



Application of Risk Identification in the Safety Production of Electric Power Enterprises

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Abstract: With the continuous maturation and application of electric power technology, the electric power system is gradually evolving towards a larger grid, ultra-high voltage, larger units, and increased intelligence. The structure and operation of the power grid are becoming increasingly complex, with interconnectedness at all levels. Even a minor fault in the production process of power enterprises can result in numerous safety accidents and extensive power outages, significantly impeding social and economic development. Given the pivotal role of the power industry and the criticality of grid reliability, it is imperative to enhance safety management in power supply enterprises.

Addressing this issue requires proactive measures to prevent and mitigate power production accidents, minimize safety risks, and reduce the occurrence of grid failures. This research focuses on the safety production risk management of electric power enterprises, exploring the application of risk management theory in the production, transmission, and distribution of electric power. The first step in power engineering safety risk management is to accurately and comprehensively identify risk factors. Only by effectively identifying these factors can risks be analyzed and controlled appropriately. This paper emphasizes the identification of production safety risks in electric power enterprises, employing a literature research method and expert interviews to identify risks in the field of safety production within the electric power engineering sector. The study evaluates potential risks in the operational processes of real-world power enterprises and describes methods for safety risk assessment and control in the electric power industry. The findings hold substantial theoretical significance and practical value for the future development of the power system.

Keywords: Power Engineering, Risk Management, Risk identification, Safety risk identification

Introduction

China is the world's second largest economic country, economic development must need energy strong support. Electric power is an indispensable clean energy in modern life, and it has naturally become a key basic industry in the national economy and occupies an important seat in the development of the national economy. As a pillar industry related to national security and the pulse of the national economy, the electric power industry undertakes the basic mission of providing safe, economic, clean and sustainable power supply for social and economic development. With the improvement of people's production and living standards and the continuous progress of social civilization, the development of national economy and the improvement of social life on the power industry requirements and dependence more and more. It is the basic requirement of modern society to provide users with sustainable electric energy with safe and high quality.

Electric power engineering is related to the production, transmission and distribution of electric energy. The safety risk of power engineering refers to the hidden danger and threat brought by various events or factors during the production, transmission and distribution of electric energy to the operation of power engineering and the power supply of users. In order to ensure the safe production of electric power and the stable and orderly operation of electric power system, it is necessary to establish and perfect the safe production management mode of electric power enterprises driven by risk control^[1]. It is necessary to give full play to the leading role of risk management and control, strengthen the ability to comprehensively manage and control technical, personnel, environmental and management risks, and eliminate or reduce security risks^[2].

Electric power safety concerns people's livelihood, is the starting point of all production and management work and foothold. This is a prerequisite for the pursuit of corporate profits and sustainable development^[3]. Effective safety risk management is the necessary means and strong guarantee to strengthen the safety foundation. Although in the power enterprise management process, always take safety production as the first priority. However, in the safety management of power engineering, there are still problems of imperfect management system and weak awareness of risk management.

This paper takes the safety production risk management of electric power enterprises as the research object, and focuses on the operation link for power supply enterprises. Design a risk management identification method for power production process suitable for power supply enterprises. In order to improve the power supply enterprise's power

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production safety risk identification ability, the paper makes an in-depth research on the safety risk identification of electric power enterprises. It provides the foundation for enterprise risk analysis and risk control.

Literature Review

Farmer first proposed quantitative risk identification method in 1967. In 1974, the United States Atomic Energy Commission identified and assessed the accident risk of commercial atomic power plants [4-7]. Later, the Netherlands Institute of Nutrition Science, Japan Institute of Safety Engineering, University of Ontario, Canada and other institutions have carried out risk identification studies [8-10]. Although a systematic and complete risk identification management system theory has not been created in China, many methods and experiences to reduce risk sources have been summarized in long-term production practice. Expert interview method is the main risk identification method at present, which can analyze and judge the results qualitatively. Qualitative analysis and evaluation involve a large number of human factors, so special attention should be paid to the selection of expert members, standardized expert investigation process, scientific summary, analysis and summary of the investigation results. In view of the special status and safety situation of electric power industry enterprises, the relevant state departments have issued relevant regulations and laws and regulations, mainly "electric power safety work regulations", "electric power production accident investigation regulations" and "25 key requirements to prevent major accidents in Electric Power production", "Safety evaluation" and so on. These policies and suggestions are the important theoretical basis for safety management risk identification of electric power industry enterprises. In addition, the pre-control measures of dangerous points in electric power enterprises also provide an effective basis for the identification, prediction and control of the locations, parts, places, appliances or actions that may occur in electric power enterprises [11-14]. Risk is often also an opportunity for enterprise development [15]. Although the research and application of risk management in China is moving towards a new stage of development, it still focuses on theoretical research and data analysis, and there is a lack of systematization. The practice and application of safety risk management in electric power enterprises is not systematic and comprehensive, and it needs to be further improved and improved. The risk management awareness of enterprise managers still needs to be further improved.

