMENT IN ELECTRIC POWER MEASUREMENT

(1) Advantages of Standardization in Electric Power Measurement Technology

First, the electricity company has kept up with the times, so its equipment should be in line with industrial development and regularly updated. Soon, new measuring instruments will be available to replace the old electrical measuring devices. At the same time, many sectors have begun to introduce automation and use it. Regular maintenance and servicing of the electrical power measuring equipment need to be performed in the area of automation for electrical power measurement to ensure normal operation of this system. We need to adhere to the standard configuration and Operating Procedures for Electric Power measuring devices strictly in order to reduce measurement errors caused by incorrect settings. Therefore, from the perspective of Electric Power measurement technology, the main focus should be on the Standardisation of Electric Power measuring instruments to ensure the accuracy and safety of measurement activities. Second, after conducting the electric power measurement work, we will use some test equipment to observe and examine the data and devices. Standardisation of these testing tools is required to determine whether the electric power measurement activities meet the relevant standards; otherwise, it will not be possible to ensure consistent maintenance of the electric power measurement equipment provided to power supply and consumption enterprises. Therefore, standardisation of electric power measurement equipment can be applied to general management of electricity and, at the same time, is also needed for these purposes. Thirdly, standardised electric power measuring equipment helps extend the application



Fig. 2. Analysis Diagram of Standardized Management and Key Application Points in Electric Power Metering Management

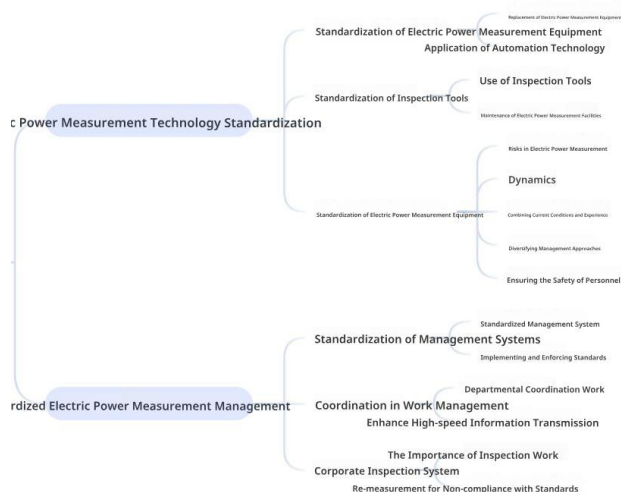


Fig. 3. Advantages of Standardized Management in Electric Power Measurement

scope of automation technology to electric power measurement work. It will reduce the risk of electric power quality issues, ensure the safety of staff, and help to maintain the performance of electric power metering equipment.

(2) Advantages of Electric Power Measurement Management Standardization

The first is to establish a normalised electric power measurement management system and apply it in the initial store construction, during the construction period, and upon completion. It will ensure that the power supply to the store is effective and accurate. In addition, to organise the work better, the departments of the company will need to communicate and share information more frequently. Establish a corporate inspection mechanism to conduct all-weather checks and device tests of the electric-power measurement results, thus reducing measurement errors. If the measured data do not meet the requirements, a new measurement will be promptly carried out to ensure the accuracy of the measurement results. Therefore, by implementing standardised management for electric power measurement, the scientific nature of the management will be improved, the implementation of management processes will be facilitated, and both the effectiveness and efficiency of electric power measurement will be enhanced.

D. CURRENT ISSUES IN THE STANDARDIZED MANAGEMENT OF ELECTRIC POWER MEASUREMENT TECHNOLOGY

The problem of power supply shortages is even more severe outside major metropolitan areas in China amid rapid economic growth and advancing scientific progress, severely restricting the country's overall economic and social development. At the current stage, Electric Power Measurement Technology is undergoing continuous improvements and seeking breakthroughs; It showcases new features such as all-around, intelligent, integrated, and practical characteristics. To ensure the normal operation of the power grid system and positively impact the national economy and society, we must strengthen the application of standardized Electric Power Measurement methods to reduce potential risks and uncertainties. Using unified standard methods can significantly enhance the safety performance of power generation devices and help save human resources and other related costs, thereby further improving corporate operational performance. All industries should uphold the principle of 'low carbon and environmental protection' to achieve long-term sustainable development goals. Therefore, applying advanced technologies such as Automatic Control and human-computer interaction to minimize human labor while maximizing the use of other material assets is a very advantageous approach. This approach not only helps drive society towards a greener path but also supports the smooth advancement of electrical testing work nationwide, ensuring the long-term interests of the country and society are protected.

