

DISCUSSION ON A NEW MODEL OF WATER AND ELECTRICITY GENERAL CONTRACTING MANAGEMENT BASED ON TECHNOLOGY LEADERSHIP AND STANDARDS FIRST

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Abstract: With the development of basinization and scale of hydropower project construction, the adoption of the EPC general contracting model for large-scale hydropower project construction is an innovation in the construction model, and it also poses challenges to the general contracting management level of hydropower projects. This article adopts the practice of general contracting management of Yangfanggou Hydropower Station design and construction, adopts the model of a close alliance, strengthens technological innovation and optimization through the integration of design and construction, improves the level of engineering technology, and further improves engineering risk control capabilities and efficiency, in terms of quality and Standardization takes precedence in safe and civilized construction management, and informatization is implemented in the entire process of project construction to improve the informatization level of project construction and operation management, which can provide reference for similar general contracting projects of hydropower projects.

Keywords: Technology integration; Standardization; Unformatization; General contracting; Yangfanggou Hydropower Station

1 PROJECT OVERVIEW

Yangfanggou Hydropower Station is located in Muli County, Liangshan Prefecture, Sichuan Province in the middle reaches of the Yalong River. It is the sixth-level hydropower station in the planned "one reservoir and seven levels" of this river section. The normal water storage level of the power station is 2094m, the corresponding storage capacity is 455.8 million m³, and the installed capacity is 1500MW. The engineering hub consists of major buildings such as a concrete double-curved arch dam, flood discharge and energy dissipation buildings, and a water diversion and power generation system.

Yangfanggou Hydropower Station is my country's first large-scale hydropower project with a million-kilowatt capacity constructed using the design and construction general contracting model. It was built by a consortium composed of China Water Conservancy and Hydropower No. 7 Engineering Co., Ltd. and PowerChina East China Survey and Design Institute Co., Ltd. The project started in January 2016, and the river closure was completed ahead of schedule on November 11, 2016. It is planned that the first unit will generate power in November 2021, and the project will be completed in June 2023.

In more than two years of exploration and practice, Yangfanggou General Contracting Department has fully integrated design and construction technology, focused on design innovation and optimization, put standardization first in quality and safety management, fully utilized the role of informatization in construction management, and provided Useful exploration has been made in innovating the general contracting management of design and construction of large hydropower stations.

2 INTEGRATION OF DESIGN AND CONSTRUCTION TECHNOLOGY

2.1 Ensure Supply of Design Products

The design leader is not only the first person in charge of the design team, but also a team member of the general contracting department. He participates in project management and establishes a platform for good communication between design and construction. As a functional department of the general contracting department, the design management department works under the leadership of the general contracting department, making it easier and faster to contact and communicate with other functional departments[1]. As a work area of the general contracting department, the design representative office closely cooperates with the construction and gives full play to the design skills. Technology leads the way and serves on-site construction.

Since design drawings require approval by the design supervisor before they can be used for construction, the arrangement of the design schedule plays a vital role in the progress of the entire project. The design department hosts monthly meetings, with relevant departments and work areas participating. Based on the annual plan, they discuss the

construction drawing supply plan within the next three months, and the 3-month drawing supply plan will be included in the design department Daily work assessment scope[2]. For projects that are temporarily added or constructed in advance, the design unit must be notified in advance to allow reasonable design time. During the design process of construction drawings for key line projects, the designer communicates with each work area in advance the main content and relevant details in the drawings. The work area can prepare for construction in advance, which will help shorten the construction cycle and ensure the achievement of progress goals.

In the case that some working surfaces fail to meet the progress requirements due to various factors during the construction process, the designer actively participates in the progress analysis and adjustment of the project, and ensures the progress requirements through design changes, construction method changes and other measures approved by the owner.

