



Analysis of the Essential Characteristics, Functional Roles, and Key Optimization Measures of Ultra-high Voltage Engineering Construction

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Abstract. Ultra-high voltage project construction has an important position in the power industry, is the "west to east power transmission, north to south power supply, water and fire mutual relief, wind and wind complementary" energy transportation "main", and plays a service "double carbon" goal, support the construction of new power system, to ensure the safe and reliable supply of electricity and other multiple roles. This study analyzes the essential characteristics of UHV project construction from multiple perspectives. Ultra-high voltage projects have the common characteristics of infrastructure projects and the characteristics of power grid infrastructure projects. Compared with conventional power transmission and transformation projects, Ultra-high voltage projects also show their unique characteristics, including high resource coordination pressure, difficult on-site construction, high independent innovation requirements and unique project construction and management mode. At the same time, the four functions of Ultra-high voltage project construction are expounded: ensuring the safe and reliable supply of electricity, promoting the revolution of energy supply, serving the construction of new power system and promoting the high-quality development of power grid. In addition, the key measures to improve the construction management system of Ultra-high voltage projects are also proposed, covering many aspects such as safety management, quality management, schedule control, cost control, technological innovation and team construction, in order to promote the high-quality construction of Ultra-high voltage projects and achieve sustainable development of power grids.

Keywords: Ultra-high voltage; Engineering construction; Power grid

1 Introduction

The construction of ultra-high voltage project (Hereinafter referred to as UHV) has an important position and plays an important role in the historical process of power industry. The UHV project has become the "main artery" of energy transportation for "west power transmission to east, North power supply to south, mutual relief of fire and water, and complementary scenery" [1]. In order to better play the important role of UHV service "dual carbon" goal, support the construction of new power systems, ensure the safe

and reliable supply of electricity, and improve the security of industrial chain and supply chain, it is necessary to promote the power grid to gradually realize the sustainable development goal with the high-quality construction of UHV projects^[2]. This study analyzes the essential characteristics of UHV project construction from multiple perspectives, deeply analyzes the functions of UHV project in the new development stage characterized by "large-scale, high-intensity and high-quality", systematically analyzes the new situation, new environment and new requirements of UHV project construction, and proposes key measures to improve UHV project construction.

2 The Characteristic Essence of UHV Project

UHV projects have the common characteristics of infrastructure projects and the characteristics of power grid infrastructure projects. At the same time, UHV projects also show unique characteristics compared with conventional power transmission and transformation projects^[3].

First, there is greater pressure on resource coordination. The pre-work process of UHV project is long, many links, difficult and arduous. The UHV production cycle is long, the project construction period is tight, and the overall arrangement of resources and the orderly promotion of construction are facing severe challenges; The demand for materials is large and concentrated, which requires the supply of engineering construction materials to be safe and high quality, and the response speed is fast. Multiple inter-provincial and inter-regional UHV projects need to be promoted in parallel, and the pressure of resource pooling is greater^[4].

Second, on-site construction is more difficult. Compared with conventional power transmission and transformation projects, UHV projects involve remote mountainous areas, plateau areas, desert Gobi and other geographical environment complex, sparsely populated areas, facing high altitude, low pressure, strong ultraviolet light and extreme temperature difference construction environment, construction conditions are harsh, material support difficulties, high personnel safety risks, the project faces great challenges.

Third, independent innovation requires higher standards. Facing the unknown natural environment of sand desert, high altitude, extreme geological conditions and meteorological conditions, UHV project management model innovation needs to be high. There is an urgent need for new high-end equipment adapted to the regional "blank area", and for UHV cross-span equipment adapted to the construction of "no man's land" and mechanized construction equipment under extreme natural geographical conditions, it is necessary to increase the research on independent innovation^[5].

Fourth, the project construction management mode is unique. Compared with the conventional multi-subject and phased management mode of power transmission and transformation projects, UHV projects emphasize the owner-led project construction and management mode, give full play to the overall advantages of power grid companies in power technology research and development, project construction and operation, and fully mobilize the resources and strength of each relevant subject in the project construction chain. On the basis of the owner-led model, it emphasizes the construction

and management of provincial companies/UHV companies, the business support of directly affiliated units, and the full play of the advantages of each unit.