III. THE IMPORTANT SIGNIFICANCE OF PROMOTING MEASUREMENT STANDARDIZATION CONSTRUCTION IN POWER SYSTEMS

A. MEETING THE DIVERSIFIED ELECTRICITY CONSUMPTION NEEDS OF USERS

With the development of deep-seated reforms and industrial restructuring at present, the construction of electric power facilities has become a public concern. Good Management and Operation of the power grid will help meet the various and different energy needs of all kinds of users. As both the quantity and types of electrical appliances continue to rise, the required accuracy and reliability of power measurement technology are now very high. The spread of Information Technology in the power industry has promoted innovation

and improvement in power-measuring technology, and now this sector is developing at a high speed. In the new environment, to ensure the accuracy of measurements by the Power Supply Organisation, some work must be done according to standardised technical and operating procedures to achieve the desired purpose. By using the new Electric Power Measurement equipment properly, the operating conditions of the power system can be observed in real time; thus, risks from human error during operation are reduced, and a balanced and harmonious development of social interests and social benefits for enterprises will be promoted.

B. OPTIMIZED OVERALL EFFICIENCY IN THE ALLOCATION OF ELECTRIC POWER RESOURCES

As the world becomes increasingly interconnected and advances the economic and social development of their respective countries, effectively utilizing limited and valuable natural resources to address current challenges has become a key issue that governments must urgently address—particularly regarding the numerous difficulties in power supply and consumption. Increasing demand due to population growth, alongside the added pressure from emerging renewable and unconventional power generation methods impacting existing systems, forces us to confront these challenges in a harsh reality. Therefore, to ensure that people nationwide and worldwide can enjoy a sufficient, reliable, and stable power supply while minimizing waste, advancing the construction of an electric power standardization and measurement management system has become a key direction for power supply organizations to secure the achievement of measurement management goals in the new era.

C. COMPREHENSIVELY IMPROVE THE EFFICIENCY AND SAFETY OF ELECTRIC POWER MEASUREMENT

With the addition of intelligent systems, automation and other information technology in the field of electric energy measurement can be used to collect, analyse and calculate measurement data more accurately through big data, cloud computing, the Internet of Things and other technologies. Considering the accuracy and practicality of electric energy measurement, all-encompassing and dynamic observation can be carried out to collect real-time data on the working conditions of the power grid and ensure a stable and safe operation of the system. Research on the integration and standardisation of electric power measurement systems has improved the quality of measurement in recent years, providing strong support for the long-term development goals of Electric Power Enterprises. At the same time, under the concept of sustainable and environmentally friendly development, Automation and Intelligent Systems for Electric Energy Measurement have reduced the use of human and physical resources significantly, thereby contributing substantially to the development of Electric Energy Measurement. The planning of the actual work process for the stable and effective electric power management system should be based on standardisation of technology and equipment.

Only then will it be possible to carry out the measurement work smoothly and provide the basic support for all-round, modern and intelligent electric power management systems.