2.2 The Implementation of Design Intentions is Further Improved

Under the EPC model, design and construction are closely integrated. The general contracting department has established a mutual signing system for design and construction technical documents. All design drawings are countersigned by the general contracting technical management department and relevant work areas before issuance, and the design plan and on-site construction may exist Conflict issues and problems that are inconvenient for construction should be resolved before the drawings are submitted to the supervisor for review to improve the implementability of the design plan[3]. Similarly, the layout of construction branch tunnels, construction plan measures, etc. are also countersigned by the designer to ensure that the temporary construction layout and construction measures can better meet the overall structural requirements of the project and make the layout more reasonable. The design and construction are fully reflected in the determination of technical documents. Integrated advantages.

In terms of on-site design modifications, in response to changes in on-site geological conditions and construction conditions, the designer keeps abreast of changes in on-site conditions, understands the needs during the construction process, and more actively participates in on-site design modifications to address the urgent needs of the project and proactively create new solutions for the construction. favorable conditions.

2.3 Further Improve Project Risk Control Capabilities and Efficiency

Through the mutual signing system of design and construction technical documents, the design plan and construction measures can truly adapt to the actual site conditions and equipment capabilities, making them more effective and operable. Major technical plans adopt a special discussion system, and scientific decisions on technical plans are made through special discussions. Full disclosure of construction drawings and construction technical requirements step by step, coupled with sufficient daily communication, enables the construction team to thoroughly understand the design intent and master the key points of quality and safety control, which is conducive to better control during construction[4].

Establish an integrated working mechanism for dynamic design and construction, closely integrate design with geology, construction, and monitoring, and adopt the concept of "dynamic design and construction" to optimize excavation and support parameters in a timely manner to guide safe and rapid construction. Technical quality risk management and control meetings are organized every week, and countermeasures are proposed based on the quality, safety and risks discovered through geological analysis, safety monitoring, scientific research and on-site supervision in the design, to improve the project risk management and control capabilities and efficiency, and to effectively ensure the technical safety of the project. construction.

3 TECHNOLOGICAL INNOVATION AND OPTIMIZATION

3.1 Pursue Optimal Engineering Value and Overall Project Benefits

Design is the leader in project construction. It is necessary to rationally design hub buildings and electromechanical equipment under specific hydrological, geological and other conditions to meet various requirements for power station operation. Under the EPC model, the contract is a lump sum model, and the design unit plays a more prominent role in project construction and general contract performance.

Under the EPC model, all parties involved in the construction have different focuses due to their own responsibilities and requirements. The owner will put forward high-quality and high-standard requirements for the project without changing the total price; the supervisor will conduct a multi-dimensional review of the functionality, safety, investment, etc. of the design results; the general contractor will control the cost while ensuring quality and safety. Require[5]. This requires the design unit to have more comprehensive and profound technical capabilities and the coordination and communication ability to handle complex relationships. Excellent design must pursue the optimal engineering value and overall project benefits, and must comprehensively balance the optimal realization of multiple goals such as project safety, quality, schedule, operation management, and life cycle costs.

3.2 The Concept of Quota Design Runs Through The Entire Design Process

Design units must always pay attention to the impact of the solution on cost during the product design process. Designers must be familiar with the contract's functional requirements, contract project and project quantity requirements. Each product must be compared with the contract price, and the design limit shall be Put it into practice[6]. The General Contracting Department gives full play to its design technology advantages, and while ensuring that the functions of each part of the project meet the contract requirements and facilitates operation and maintenance, it actively carries out technological innovation and design optimization through the integration of design and construction to enhance the value of the project. Actively think about design optimization, strictly control changes through refined design, and ensure that the total investment is within the limit of the total contract price.

From 2016 to 2017, 23 major optimization items were completed and passed the review, such as the optimization of the arch dam foundation surface and in-depth research on the body structure, in-depth research on flood discharge and energy dissipation facilities, and the optimization of the treatment plan for the collapse and slope accumulation, etc., saving project investment. More than 70 million yuan. Complete construction optimization 10 For items, construction optimization is mainly to improve construction conditions, reduce construction safety risks, improve construction efficiency or ensure construction progress, etc., which is basically the same as the bidding investment[7].

