Optimizing the Management System of Ultra-high Voltage Engineering Construction under the New Situation

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Abstract. Ultra high voltage engineering is an important carrier of the new energy supply system. The current construction management of ultra-high voltage power grid projects faces problems such as insufficient construction management strength, structural shortage of participating teams, insufficient supply of equipment and materials, and limited equipment level. Continuously optimizing the management system for ultra-high voltage engineering construction can guide effective solutions to the above-mentioned issues at the top-level design level. This article focuses on the optimization of the management system for ultra-high voltage engineering construction in the new stage, serving the high-quality development of engineering construction. The construction management system of ultra-high voltage engineering includes one mission task, two core objectives, four basic principles, three improvement directions, five management methods, and ten key tasks.

Keywords: Ultra-high Voltage Engineering, Management System, Professional Management, Construction Method.

1 Introduction

The construction of ultra-high voltage engineering plays an important role in the historical process of the power industry, and has become the "main artery" of energy transportation for "west to east power transmission, north to south power supply, water and fire mutual assistance, and wind solar complementarity". Compared to conventional power grid construction projects, ultra-high voltage projects have special characteristics in terms of technology, region, and construction, requiring higher-level demonstration and innovation in technology, equipment, personnel management, and other aspects. There are still some problems in the current construction and management of ultra-high voltage power grid projects, such as insufficient construction management forces, structural shortage of participating teams, prominent contradictions in equipment and material supply, and limited equipment level. These issues not only affect the construction progress and quality of ultra-high voltage power grid projects, but also

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increase construction costs and risks. The principles of group operation, intensive coordination, and standardized construction followed by conventional power grid engineering management are not fully suitable for the actual management of ultra-high voltage projects. It is necessary to establish a full process management system that meets the requirements of the new development stage of "large-scale, high-intensity, and high-quality" by combining the characteristics of each ultra-high voltage project.

Ji et al. (2016) constructed a multi-level, all-round grid management system [1]. Xie et al. (2018) developed a "three in one" support system for evaluation incentives, party building work, and risk control, and established the "Excellent 151" management system for the owner project department of ultra-high voltage engineering [2]. Ma et al. (2019) proposed a safety management system for the entire process of ultra-high voltage substations, which includes design review, infrastructure construction, completion acceptance, and operation and maintenance stages, starting from both personnel and equipment aspects [3]. Wang (2019) strengthened the management of the operation and maintenance of ultra-high voltage substations, emphasizing the adoption of lean management concepts and methods [4]. Qiu (2020) established a management mechanism for on-site construction of ultra-high voltage AC test demonstration projects [5]. Wang et al. (2020) explored the establishment of a new management model that highly integrates industry and finance, and studied the construction of a smart engineering financial management system [6]. Huang (2023) will improve the management mode of ultra-high voltage construction from the aspects of confirming the management responsibility subject, carrying out "five dimensional" professional management, strengthening information construction management, and enhancing on-site safety management [7]. Luo et al. (2023) proposed a dual cycle management method for the lifecycle of construction technology management based on the coordinated innovation management mechanism of "industry university research application"[8].Zhao et al. (2022) focused on the practice of the Luoshan Yangtze River Great Leap Ultra High Voltage Project and proposed that collaboration between industry, academia, research, and application is one of the key factors in leveraging the long function of the industrial chain [9]. Liu et al. (2023) analyzed the dynamic evolution process of resource providers and receivers in collaborative innovation decision-making from the perspective of resource sharing among collaborative innovation entities [10]. Zhu et al. (2023) proposed a linear engineering project collaborative governance framework based on stakeholder theory, and proposed a collaborative governance path centered on fully respecting the interests and demands of all stakeholders [11]. Fu et al. (2024) summarized important measures in the early stage of project integration collaborative management, including the construction of an integrated management system, a systematic collaborative mechanism, and a comprehensive linkage management model [12].

Under the constantly changing new situation and requirements, grasp the overall requirements of power grid construction, based on the functional role of ultra-high voltage construction, summarize the practical experience of ultra-high voltage construction, adapt to the new situation of ultra-high voltage construction, meet the practical challenges of ultra-high voltage construction, fully utilize the theory of ultra-high voltage construction management, and construct the overall framework of ultra-high voltage engineering construction management system.

