Practice of Risk Management and Control in Technical Transformation Project of Coal Handling System

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Abstract: As an important auxiliary equipment of coal-fired generating units, the coal handling system has become the main means to improve the economy of coal-fired generating units and the level of energy saving and environmental protection of the coal handling system by upgrading the system or equipment technology. This paper mainly discusses how to effectively analyze, identify, manage and control the risks of safety, quality and progress in the implementation process of the technical transformation project of coal handling system, and summarizes the operational risk management and control countermeasures and concepts, in order to provide management reference for related enterprises and similar projects.

Keywords: Coal-Fired Power Generation; Coal Handling System; Technical Transformation Project; Risk Identification; Risk Management and Control

1. Introduction

1.1 Research Background

As the core link connecting the coal mine and the boiler, the coal handling system plays an important role in the fuel supply of coal-fired generating units. The dust and water pollution produced by the coal handling system in the process of raw coal handling, storage and transportation are the main pollution emissions of coal-fired generating units. With the continuous strengthening of national energy-saving and environmental protection policies and the increasing demand for efficiency improvement of coal-fired generating units, the technical transformation of coal handling system has become a necessary way to improve production efficiency, reduce energy consumption and reduce pollution emissions of coal-fired generating units. The technical transformation project of coal handling system (hereinafter referred to as the technical transformation project) faces many risks in the implementation process due to the harsh and complex working environment, covering many specialties such as machinery, water, electric control, etc., the uneven scale of the project, and the implementation period from several days to many years.

How to effectively manage and control safety, quality, progress and other risk factors at all stages of the implementation process of the technical transformation project to ensure the safety, high quality and planned progress of the technical transformation project has become the key to the success of the project.

1.2 A Review of Domestic and Foreign Research

1.2.1 Research status of risk management and control

Risk identification and assessment methods include quantitative and qualitative methods. Due to the different emphasis of risk assessment, there are many types of methods and their applications are more mature. Xu et al. (2024) This paper reviews the risk theories, methods and models in different disciplines, compares the origins, connections and differences of risk concept research in modern risk science and other disciplines, clarifies the differences of risk understanding and assessment in different disciplines, and provides a basis for future interdisciplinary cooperation.[1] Risk assessment is to identify and analyze events that may affect individuals, assets, processes, and the environment, and make management decisions based on risk analysis. Qualitative analysis focuses on the

identification of risks and necessary controls that require detailed analysis, while quantitative analysis attempts to assign objective numerical or measurable values to the components of risk assessment and potential loss[2].

Risk countermeasure is an important practical content in risk assessment research, and the rationality and feasibility of countermeasure formulation are directly related to the practical significance of research results. Li et al. (2019) revealed the interdependence and influence strength of different risk factors through the ISM hierarchical structure model, provided risk mitigation strategies for thermal power plants, and had practical guiding significance for understanding and improving the safety management of thermal power plants.[3] With the rapid development of power market, safety production has become the key foundation for the stable operation and market competitiveness of enterprises. A comprehensive study of safety production management strategy will help to enhance the reliability of equipment, enhance the safety awareness of employees, and promote the sustainable development of enterprises.[4] Risk is a complex and multifaceted concept, which has different definitions and approaches in different disciplines. Measures such as strengthening the safety training of outsourcing personnel, implementing the post safety responsibility system, standardizing the safety management system and improving the power safety supervision system can improve the safety production management level of power enterprises, reduce the occurrence of safety accidents, and ensure the safety of life and property of personnel[5]. Kulembayeva et al. (2022) found that increasing the number of projects of a single type can improve profits, proposed a methodology to evaluate the effectiveness of outsourcing business models, and linked strategic objectives with business models in the process of realization. The uncertainty of economic policy is the key factor for enterprises to adopt labor outsourcing.[6]

1.2.2 Research review

At present, the research on risk identification, evaluation and countermeasures has achieved remarkable results in the fields of power engineering equipment maintenance and technical transformation, which provides important support for related risk management. Risk identification and evaluation methods are rich and mature, such as risk matrix, analytic hierarchy process, fuzzy mathematics comprehensive evaluation method, etc., which can comprehensively and accurately identify and evaluate risks and provide a strong basis for management decisions. Risk countermeasure research focuses on practice, and the strategy formulated is reasonable and feasible, which is of great significance to improve the level of safety production management and enhance market competitiveness of power enterprises.

