

# ***Risk Control Analysis in Electric Power Engineering Project Management***

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**Abstract:** With the development of social economy, the number and scale of electric power construction projects are increasing. Their contents are changing from "single" in the past to "diversified" at present. And the contents of project management are constantly being improved and updated. The function and structure of the electric power construction project in China are relatively complex, involving many factors. There are certain risks in safety, quality, investment, construction period and operating benefit. How to better solve the problems existing in the actual operation process and how to better manage power companies and improve the efficiency and economy of power company projects are the key issues that need to be considered. In order to ensure the economic and social benefits of electric power projects, improve their engineering quality, the project managers must analyze various possible risk factors in time during the construction of electric power projects, and take effective measures to minimize the risks.

**Keywords:** power engineering, project management, risk control

## **1. Introduction**

With the progress and development of society and the overall improvement of people's living standard, the demand for electricity is further increased, which poses a certain challenge to the power system, and also requires relevant enterprises to actively follow the trend of revolution, actively adapt to the reform and change, and carry out innovative development. In recent years, the changes of power system are obvious to all. However, because of the long construction period, high technical requirements and many uncertain factors, there are many risk factors [1]. In the project management such as project duration and cost management, which will inevitably lead to a series of failures, problems and troubles, especially in risk control. In order to let decision-makers of power engineering project management risk control better understand the current situation and future development direction of the industry, so as to better use the knowledge learned in the future work to improve the work of power engineering project management risk control, this paper analyzes the nature, analysis methods, existing problems, and recommended solutions of power engineering project management risk control. This paper first makes a brief introduction to the project management and risk control of electric power engineering, summarizes its nature and characteristics and other theoretical content. Then analyzes the factors and analysis methods that need to be emphatically considered in the current project management and risk control of electric power engineering. Finally, it points out the problems reflected in the current situation of the project management and risk control of electric power

engineering, and then puts forward corresponding solutions and suggestions for these shortcomings and problems.

## **2. Overview of Power Engineering Project Management and Risk Control**

In order to have a more intuitive understanding of the content of risk control of power engineering project management, we will briefly review the basic definition and connotation of power engineering project management and risk control, as follows.

### **2.1. Introduction to Project Management**

In fact, project management is a process of strict supervision and arrangement from the beginning of investment to the final acceptance of the project. It is a process of strict control of cost, quality and construction period. It is a process of low cost, good quality and short construction period. In concrete construction, it is necessary for project management to run through every detail and every key point of the construction. The management of the project should be implemented and supervised in time, which is the basis to ensure the successful completion of the project and the good control of project risks. Project management runs through the whole process of electric power engineering from the early investment decision-making to the end of the later project. Its basic elements include construction safety, quality, investment and time limit [2], which are aiming at using existing resources to achieve the goals of low investment cost, safety and security, good engineering quality and short construction period. In order to achieve the above objectives, the managers of related projects need to strictly control and manage various unpredictable influencing factors that will occur in the process of project implementation, such as environmental factors, geological factors, financial factors, human factors, technical factors, meteorological factors and so on, which will run through the project all the time [3].

### **2.2. Introduction to Risk Control**

Risk control is to make use of various resources and materials to predict the possible influencing factors during the operation of the project and formulate solutions. Comprehensively consider the environmental factors, technical factors and financial factors during the project, and then effectively control the construction period, cost and quality. So as to ensure the smooth progress of the project, maximize the benefits of the project and minimize the risks.

According to the time stage, the risks of engineering projects can be divided into investment and project establishment risks before construction, construction risks during implementation, and delivery and operation risks after construction. According to the project objectives, the risks of electric power construction projects can be divided into safety control risks, investment control risks, project quality risks and construction period risks; According to the actors of the project, we can attribute the risks that will occur in the process of project construction to the risks brought by the investment unit, the risks brought by the design unit, and the risks among the construction unit, the construction party and the users[4]. As far as project management is concerned, risk control plays a very important role. Focusing on the risk sources, it makes full use of information resources in the process of project construction, and further accurately analyzes and screens out management organization and technical risks including social environment, engineering geology, capital investment, personal behavior, technical level, meteorological weather and so on. Based on this, project managers can take different treatment measures and solutions for different risks, reduce the possibility of risks, and even avoid them [5].

### **3. Risk Control Content in Power Engineering Project Management**

In this chapter, we will first introduce the three stages of the conventional risk control procedure, and then introduce the three most common risk controls for power project management risk control, namely, quality risk control, schedule risk control, and cost risk control, as follows.