IV. APPLICATION OF STANDARDIZED MANAGEMENT STRATEGIES IN ELECTRIC POWER MEASUREMENT

A. STANDARDIZED MANAGEMENT OF INSTRUMENTS AND METERS

Based on actual circumstances, the rules and regulations for scientific and technological management should be comprehensive and specific, and then these rules must be effectively enforced. First of all, we should consider all the choices of measurement tools reasonably and improve their accuracy. Select a suitable device, then consider where to place it and what kind of connections need to be made to improve the precision of measurement. First of all, we need to know all the electricity in the area, and then we can choose a good way and wiring scheme to minimise measurement errors. Set up the position of the measurement points correctly, as well. If the measurement point is too far from the site, secondary load and secondary circuit losses will be larger, and thus the measurement accuracy will decline. Therefore, a suitable one will be chosen to determine the ratio of the current transformer. Next, we will enhance the accuracy of measurement equipment and promote the standardisation and formalisation of electricity consumption measurement. To enhance the accuracy of measurement equipment, more efforts will be made to increase the precision of electric energy meters through hardware infrastructure upgrades in accordance with electricity measurement standards. Strengthen the advance of technology to systematically replace old equipment and products, and strictly refrain from using electric-energy meters that have been banned or discontinued by the government. Measurement technology will also continue to develop, and in the future, the goal of electricity measurement is full automation, digitalisation and remote control. In accordance with the measurement supervision standards, strictly verify the results of the measurement work, use the company's professional technical strength, and continually improve measurement accuracy. Select an appropriate-accuracy measuring instrument according to the actual circumstances, and before use, perform an error check to ensure that the error of the instrument does not exceed the given standard.

B. STANDARDIZED MANAGEMENT OF ELECTRIC POWER MEASUREMENT WORK PROCEDURES

Ensure the accuracy of electricity measurement and optimise the standardised management process for this function. First, according to the actual circumstances, choose a suitable connection mode for the device; second, set up the measurement points accurately to prevent missing or erroneous data; finally, strictly follow the standard operating procedures for data processing and promptly correct any deviations.

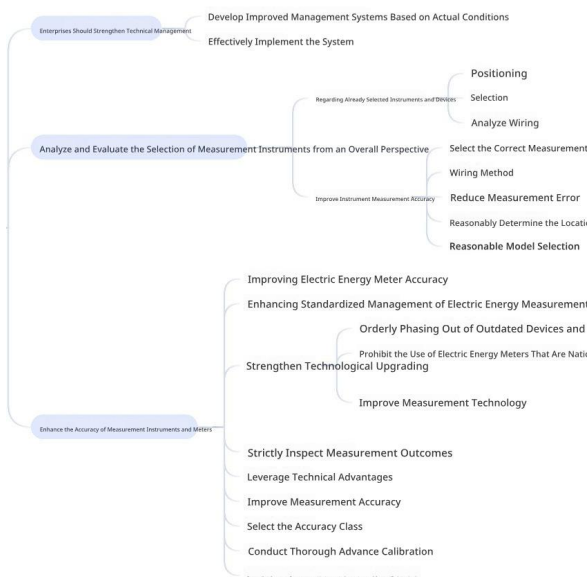


Fig. 4. Standardized Management of Instruments and Meters

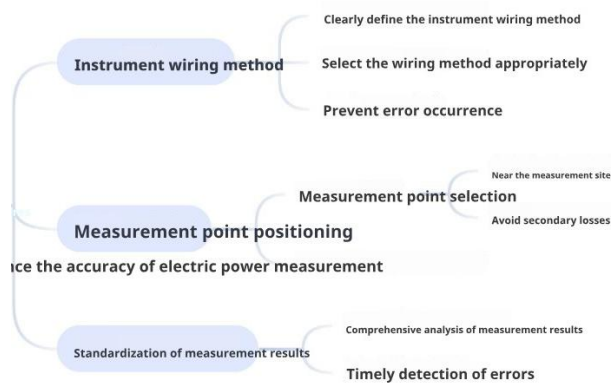


Fig. 5. Standardization of Work Procedures

C. STANDARDIZED MANAGEMENT OF STAFF

When implementing standardized governance of Electric Power Measurement, the 6S management principles should be emphasized: neatness, orderliness, cleaning, maintaining tidiness, ensuring safety, and enhancing quality. Junior employees should receive training on the 6S management principles through educational materials or expert lectures to strengthen their Management Capability. Implementing 6S management within the measurement center team requires establishing and enforcing more detailed workplace management rules. Using evaluation and scoring methods to motivate staff to complete tasks such as organizing items, cleaning the office, and solving problems will help create a clean and dust-free office environment. If anyone fails to meet the specified rating requirements, corresponding points shall be deducted, and penalties imposed on the violators. At the same time, closely link assessment results to the salaries of supervisors to motivate participants in electric power measurement.