3 Functions of UHV Project Construction

3.1 UHV Construction is Needed to Ensure Safe and Reliable Supply of Electric Power in Our Country

China's energy resources and demand in the geographical distribution of extremely unbalanced, power demand is mainly concentrated in the central and eastern, but available resources are far from the power demand center, which coal is mainly concentrated in the north and northwest, hydropower resources are concentrated in the southwest, most of the development of wind and solar energy concentrated in the west and north, long distance, large-scale transmission of energy has become an inevitable choice. UHV technology has the advantages of large transmission capacity, long transmission distance and low line loss, which can realize the interconnection and mutual backup between different regional power grids, effectively cope with sudden power supply problems, and improve the reliability and anti-risk ability of power grids. Therefore, it is necessary to rapidly expand the scale of trans-regional and trans-provincial transmission by vigorously developing UHV transmission, fundamentally improve the power grid transmission capacity, and ensure safe and reliable power supply^[6].

3.2 UHV Construction is Needed to Promote the Revolution of Our Energy Supply

China's power development has long adopted the provincial and local balance model, where the lack of power where the construction of power plants has become unsustainable. With large capacity, long distance and low loss, UHV transmission can realize large-scale and long-distance power transmission, efficiently transport clean energy such as wind energy and solar energy abundant in the west to the eastern region, connect the energy supply center with the load center in the central and eastern regions, and make it possible to develop large-scale scenic bases in the western inland desert, Gobi and desert. The diversification of energy supply and transportation modes can not only meet the electricity demand of central and eastern China, relieve the pressure on land and environmental protection, but also promote the adjustment of the energy structure and optimization of the layout, and promote the coordinated development of the eastern and western regions. As an important carrier of new energy supply and consumption system, UHV undertakes an important mission of energy optimization. Accelerating the high-quality construction of UHV is a strategic way to optimize the allocation of energy resources across the country and ensure the transformation of energy and power.

3.3 UHV Construction is to Serve the Needs of Constructing New Power Systems

As an important path to accelerate the construction of a clean, low-carbon, safe and efficient energy system, the construction of UHV projects is an important "power engine" to implement the new development concept and promote high-quality development, and has a leading, basic and strategic role. In recent years, China's energy and power independent security capability has continued to improve, and a multi-wheel drive energy and power production system has basically formed. Deepen the power supply structure adjustment, and continuously increase the "green content". As a basic project to build a new type of power system, accelerating the construction of UHV power grid project can promote the coordinated development of power grids at all levels, in terms of power transmission, will improve the main network structure in the northwest and northeast regions, and accelerate the construction of Sichuan-Chongqing UHV AC main network to support the safe and efficient operation of cross-regional DC power transmission. In terms of power supply, it will expand and improve the UHV network in North and East China to accelerate the construction of the UHV backbone network in Central China, and build an optimized allocation platform for water, fire, wind, light and other resources to improve the absorption capacity of clean energy.

3.4 The Construction of UHV Projects is the Need to Promote the High-quality Development of Power Grids

The power grid is the hub platform for the optimization of a wide range of energy and electricity, and the construction of new power systems has accelerated, and the form, function and technology of power grids have been comprehensively upgraded. Strong UHV and main network is the basis of high-quality development of power grid, is the construction of power grid "artery". The power grid company continues to improve the grid structure, comprehensively improve the quality and efficiency of power grid development, vigorously promote the high-quality development of power grids, and effectively promote the optimal allocation of power resources across the country. Power grid construction is related to the clean and low-carbon development of energy, the safe and stable operation of the power grid and the optimization of the business environment, is the key to the construction of an energy Internet centered on electricity and the realization of high-quality development, and is the material foundation for the construction of an international leading energy Internet enterprise with Chinese characteristics. Power grid construction is the core business of power grid enterprises and an important link of power grid development. Through the practical exploration of UHV project construction, a power grid construction management system with smooth horizontal coordination, complete vertical penetration, effective system, perfect mechanism, efficient operation and strict assessment should be established, and efforts should be made to improve the lean management level of power grid construction and effectively promote the high-quality development of power grids^[7].