#### **3.1. Basic Procedures for Risk Control**

In view of the characteristics of large-scale, long investment cycle, wide sources of risks, and difficulty in risk control of power engineering projects, and to maintain its effectiveness, it is necessary to ensure that the operator for risk control in the process of project management should not only have a good understanding of the risk itself, but also understand the basic procedures of risk control. To make risk control work orderly, the first stage is risk analysis. The first step is data collection, which requires completed before the official start of the project, mainly collecting all data and information related to the project, including the project plan, execution book, etc. Then compared with similar projects, analysis and data statistics [6]; The second is to establish a risk analysis model, quantitatively analyze the possible risks of each project and their probability, determine the corresponding parameters and weights, and determine the risk and its probability through model analysis [7]. According to the results of model analysis, a conclusion is drawn, and the value and risk of the project are evaluated at the same time. The specific methods can be analytic hierarchy process (AHP), image map method, etc.

#### **3.2. Quality Risk Control**

Different from the risk management of other construction projects, the power project management should not only refer to the quality acceptance standards of general construction projects, but also combine with the relevant industry norms of the power industry. For example, in order to facilitate the construction of later electrical installation projects, the coordination between substation civil engineering and electricity should be considered [8]. Before the power installation and cable laying construction activities are carried out, it needs to be compared with the drawing size and physical size. In addition, for the building part, we should pay attention to the reasonable overall arrangement of retaining walls, structural supports and other construction parts, and pay attention to the requirements of the construction period. For electric power engineering, it is also necessary to realize "six-oriented" management, that is, clear work objectives, standardize work contents, streamline work steps, format work records, normalize work behaviors and normalize work improvement [9]. Ensure civilized construction of power engineering projects, do not cut corners, formulate clear acceptance standards for all links of quality acceptance, and strictly control project quality risks.

#### **3.3. Duration Risk Control**

Progress risk control is a problem that must be paid attention to in any project management, especially in electric power engineering, because of its huge scale, and long investment period, and there are many links involved from project initiation to completion. If we want to control the progress of the project within a reasonable range, we must first resort to scientific management methods and analytical techniques for thorough and systematical analysis. At the same time, formulate corresponding countermeasures for potential risk factors that may affect the progress and deal with them, so as to ensure that the power engineering project can be completed on schedule. Specifically, in the process of power engineering project management, it is necessary to strictly supervise the construction plan of the project, and formulate the project construction plan before the project is established, so that the whole project can be implemented within the scope of the construction plan

[10]. In addition, in order to further strengthen the risk management of the construction period, managers also need to attach importance to the application of network technology and strengthen the risk management.

### **3.4. Cost Risk Control**

First of all, in terms of contracts, the cost risk shall be controlled to the minimum and the countermeasures shall be implemented in the specific environment on the premise of ensuring the performance of the contract. For project managers, we must pay attention to the management of business dealings and the division of responsibilities, and don't blindly sign documents and materials to avoid risks. Every document should be supported by a reliable basis.

Secondly, in visa application, we should pay attention to management norms, implement measures in time, and avoid power imbalance; Any problems related to the major interests of the construction unit must be written in black and white, and the visa method should be clear. In short, we should follow the three principles of cost risk control: low bid, high visa and high settlement.

Thirdly, we should pay attention to process settlement in settlement, avoid the financial pressure brought by the delay of settlement, and fully reflect the time value of funds [11]; In addition, managers should also pay more attention to the data collection in the construction process, put the intermediate settlement and phased settlement in place, standardize the accounts receivable management procedures, and recover the current payment in time.

Finally, in terms of data management, we should standardize the time limit data to reduce the possibility of time limit claim disputes. According to the contents of the contract, for the delay of the construction period caused by force majeure, the corresponding visa work should be done well. At the same time, the data management should be strengthened to avoid the losses caused by the claim for the construction period.

## **4. Current Situation of Risk Control in Power Engineering Project Management**

Next, we will introduce the current situation of the risk control of power engineering project management, as well as the existing problems and drawbacks, which can be classified into three major problems, namely, the ignorance of the importance of project management, the lack of management information, and the lack of risk control and pre control measures, as shown below.