4 STANDARDIZED MANAGEMENT FIRST

Standardization is the establishment of common, reusable rules for repetitive matters in management activities. It includes the process of formulating, publishing and implementing standards. The General Contracting Department comprehensively implements standardization of quality, safety, construction and material management.

4.1 Quality Management Standardization

In accordance with the contract requirements, the general contracting department strengthens internal self-discipline management, and consciously controls project quality during the front-line construction process, so that project quality is more guaranteed. The General Contracting Department actively promotes quality standardization operations. Based on the progress of the project, it formulates standardized documents for main construction processes, and prepares quality process standardization for slope excavation, cavern excavation, mortar anchors, shotcrete, steel bar formwork, and anchor cable construction. Manual; in order to let the standardization results go deep into the front line and be implemented by people, the general contracting project department subdivided the construction process documents into three categories: "construction process standards, construction process manuals, and construction quality understanding cards" for personnel at different levels and different management departments. levels, respectively provided for use by project managers, on-site quality inspectors, and front-line operating workers, so that the key points are highlighted, easy to understand, and convenient for on-site operations. Carry out hierarchical publicity and implementation training on process standardization, fully covering on-site quality management, engineering technology, construction management and other levels of personnel. On-site construction strictly follows standardization requirements, which greatly improves the standardized construction awareness of on-site personnel at all levels and effectively promotes the project Improvement of quality.

The Yangfanggou General Contracting Department has established the first quality management standard demonstration exhibition hall in the domestic hydropower industry, which comprehensively displays quality management system documents, civil and mechanical and electrical construction process quality control standards and standard process exhibits to provide on-site training and benchmarking construction for the project. A dedicated place. By the end of 2017, this project had completed a total of 3,682 unit inspections, with a pass rate of 100% and an excellent and good rate of 96.4% (contract requirement of 85%).

4.2 Safety Management Standardization

Under the general contracting model, the safety management responsibility of the project entity is the responsibility of the general contractor who is directly responsible for production management, and the general contractor's responsibilities are more clear. The general contracting department actively and orderly promotes safety management work, taking advantage of the integration of design and construction in the investigation and rectification of hidden dangers and the planning of special safety measures, and based on the actual situation of the general contracting project, established "one manual", "two plans" and "seven The main line of security management of "account" is implemented more effectively. A safety standardized atlas has been compiled and distributed to each work area, with unified standards for pipeline layout, adjacent protection, safety warnings, temporary facility layout, etc., and the image of safe and civilized construction has been steadily improved.

The first safety facility experience hall in the Yalong River Basin was established to simulate emergency rescue, falling from high altitude, object hitting, electric shock and fire, adjacent instability and other emergency situations, making safety education and training routine and comprehensively improving safety education. In terms of construction, the

general contracting department unified the planning and layout of temporary construction facilities. Temporary construction factories and enterprises such as steel bar factories, formwork factories, and comprehensive warehouses have unified standards, and random private construction is strictly prohibited. Strictly organize and implement production safety standards to ensure on-site production safety since entering the site. Yangfanggou Hydropower Station passed the first-level assessment of power safety production standardization in the first year after the project started.

5 THE WHOLE PROCESS OF PROJECT CONSTRUCTION AND ALL-ROUND INFORMATION MANAGEMENT

The application of informatization in hydropower projects has become a major trend. Efforts to promote the informatization construction and management of hydropower projects will help improve the construction quality and management efficiency of hydropower projects. Under the traditional model, design, construction, and operation and maintenance are separated in the industrial chain, with poor coordination capabilities and the failure to effectively circulate data at each stage, which has greatly hindered the development of information technology. The general contracting model can break industrial fragmentation and realize real-time sharing of information. The Yangfanggou General Contracting Department has established an information platform of "one OA platform + one BIM system", which is of great significance for improving project management efficiency[8].