2 Overall Framework of Ultra-high Voltage Construction Management System

The construction management system of ultra-high voltage engineering includes mission tasks, core objectives, basic principles, improvement directions, management methods, etc.

2.1 Mission and Task

The mission is to promote the high-quality construction of ultra-high voltage projects and serve the high-quality development of power grid infrastructure projects.

The overall vision of the power grid infrastructure system is to achieve high-quality development, ensuring that all aspects of the system work together towards "one goal, one direction", and further integrating human, material, technological, management, data and other resources around the strategic thinking of power grid infrastructure, promoting theoretical innovation, management innovation, and technological innovation, and supporting the high-quality construction of new energy systems, new power systems, and new power grids.

Making high-quality construction of ultra-high voltage an important component of the overall vision of the power grid infrastructure system. Adapting to new internal and external situations and requirements, meeting the practical challenges of ultra-high voltage construction, fully utilizing the theory of ultra-high voltage construction management, promoting the integration, structuring, digitization, and dynamic management of ultra-high voltage construction, systematically improving the management capabilities and levels of ultra-high voltage construction, continuously enhancing the core competitiveness of ultra-high voltage business, and fully leveraging the functional role of ultra-high voltage engineering.

2.2 Core Objective

Strengthen theoretical guidance and management innovation, with the core goal of synergistic improvement of professional management and construction methods, to ensure the fulfillment of the mission and tasks of ultra-high voltage engineering.

One core goal is to enhance professional abilities. In response to the current problems in professional management, we will highlight the concept of "lean management", refine the granularity of professional management, strengthen the control of key links such as design, equipment, and site, and vigorously promote the improvement of professional management elements. We will continuously enhance the cohesion of professional systems horizontally and the penetration of professional management vertically, and promote the professional management capabilities of the power grid to a new level.

The other core goal is to enhance capacity building. Consolidate the achievements of engineering standardization construction in recent years, and focus on the new re-

quirements for the construction of new power systems; Using modern intelligent construction technology to continuously expand mechanized construction scenarios; Implement the concept of green development and promote the green development of the power grid; Empowering with digital technology to promote intelligent upgrading of the power grid; Promote the construction capacity to a new level and comprehensively advance the high-quality construction of ultra-high voltage power grid projects.

2.3 Basic Principles

One is the principle of integrated management. Consolidate the achievements of standardization, normalization, and professionalization management in recent years, optimize the management mode based on the current professional management system and institutional standard system, and establish a fully integrated management mode for "various professions".

The second principle is structured management. Sort out the logical relationship between management elements, management organizations, and project management scenarios, establish connections between various entities, and achieve full process control over the entire construction process, all links, and all elements.

The third principle is the digitization management. Integrating digital information technology with professional management, utilizing the "Big Cloud IoT Intelligent Chain" technology to provide a "panoramic" display and analysis of massive ultra-high voltage engineering information data, achieving information connectivity during the construction process.

The fourth principle is dynamic management. Adapting to the changes in the situation and environment faced by the construction of ultra-high voltage under the new development stage, integrating the latest achievements of theoretical innovation, technological innovation, and management innovation, and iteratively improving the ultra-high voltage management system.

2.4 Improvement Direction

To achieve the core goals of ultra-high voltage construction, we will guide the continuous high-quality construction of ultra-high voltage projects by optimizing professional management, optimizing construction methods, and promoting collaborative improvement.

One is innovation driven professional management. Establish a horizontal collaborative promotion mechanism that is dialectically unified, complementary, and mutually reinforcing, carry out innovative research on professional management, form innovative achievements in various professional work mechanisms, build a unified digital control platform, strengthen the professional capacity building of the team, and promote the orderly operation of the professional management system.

The second is to steadily achieve high-quality construction. Strengthen technology leadership, technology drive, and demonstration leadership, conduct research on construction standardization, mechanization, greening, and digitization related technol-

ogies and measures, form a series of technical specifications, carry out pilot demonstration project construction, and form a modern construction model through "point to surface" and "face to face comprehensive".