### **4.1. Neglected the Importance of Project Management**

Influenced by traditional ideas, many managers have been using simple management methods in the process of project management, which greatly weakens the implementation of project management. Due to the imperfect management system, the project site is in chaos, which is not conducive to the smooth implementation of the project construction. At present, the construction of electric power projects in China mainly relies on some advanced ideas and management experiences from abroad. Due to the differences in geographical conditions, natural environment, human factors and other aspects, some management systems are not suitable for the management of electric power projects in China, and some systems appear contradictions and repetitions in the implementation process. Combining with the actual situation of China, perfecting the project management system and formulating an effective management mechanism in the specific project construction process can reduce the occurrence of project risk problems [12].

## **4.2. Low Management Informatization Level**

With the improvement of science and technology, the informatization level of various industries has made progress, and the traditional power engineering project management information platform restricts the modern management of power engineering to a great extent. Because the management mode is too single, the scope involved is limited, and the information management platform among various functional departments is independent, which can't meet the requirements of comprehensive management of power engineering projects. These problems existing in power engineering project management can't be found in time, which makes the power engineering project management more difficult [13].

## **4.3. Inadequate Risk Analysis and PRE-control**

In the past, the risk events such as casualties and equipment safety accidents occurred in the process of power engineering project management, to a great extent, reflected the deficiencies of power engineering project management. The managers of power engineering projects did not do a good job in on-site management, their functional responsibilities were not in place. They did not carefully check and analyze the existing personnel risks, environmental risks, equipment risks and other factors in combination with the current project construction situation. They did not actively carry out targeted risk assessment, and the implementation of pre-control measures was not in place [14].

## **5. Suggestions on Risk Control in Power Engineering Project Management**

In order to improve the above common problems in risk control of power engineering project management, this paper puts forward five different suggestions. They are timely collecting all kinds of information and data generated in the process of project management, establishing risk evaluation index systems, establishing risk early warning models, formulating appropriate pre-control, emergency and rescue plans, and adopting institutionalized management methods. The details are as follows.

### **5.1. Collect Information and Data Generated in the Process of Power Project Management in Time**

From the above analysis of the content of risk control in power engineering projects, it can be seen that there are not only many types of risks, but also close interaction among different risks. Any problems in risk control management will bring unpredictable losses to the project. In view of this situation, in the process of risk management of power engineering projects, we should first collect all kinds of information and data generated in the process of project management in time. Then use the correlation analysis method of big data to predict possible risk problems in advance, so as to lay the foundation for risk control. For example, the total installed capacity of a power engineering project is 2×600MW, and the total investment scale is 5,058.57 million yuan, of which the registered capital of the project accounts for 20% and the bank loan accounts for 80%. The construction period is 2 years, so it is necessary to know the progress of the project and the implementation of the cost plan at any time during the project. Comprehensively collect geological survey data, technical index data and cost data related to the project. Then, the information software is used to analyze and process the data, and the information related to the project risk control is extracted for the reference of risk managers [15].

### **5.2. Constructing Risk Evaluation Index System**

In the process of risk management of power engineering projects, based on comprehensive collection

of relevant engineering data, a risk evaluation index system should be established to evaluate the project risks qualitatively and quantitatively. The entropy weight model, fuzzy matter-element model, etc., combined with expert evaluation methods, can be used to formulate a scientific risk evaluation index system. The evaluation index system should meet the requirements of comprehensiveness, systematizations, refinement and measurability. Taking the quality risk evaluation index system of the above-mentioned project as an example, in the process of construction, key quality indexes can be extracted from three dimensions. The quality of project design, project construction and project acceptance respectively [16]. Among them, the project design quality indicators mainly include design drawing review rate, engineering quality supervision degree, quality inspection qualified rate, etc. Construction quality indicators mainly include repair rate, good visual rate, spot check rate of physical projects, and the incidence of major quality accidents. The project acceptance indicators include the first acceptance rate, the acceptance rate after treatment, the quality complaint rate, etc. The above indicators include both positive indicators and reverse indicators. After determining the indicators, it is necessary to use expert evaluation method to empower them, and then carry out quality risk evaluation. The results of the quality risk assessment of the above projects are shown in Table 1 .

Table 1: Project quality risk assessment results [17].