However, although there are many risk assessment methods, in the face of complex and changeable power engineering environment, a single method may be difficult to assess the risk comprehensively and accurately, and further optimization and combination or innovation of methods are needed. In the study of risk countermeasures, some strategies are not closely combined with theory and practice, resulting in a discount in the implementation effect, so it is necessary to strengthen the application research.

2. Characteristics and Risks of Technical Transformation Project

2.1 Characteristics of Technical Transformation Project

The technical transformation project of coal-fired generating units generally refers to the technical upgrading of the existing coal handling system and equipment, the improvement and replacement of equipment and facilities, in order to improve the operation efficiency, safety and reliability of the system or equipment, reduce environmental pollution, and eliminate safety risks or hidden dangers. From a project management perspective, key features include:

The technical complexity of the system or equipment is strong. The technical transformation of coal handling system involves many links, including the technical updating and equipment replacement of coal handling equipment (such as conveyor belt, elevator), automatic control system, environmental protection facilities, etc.

The scale of the project is uneven and the coverage span is large. Technical transformation projects vary in scale according

to the scope of transformation, ranging from the transformation of a unit of equipment to the optimization and upgrading of a system.

The implementation of the project is difficult and the management process is cumbersome. Technical transformation projects usually need to be completed without affecting the normal production of coal-fired generating units, and need to coordinate multiple departments and links in the implementation process, which is difficult to manage and inefficient.

2.2 Main Risks Faced by Technical Transformation Project

After the technical transformation project enters the implementation stage after the preliminary feasibility study, implementation plan formulation and equipment procurement, the project department or the owner generally only pays attention to the safety, quality and progress risks in the process of project implementation.[7]

Risk of security implementation. In the construction process of the technical transformation project, there are many links such as equipment removal, installation, commissioning and so on, which have certain potential safety hazards and may lead to casualties, equipment damage and so on.

Risk of process quality. Process quality problems may occur in many links of technical transformation projects, such as design, manufacture, installation and commissioning, which directly affect the implementation effect of the project, and even lead to project failure.

Risk of progress control. According to the scale and scope of influence of technological transformation projects, the implementation cycle span is large, from a few days to a year. In the actual implementation process, it is often affected by many factors, resulting in uncontrollable or difficult to control the progress.[8]

3. Safety Risk Identification and Control of Technical Transformation Project

3.1 Analysis and Identification of Safety Risks

Safety production has a veto power in China's electric power construction projects, and safety risk is the most important risk in technical transformation projects. Effective analysis and identification of security risks is the premise of risk management and control.[9] Common measures include:

Safety analysis at the beginning of the project. Before the start of the project, organize relevant personnel to systematically analyze the potential safety hazards that may arise during the implementation of the project and identify the possible sources of safety risks.

Develop a list of security risks. According to the assessment results, prepare the safety risk list, list the types of safety accidents that may occur during the implementation of the project, and assess the probability and impact of various accidents.[10]

Research and draw lessons from industry experience. Actively investigate the safety management experience of the same industry, the same type or brother units, analyze the causes of safety accidents in past projects, and prevent the occurrence of similar problems.

3.2 Management and Control of Security Risks

Continuously strengthen safety training and education. Carry out strict safety training and education for members of the project department regularly to ensure that all personnel have sufficient safety operation rules and understand the potential safety risks and hidden dangers in construction.[11]

Strict safety construction plan preparation and approval process. Formulate a detailed construction safety plan, clarify the safety measures in the construction process, and ensure that each measure is effectively implemented.

Normalized safety supervision and guardianship. Establish the safety supervision and monitoring mechanism in the implementation process, and arrange part-time or full-time safety officers to carry out daily supervision and monitoring on the construction site[12]? Ensure that safety measures are in place.

4. Quality Risk Identification and Control of Technical Transformation Project

4.1 Quality Risk Analysis and Identification

Construction quality risk is directly related to the smooth implementation of technical transformation projects and the effective landing of technology and equipment. In the implementation stage, because the

corresponding technology and equipment have landed, it is necessary to focus on the control of the process quality of installation and commissioning. Effective quality risk identification methods include:

Formulate the quality standards for the acceptance of parts and sub-items. Analyze and disassemble each construction process, list each construction node in time or space order, and formulate quality standards for each construction node. Through the formulation of quality standards for each link in the construction process, possible quality problems can be anticipated in advance.