The third is to promote the coordinated improvement of professional management and construction methods through integration. Adhere to the system concept, deeply understand that professional management and construction methods are interconnected organic whole, and jointly serve the core theme of "high-quality development". Consolidate the joint force of professional management to promote the implementation of construction methods, and enhance the quality and efficiency of professional management through the in-depth promotion of construction methods.

2.5 Management Methods

Implement improvement measures for ultra-high voltage management and promote the practical application of various ideas and concepts through effective management methods.

One is the legal method. In order to promote the scientific and standardized management of ultra-high voltage engineering construction, ensure the legitimate rights of all parties involved in engineering management, and use the relevant legal and regulatory system of engineering construction to constrain the various relationships that occur between various parties in ultra-high voltage construction activities.

The second is administrative methods. To ensure that all construction work of ultra-high voltage is carried out according to plan and requirements, relying on the means of commands, regulations, instructions, rules and regulations in the administrative system, directly commanding subordinate units to carry out various construction management work, and implementing closed-loop evaluation management.

The third is the economic method. Based on various economic laws, economic adjustment measures such as profits, prices, wages, bonuses, and economic contracts are used to adjust the relationships between different economic entities in the process of ultra-high voltage construction, in order to obtain various economic and social benefits.

The fourth is educational methods. With the aim of promoting the strategic thinking of power grid infrastructure, educational methods such as lectures, training, on-site learning, and team building activities are used to influence the differentiation of each member, thereby improving the spiritual and cultural literacy and professional quality of the educated.

The fifth is technical methods. To improve the efficiency and effectiveness of ultra-high voltage engineering management activities, various information technology, decision-making technology, planning technology, organizational technology, control technology, financial technology and other technical means are adopted to promote the digital transformation of ultra-high voltage construction management.

3 Key Measures for Improving the Management System of Ultra-high Voltage Engineering Construction

3.1 Professional Management

Consolidate the foundation of safety and reduce safety risks from the source. Implement the concept of "great security", establish systematic thinking, strengthen problem orientation and scientific coordination. Establish a three-level safety management system, strengthen the safety responsibility of all employees, and build a solid foundation for safety. Strengthen safety education and training, improve the level of mechanized construction, and implement full coverage of safety control. Optimize design, material, and construction management, manage risks throughout the entire process, strengthen hidden danger investigation and anti violation management. Establish a closed loop of inspection and evaluation, combine self-evaluation with external supervision, continuously improve safety management, and ensure the efficient progress of engineering safety.

Pay close attention to quality and strengthen quality control throughout the entire process. Prioritize prevention, strictly control design quality, optimize design processes, and ensure first-class design, technology, and quality. Establish a standardized system for equipment quality management, implement supervision and supplier evaluation, refine daily management, and optimize installation quality control. Promote the continuous improvement of civil engineering quality and lay the foundation for creating high-quality projects.

Carry out schedule modeling to scientifically empower schedule management. Establish a reasonable and unified schedule management system. Develop a schedule plan for the system, clarify the overall objectives of ultra-high voltage engineering construction, and establish a hierarchical breakdown schedule system. Do a good job in pre project progress management, strengthen construction drawing progress management, enhance equipment manufacturing progress management, and comprehensively improve the quality and efficiency of pre project management. Strengthen on-site construction progress management, scientifically formulate reasonable construction periods, achieve scientific coordination of construction timelines, and optimize the allocation of construction resources.

Strengthen process control to precisely deepen cost control. Strengthen the whole process cost control, enhance the source control of preliminary budget, and strengthen the management of construction drawings. Establish a sound cost management system, implement the optimal concept of full life cycle cost, maximize the benefits of the project throughout its entire life cycle, strengthen settlement quality and efficiency control, deepen process division settlement management, strengthen on-site design, construction, and settlement verification, ensure accurate quantity, price, and cost basis, and achieve zero error in project settlement. Strengthen the control of key cost links and achieve precise control of the engineering cost process.