Fig. 6. Standardized Management of Staff

V. NEW INITIATIVES TO ENHANCE THE MANAGEMENT LEVEL OF ELECTRIC POWER MEASUREMENT TECHNOLOGY

A. IMPROVE THE ELECTRIC POWER MEASUREMENT MANAGEMENT SYSTEM

Without rules, there can be no order; only by establishing an orderly management framework and processes can work be carried out smoothly. For electric power companies, it is essential to develop a comprehensive and effective set of operational strategies to drive modern business operations and optimize management efficiency. The primary task is to thoroughly re-examine the existing regulations, extracting their strengths while eliminating deficiencies. After removing rules that lack strictness and rationality, these regulations will be further refined through detailed discussion and research to make them more comprehensive. This process aims to achieve full-spectrum, multi-dimensional control between superiors and subordinates, implementing mutual supervision and assistance at every stage to enhance the overall system's transparency and instill confidence in customers. Additionally, all employees should be encouraged to put forth their utmost effort to perform their duties flawlessly. Furthermore, investment should be made to involve more electric power managers in training to enhance their management capability, and to link work performance with managers' salaries in order to stimulate their enthusiasm and initiative. In addition, the capacity for electric power measurement management should be strengthened by boosting staff motivation through rewards and penalties, while regular assessments of managers should be conducted to improve the evaluation system and comprehensively elevate the quality and standards of electric power measurement management.

B. STRENGTHEN COMPREHENSIVE ELECTRIC POWER MEASUREMENT MANAGEMENT

To ensure the high quality of electric power measurement work and maintain the high accuracy and stability of related devices, company leadership must rigorously carry out the tasks related to device management. At the same time, they need to recognize that during the company's operations, it is necessary and important to identify the measurement device requirements and their value. In addition, it is necessary to establish a supervisory mechanism to implement a comprehensive management process for electric power measurement equipment. Every inspection, upgrade, modification, or retirement of devices should be thoroughly documented to fully grasp the specific operation status and technical specifications of the equipment. Moreover, investment is required to enhance employee skills and overall capabilities, including the introduction of leading technologies and best practices within the industry, with a focus on innovation and continuous exploration of new products and services.

C. STRENGTHENING THE APPLICATION OF NEW TECHNOLOGY

As the force of all development, innovation should be applied to all parts of work, including all links in electric power management. Improve management capabilities with high-end technology and speed up task processing to achieve standardisation; thus, the goal of standardised management can be realised. Regularly hold skills training courses to improve the management concept and professional ability of electric power measurement personnel, enabling them to perform electric power measurement work effectively. In the course of new-technology development, increase investment and introduction in this area, motivate employees to carry out in-depth studies of the subject, and promote the dissemination of scientific knowledge. Create a good environment that encourages all people to participate in learning and development together to drive the rapid progress of new technologies. All levels of the organisation need to pay attention to using new technologies and new devices, continuously strengthen scientific research, optimise the upgrade of existing devices, improve the operating efficiency of electric power equipment, and ensure that measurement data is more accurate and reliable.

D. ELECTRIC POWER ENTERPRISES SHOULD IMPROVE THEIR INTERNAL MANAGEMENT SYSTEMS

Add relevant workflows and systems to continuously improve the operating level of the electric power company. Only all-encompassing regulations can standardise employee behaviour and ensure legal compliance of the company. Based on the actual situation, develop an optimised and suitable set of rules to promote the rapid development of the company and meet real-world needs. In addition, the above rules will ensure the accuracy and reliability of the electrical power measurement work. Management staff need to have clear roles and responsibilities; all links in

the management process should be open to view, closely monitored, and thus work more effectively and rationally. In addition, the company can set a salary-management plan that pays employees according to their level of contribution to the company. In this way, the staff will be more motivated and enthusiastic about their work, take more initiative, have a stronger sense of responsibility for their positions, and thus boost the efficiency and quality of electric power measurement to improve enterprise profits.

VI. CONCLUSION

In short, the standardised methods for electric power measurement and management are now widely used and are relatively advanced and efficient in terms of current technology. Increase the efficiency and quality of work, strengthen all-around development capabilities and market competitiveness for enterprises, and thus drive the continuous development of electric power enterprises.

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