Set quality inspection points for key processes. The essence of establishing quality inspection points is the control of process quality. During the implementation of quality inspection points, through multiple witness and acceptance, process quality problems can be effectively found and related management risks can be avoided.

Carry out the work of looking back, re-inspection and re-acceptance. In view of the problems arising in the process of project implementation, the project should be checked and accepted again, so as to achieve closed-loop management of past quality problems and further identify potential risks.

4.2 Quality Risk Management and Control

Conventional quality risk control measures are more standard and normalized, and some measures with better implementation effect can be used for reference:

Formulate safety, technical, organizational and environmental protection measures. The safety technical organization measures can be compiled and approved by the Owner according to the actual situation of the construction area and equipment and facilities, project management regulations and previous project management experience on the basis of the four measures and two schemes (safety, technology, organization, environmental protection measures and construction scheme, environmental protection scheme) of the construction party. It is necessary to clarify that the implementation of the measures and the main responsibility are the Owner.[13]

Quality inspection point and multi-level acceptance. In view of the key nodes or processes of the project, especially the concealed works, it is necessary to set up quality inspection points and carry out multi-level acceptance, so as to realize the direct control of quality by multi-level management departments.[14]

Establish a closed-loop management account for quality problems. The problems found during construction and acceptance generally need to be checked and corrected immediately. However, in some non-urgent quality problems with the possibility of follow-up rectification, pre-control measures can be taken and included in the rectification plan, the completion time and the responsible party can be clearly defined, and closed-loop management can be carried out in the form of accounts.

5. Risk Identification and Control of Technical Transformation Project Progress

5.1 Analysis and Identification of Progress Risk

The progress risk in the implementation of technical transformation projects generally refers to the delay of the construction plan caused by the failure of a certain node or the whole project to be completed on schedule. For the coal handling system, schedule risk is the most difficult and flexible risk to grasp. As one of the auxiliary systems of coal-fired generating units, the coal handling system is a general auxiliary equipment, which is rarely carried out simultaneously with the major and minor repairs of the unit, resulting in a certain degree of standby reliability of the coal handling system during technical transformation or maintenance.[15] The construction plan of the technical transformation project should be strictly coordinated with the operation of the unit, and it is necessary to ensure that the standby can be restored quickly, so the schedule risk often exists in the technical transformation project.

Coal-fired generating units are often designed with raw coal bunkers, which can ensure fuel supply for 2 to 4 hours only by storing coal in raw coal bunkers even at the highest load of the unit. It can be seen that on the premise of ensuring a certain reserve of raw coal bunker, the technical transformation project that directly affects the operation of coal handling system can also "stop as soon as it is dry", and the actual construction period can be shortened at the expense of construction efficiency.

5.2 Management and Control of Progress Risk

In the field of management and engineering practice, schedule management has standard management means and methods to follow.[16] Because the control of progress risk in the implementation process is often full of uncertainty, it is basically impossible to achieve the desired results through one or several methods or standards for progress management. The practical and feasible concepts of schedule risk management and control are as follows:

The opinions of the system or equipment user department shall be taken into account when formulating the construction period plan, and the project department shall be led by the user department in the construction period management[17], so as to strive for the construction window as much as possible, especially when there is the possibility of emergency recovery during the construction period.

The principle of "point, line and surface" should be followed in the allocation of construction resources. "Point" refers to a basic operation unit, including the minimum personnel, materials and management resources necessary for a process; "Line" refers to a basic operation process composed of multiple "points"; "Surface" refers to an operation process or working surface that must be carried out simultaneously to complete a project. When implementing the project, we should ensure more "points", normalize more "lines" and achieve more "faces".

In the management of construction period, performance management should be carried out appropriately, assessment or reward should be carried out according to the process, and the reward should be emphasized while the assessment should be neglected, so as to stimulate the enthusiasm of the construction party and reduce the negative impact as far as possible.

6. Conclusion

Through scientific risk analysis and identification, the implementation of practical management concepts and the improvement of risk management and control measures can effectively reduce the impact of related risks on technological transformation projects. In the practice of technological transformation project management, we should continue to strengthen the overall management of safety, quality and progress to ensure that the technological transformation project can be completed with high quality as planned while controlling risks.

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