Due to the continuous expansion and development of power grid scale, the task of power grid construction and upgrading is more and more heavy, and the problem of safety risk control in the on-site operation of power enterprises is more prominent and urgent. The key to the safety control of electric power enterprises lies in the identification and prevention of risks. Therefore, it is necessary to scientifically and comprehensively identify all kinds of risks that may exist in field operations in view of power production, transmission and distribution. This provides a basis for formulating prevention and control measures to deal with the occurrence of risks, effectively preventing the occurrence of risks, and ensuring operation safety.

Basic concepts of risk management

Risk is the chance that a potential loss becomes a reality (the possibility of loss). Enterprises will encounter various uncertain events in their business activities to achieve their goals. The probability and magnitude of these events cannot be predicted in advance. These events will have an impact on the business activities of enterprises, thus affecting the extent of the realization of enterprise objectives. This process in a certain environment and within a certain period of time, the objective existence of all kinds of uncertain events that affect the realization of enterprise goals is risk.

Risk management refers to the management process of how to minimize risk in an environment where risk is guaranteed. For modern enterprises, risk management is the identification, prediction and measurement of risks. Thus choose effective means to reduce costs as much as possible, deal with risks in a planned way, and finally obtain the economic security of safe production.

Identification of safety risks in electric power enterprises

Power safety risk runs through the whole process of power engineering system operation. Only through risk assessment and management, and taking various measures to control it within a certain range, can we ensure the safe operation of power system. If the safety risk is not controlled, beyond a certain range, it will inevitably appear serious accidents in the power system. Heavy will affect the power supply, causing a large area of power outage accident and personal safety accidents. Safety risk management is the implementation of risk identification, risk analysis and risk response for systems, projects and enterprises, so as to control risks, prevent accidents and ensure safety.

In the process of power engineering safety risk management, the primary task is to identify the risk factors correctly and comprehensively. Only by accurately and efficiently identifying risk factors, we can correctly grasp the law of development and change of potential risks, correctly measure the size of risks, and choose effective methods to deal with corresponding risks according to the actual situation. As the research of risk management becomes more and more abundant, the methods of risk identification become more and more perfect. At present, the main risk identification methods include Brainstorming method, Delphi method, Fault tree method, Work breakdown structure method, Flow chart method, SWOT analysis method and so on. In practical application, one or several of them is often selected for combined application. In this paper, literature research method and expert interview method are combined to identify the risk and extract the risk factors comprehensively in the field of safety production in power engineering enterprises, based on the production characteristics and risk characteristics of power enterprises and on the basis of full

consideration of reliability and economy. Construct the safety risk index system of electric power engineering enterprises.

Determination of safety risk factors in electric power enterprises

All kinds of safety accidents may occur in the daily operation of power engineering enterprises such as production, operation and maintenance. In the process of using tools and tools, construction personnel are easy to be twisted, rolled, touched, cut, stab and other injuries. In the process of electrical engineering construction, workers may suffer from falling objects, Rolling Stones, hammering, fragmentation, collapse, and other injuries caused by objects. In addition, electrical engineering enterprise safety accident is the biggest harm is live operation. During live operation, serious injuries such as electric shock, lightning strike, explosion, scalding, and fire may occur. In this paper, the factors affecting the safety risk of power engineering are analyzed from three aspects: technology, management and personnel.