4 Key Measures to Improve the Construction Management System Of UHV Projects

In terms of safety management, consolidate the safety foundation and reduce safety risks from the source. Implement the concept of "big security" and build a three-level security management system. Strengthen safety education and training, and implement full coverage of safety control. Optimize design, materials, construction management, the whole process of risk control, and strengthen hidden danger investigation and anti-violation management.

In terms of quality management, pay close attention to quality, strengthen quality control throughout the whole process, strictly control design quality based on prevention, and optimize the design process. Equipment quality management Establish a standardized system, implement manufacturing supervision and supplier evaluation, refine daily management, optimize installation quality control, and carry out special construction quality improvement activities.

In terms of schedule control, construction period modeling should be carried out to scientifically enable schedule management. Establish a reasonable and unified schedule management system, strengthen the schedule management of construction drawings, strengthen the schedule management of equipment manufacturing, strengthen the schedule management of on-site construction, scientifically formulate a reasonable time limit, and realize the scientific planning of construction timing and the optimal allocation of construction resources.

In terms of cost control, strengthen the whole process of cost control, establish and improve the cost management system, implement the concept of the optimal cost of the whole life cycle, strengthen the quality and efficiency control of settlement, and deepen the process division settlement management.

In terms of technological innovation, we will strengthen scientific and technological breakthroughs to drive technological upgrading through innovation. Focus on breaking through technical problems, independent research and development to ensure the safety of the industrial chain, full scene design technology management to strengthen differentiated design. Equipment all-factor technical management optimize UHV transformer and construction technology, and tackle key technologies of new energy delivery.

In terms of team building, guided by Party building, we will strengthen organizational construction and talent access, and optimize institutional and personnel allocation. The whole process management mechanism ensures that the design, construction and construction teams are standardized and the configuration of the project department is improved. Three-dimensional training mechanism and multiple evaluation improve personnel quality and project management efficiency.

5 Conclusions

This study analyzes the essential characteristics of UHV project construction from multiple perspectives. First, the pressure of resource coordination is large, the preliminary

work of UHV project is complicated, the production cycle is long, the material demand is large and concentrated, and multiple cross-province and cross-region projects need to be carried out in parallel. Second, site construction is difficult, UHV projects often involve remote and complex geographical environments, facing harsh construction conditions and high safety risks; Third, independent innovation requirements are high, UHV projects need a high level of management model innovation and new high-end equipment research and development to adapt to the unknown natural environment and extreme conditions; Fourth, the construction and management mode of the project is unique, and the UHV project emphasizes the owner-led mode, gives play to the overall advantages of the power grid company, and mobilizes the resources and strength of all relevant subjects.

An in-depth analysis of the functions and roles of UHV projects in the new development stage characterized by "large-scale, high-intensity and high-quality". First, to ensure the safe and reliable supply of electricity, UHV technology can realize cross-regional power grid interconnection and effectively deal with sudden power supply problems; The second is to promote the revolution of energy supply, UHV transmission can efficiently transport clean energy from the west to the east, and realize the optimization of energy allocation and layout; Third, to serve the construction of a new power system, UHV projects are an important path to build a clean, low-carbon, safe and efficient energy system, and promote the coordinated development of power grids at all levels; The fourth is to promote the high-quality development of the power grid, UHV and the main grid are the basis for the high-quality development of the power grid, and promote the optimal allocation of power resources.

It systematically analyzes the new situation, new environment and new requirements of UHV project construction, and puts forward the key measures to improve UHV project construction. In terms of safety management, consolidate the safety foundation and reduce safety risks from the source. In terms of quality management, pay close attention to quality, strengthen quality control throughout the whole process, strictly control design quality based on prevention, and optimize the design process. In terms of schedule control, construction period modeling should be carried out to scientifically enable schedule management. In terms of cost control, strengthen the whole process of cost control, establish and improve the cost management system. In terms of technological innovation, we will strengthen scientific and technological breakthroughs to drive technological upgrading through innovation. In terms of team building, guided by Party building, we will strengthen organizational construction and talent access, and optimize institutional and personnel allocation.

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