5.1 Comprehensive Office OA System

The comprehensive office OA system of Yangfanggou General Contracting Department is based on a new management structure and ideas, covering system portal, personal office, information release, comprehensive office, human resources management, correspondence management, drawing management, procurement management, system management, mobile office and other subsystem modules to realize collaborative management and control and mobile office of the general contracting project department. The comprehensive office OA system is mainly for the release and sharing of internal organizational information of the general contracting project department. Each module operates independently according to the division of labor and authority of the department. At present, more than 20 subsystems and modules related to daily management, office, and services are running normally, providing strong information technology means and support for the development of various work on the project site, and greatly improving work efficiency.

5.2 Design and Construction Bim Management System

The General Contracting Department established a BIM management system for the design and construction of the Yangfanggou Hydropower Station. Taking engineering big data management and control as the entry point, the general contracting department used digital means and BIM technology to comprehensively manage and control the project construction progress, quality, investment, and safety information. The functions of the BIM management system The modules include: comprehensive display, design management, quality management, progress investment, video surveillance, safety monitoring, water condition forecasting, intelligent grouting, concrete temperature control, etc. During the construction period of the project, the general contracting department, supervisors and owners all use the BIM management system for construction management, which can effectively realize the visual intelligent management of the project and improve the informatization level of project construction and operation management. The BIM management system uses information technology to collect and save project-related information from the beginning of the project, providing a foundation for the management of the entire project life cycle.

5.3 Quality And Safety Management App

In order to facilitate access to information and quickly deal with quality and safety issues discovered on site, the General Contracting Department developed the "Quality Management APP" and "Safety Management APP". The quality management APP includes functional modules such as quality issue tracking, quality information statistics, quality assessment application, and system standard documents, allowing project participating unit personnel to fully understand project quality management information and quickly handle quality issues on their personal mobile terminals. Improve quality management efficiency and enhance quality management transparency. The safety management APP includes functional modules such as risk identification and assessment, risk investigation and governance, risk process management and control, and system standard documents. It allows personnel from participating units to view the safety risks and control measures of each work surface on their personal mobile terminals, and evaluate the safety risks and control measures found on site. Safety risks are quickly reported, rectified and closed to improve safety management efficiency.

This project is one of the first batch of pilot projects of the State Grid's pumped hydro energy storage project. The smooth performance of the contract is of great significance to State Grid Co., Ltd., Power Construction Corporation of

China, and the entire pumped hydro energy storage engineering field. The project has just started construction. How to improve the performance model of EPC projects is still a research topic with a long way to go. It is also necessary to continuously improve and summarize the results of project performance and problems that arise during the process to provide more experience for the development of the EPC model of engineering construction.

6 CONCLUSION

The engineering EPC general contracting model is the development direction of construction project management. The core of EPC general contracting is the integration of design and construction. The Yangfanggou Hydropower Station adopts the EPC construction management model, which is the first time that my country's large-scale hydropower projects with a million-kilowatt capacity are constructed using the EPC construction management model. It is a major change in the concepts and methods of hydropower development, traditional construction systems and management models under my country's new normal. Innovation.

Through the integration of design and construction technology, Yangfanggou General Contracting Department strengthened technological innovation and optimization, improved the level of engineering technology, and further improved the implementation of design intentions and the level of engineering risk control. Standardization takes precedence in quality and safety and civilized construction management, which greatly improves the standardized construction awareness of personnel at all levels on site, ensures the quality of the project, and enhances the image of safe and civilized construction of the project; during the construction period, all parties involved in the project use the BIM management system. Construction management implements informatization in the entire process of project construction, comprehensively improving the informatization level and management efficiency of project construction. The practical exploration of general contracting management of Yangfanggou Hydropower Station can provide reference for similar projects.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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