Level I indicators	Level II indicators	Evaluation results	Remarks
	Quality supervision degree	99	Positive indicators
Design quality index	Review rate of design drawings	92	Positive indicators
	Inspection qualification rate	90	Positive indicators
	Repair rate	4	Reverse Indicators
	Good appearance quality rate	60	Positive indicators
Construction quality index	Spot check rate	70	Positive indicators
	Major quality accident rate	2	Reverse Indicators
	First time acceptance rate	95	Positive indicators
Acceptance quality index	Acceptance rate after treatment	10	Positive indicators
	Quality complaint rate	3	Reverse Indicators
	Award winning project rate	5	Positive indicators

### 5.3. Adopting Early Risk Warning Model Analysis Model Method

After the above method is adopted to determine the risk control index of power engineering, a risk early warning model can be established. Risk prediction and evaluation activities can be carried out by combining the collected engineering data [18]. In the application process of the above index system, it is necessary to standardize the actual values of each index, so as to avoid the influence of



dimensional units on risk assessment. Specifically, the data normalization method can be used to normalize the forward index and the reverse index respectively. After standardization, the evaluation value of the actual model is obtained. In order to get the final quantitative evaluation results, it is necessary to assign weights to all levels of indicators. Taking the quality risk management of electric power engineering as an example, the entropy weight method is used for weighting, and the weighted results are shown in Table 2. Then bring in the actual engineering data to evaluate the risk problems existing in power engineering.

Table 2: Calculation results of quality risk control indicators based on entropy weight method [19].

Level I indicators	Weight	Level II indicators	Weight
		Quality supervision degree	0.0871
Design quality index	0.2623	Review rate of design drawings	0.0875
		Inspection qualification rate	0.0877
		Repair rate	0.0871
Construction quality index	0.3630	Good appearance quality rate	0.0901
		Spot check rate	0.0892
		Major quality accident rate	0.0966
		First time acceptance rate	0.0873
Acceptance quality index	0.3747	Acceptance rate after treatment	0.0975
		Quality complaint rate	0.0910
		Award winning project rate	0.0989

## 5.4. Actively Control Risk and Actively Deal with Negative Impacts of Risks

### 5.4.1. Formulate PRE-control Plan

The pre-control plan is the pre-control measures before the occurrence of risk accidents or events, and the active control measures. The feed forward measures can effectively control and resolve risks and effectively prevent accidents and events from occurring. We should make full use of the "stone from other mountains", that is, make use of the existing accident cases and lessons, as well as the summarized lessons, measures, schemes, regulations and specifications. And prepare risk control strategies, schemes and measures based on the proposed power construction projects and implement them in every link of the construction process, so as to control the risks.

### 5.4.2. Formulate Emergency Plan

The emergency plan plays a very important role when the risk occurs. It is necessary to do a good job of early risk warning and response, create an efficient and capable rescue team, store corresponding emergency materials, organize periodic drills regularly. Then continuously improve the emergency plan. In fact, not all risks need to adopt contingency plans, mainly for the risks that have reached a certain level confirmed by risk assessment, so as to make the corresponding contingency plans more enforceable and targeted [20].

### 5.4.3. Formulate Rescue Plan

Making appropriate rescue plan can minimize all kinds of losses caused by risks or gradually restore damaged equipment to the best use condition. Generally speaking, the rescue plan cannot be formulated in advance, which is because we can't predict the damaged position and its degree before

the risk accident, so we can't formulate a specific plan. What we can do is only starting the emergency plan and then supplement it according to the corresponding disposal principle. It can be seen that the rescue plan can be used as an auxiliary plan of the emergency plan [21].

### 5.5. Enhance the Implementation of Risk Control

By adopting the above methods, we can comprehensively find out the risk problems existing in the power engineering project management. And then take corresponding control measures to eliminate the actual risks of the project in the embryonic stage. In this respect, it is necessary to strengthen the implementation of project management risk control, adopt institutionalized management methods, and implement supervision and rectification responsibilities. It can be linked with the performance appraisal of project management personnel, formulate corresponding reward and punishment measures. And then stimulate the initiative of personnel management, so as to ensure the effective implementation of various risk control measures.

## 6. Conclusion

To sum up, this paper introduces the basic characteristics and meanings of power engineering project management and risk control. The paper analyzes the important factors and analysis methods in current power engineering project management and risk control, points out the problems existing in the current situation of power engineering project management and risk control, and puts forward the author's personal solutions and suggestions.

Power project management is a long-term and systematic project. It is necessary to constantly analyze the causes of risk problems and take scientific and reasonable countermeasures to improve risk management and reduce the formation of accidents and losses. During the development of electric power enterprises, it is necessary to strengthen risk management, establish and improve risk management systems and schedules, set up professional risk management teams, enhance the effectiveness of risk management of electric power projects, improve the quality of engineering construction, and further improve the economic benefits of electric power enterprises.

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