Strengthen technological breakthroughs and drive technological upgrading with innovation. Apply lean management to achieve technological optimization, efficiency improvement, and quality assurance. Key breakthroughs in technical challenges, independent research and development to ensure the safety of the industrial chain, improved human-machine collaboration in mechanical construction, application of green and environmental protection technologies, and intelligent empowerment to enhance intelligence. Strengthen differentiated design through full scenario design technology management, enhance the disaster resistance capability of the power grid, and optimize fire protection and control systems. Optimize the technical management of all elements of equipment for ultra-high voltage transformers and construction technology, tackle key technologies for new energy transmission, promote the transformation of innovative achievements and the construction of standard systems.

Cultivate new forces and strengthen team support through party building. Guided by Party building, strengthen organizational construction and talent access, enhance professional capabilities, build knowledge systems, and implement assessment and evaluation. Optimize organizational and personnel configuration to achieve dual enhancement of capabilities and qualifications. The full process management mechanism ensures the standardization of design, construction, and construction teams, and enhances the configuration of the project department. The three-dimensional training mechanism and diversified assessment and evaluation enhance personnel quality and engineering management efficiency.

3.2 Construction Method

Promote the improvement of engineering construction quality and efficiency based on standardization. Complete iterative optimization of universal design, universal equipment, universal cost, and standard processes. Establish a standard system for ultra-high voltage engineering, which includes supporting documents such as the first level system, second level system, and standardization manual for the management of the Hanjite High Voltage Project. Through the full business process diagram and work task table of ultra-high voltage engineering construction, clarify the main work tasks, and analyze the standardized and normalized work content. Using universal design and technical standards as carriers, comprehensively improve the quality of engineering design.

To promote the green development of engineering construction in the direction of greening. By establishing a monthly meeting coordination mechanism, a flat organizational system of "management organization implementation" will be formed, and an environmental and water conservation working group will be established jointly composed of project departments of various construction and management units, as well as design, supervision, construction, and service units. Establish a "four in one control" system for environmental water conservation that covers the entire business chain, process, direction, and coverage. Carry out incentive assessment and evaluation, organize evaluation and assessment of environmental protection and water conservation work,

implement special environmental inspection and water conservation verification, conduct selection of environmental protection and water conservation demonstration sites, and drive the implementation of environmental protection main responsibilities.

Promote the empowerment of engineering construction technology through mechanization. Establish a fully mechanized construction management system covering design planning, equipment development, innovative construction methods, team building, and engineering applications. Vigorously implement "mechanization of personnel replacement", innovate and create construction methods, and focus on technical breakthroughs in complex terrain material transportation, foundation construction, and cross construction. Strengthen the information management of construction equipment, actively promote the use of platforms to carry out equipment leasing business, and expand equipment selection channels to configure more suitable, safe and reliable construction equipment. Improve the system of mechanized construction technology and equipment, and strengthen the control of key engineering links.

Taking digitization as its connotation, promote the intelligent upgrading of engineering construction. Carry out digital design, intelligent construction, and smart installation of ultra-high voltage engineering, promote the development and iterative upgrading of intelligent construction equipment, and achieve online monitoring of process indicators and automatic control of process flow. Carry out platform construction, upgrade and build a digital control platform that integrates infrastructure work, digital management, resource sharing, and decision-making support. Promote the implementation of digital transfer system achievements, formulate digital transfer standards, and establish an electronic delivery mechanism for engineering archives.

4 Conclusions

This article analyzes the functional role of ultra-high voltage engineering and reviews innovative practices in ultra-high voltage engineering management. Based on the functional role of ultra-high voltage construction, establish an overall framework for the management system of ultra-high voltage engineering construction. The management system for the construction of ultra-high voltage projects takes "promoting high-quality construction of ultra-high voltage projects and serving the high-quality development of power grid infrastructure projects" as its mission and task. With the core goal of improving professional and construction capabilities, it adopts legal, administrative, economic, educational, technological and other methods to formulate various key measures from 10 aspects.

This article conducts research on optimizing the management system of ultra-high voltage engineering construction and proposes 10 key tasks for ultra-high voltage engineering construction. For power grid enterprises, it is necessary to be based on reality, creatively implement key tasks according to the social and environmental differences in the areas where the ultra-high voltage projects are located, and effectively play the role of the management system.

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