Identification of technical risk factors

Risks caused by equipment, system, process technology and other factors are collectively referred to as technical risks. Equipment causes refer to the causes of safety accidents mainly caused by the unsafe state of the equipment. It mainly refers to improper storage and transportation of dangerous raw materials, equipment and by-products in the process of power production. Equipment or tools have quality defects or lack of maintenance and repair; Equipment technology transformation is not timely, equipment system is not timely update and so on. Whether the design of production process line is really reasonable, optimized and convenient, and whether the design of man-machine interface conforms to human factors engineering, etc., will affect the operational behavior of people to produce potential risks to power production. Emergency plan refers to the emergency solution plan formulated in advance for potential or possible emergencies. If the emergency plan is not scientific, targeted and timeliness, a small event may cause a major accident and lead to the breakdown of the entire power grid system when risks occur. In the process of electric power production, transportation and distribution, the design and quality of various protection facilities are also the main contents that affect the safety of electric power engineering. The protection of electric power facilities is not enough, safety protective equipment is not qualified, construction machinery is not qualified, safety equipment is not qualified, the electrical characteristics of the power grid original, mechanical characteristics of the change will affect the normal operation of the equipment, resulting in the safe operation of electrical engineering problems.

Identification of Management risk factors

Risks that may be caused by factors such as management organization, human behavior, rules and regulations are called management risks. Power engineering enterprise organization personnel management error. Insufficient enforcement of corporate rules and regulations. Cross job management is chaotic. The work safety responsibility system is not effectively enforced. Field operation management failure. Lack of coherence between departments. Electric power enterprise staff post skill is low, accident prevention consciousness is not high, safety culture atmosphere is not firmly established and so on. All these may become potential risks and seriously affect the safe production of electric power. The production equipment of electric power engineering enterprises is used beyond the life cycle, the safety of the system function design is poor, and the management of inflammable, explosive and toxic goods is not in place, which will also cause the risk of safety production, resulting in safety production accidents.

As the decision-makers of the whole power system, the management organization and managers of electric power enterprises must have the ability of planning, coordination and decision-making, and strictly prevent the problems of command error and cross management disorder. A sound safety management system can effectively prevent the occurrence of safety accidents. Through strengthening the power engineering enterprise safety culture publicity, training supervision, experience feedback, advanced standard, peer evaluation and other measures, can firmly establish the safety culture of the enterprise.

Identification of Personnel risk factors

Personnel risk mainly refers to the factors that may lead to safety risks in electric power production due to some human behavior problems in the process of power production, transmission and distribution. These problems mainly include staff not operating according to the manual, communication is not in place, work attitude is not rigorous, man-machine interface error, lack of questioning work attitude, unsafe work habits, not using the prescribed technical specifications, not using or wearing personal protective equipment and so on.

In the process of safety production in electric power enterprises, personnel's participation is more critical. The safe operation of electric power enterprises should be implemented from the aspect of personnel safety management, so as to avoid safety accidents. The occurrence of safety accidents is caused by human factors, so the power enterprise should pay full attention to the personnel safety management, from the whole to ensure that the safety management can be carried out in accordance with the rules and regulations. Safety management personnel should improve the quality level of safety management work as a whole to avoid the occurrence of illegal operations and other behaviors.

Safety risk assessment and control of electric power enterprises

Accurate assessment of risks is a reliable prerequisite for risk management. Risk identification can identify the existence of risks, but cannot determine the severity of risks. Risk assessment is a quantitative and sufficient estimation and measurement of the possible consequences of risks on the basis of risk identification. Risk assessment needs to use quantitative analysis method to estimate and predict the probability of occurrence and the degree of loss of a particular risk. After the comprehensive and systematic identification of safety risk factors, the quality safety risk index system is constructed, and the influence of safety risk index in each stage of power engineering operation on the safe operation of power system is analyzed by quantitative method. Rank the degree of impact and find out the key security risk indicators.

Risk control is the treatment of risk factors after risk assessment. Risk control means that risk managers take various measures and methods to eliminate or reduce the possibility of occurrence of risk events, or reduce the loss caused by occurrence of risk events. The four basic methods of risk control are risk avoidance, risk reduction, risk transfer and risk retention. Risk avoidance means that the investment subject consciously gives up the risk behavior and completely avoids the specific loss risk. Loss control is not giving up risk, but making plans and taking measures to reduce the possibility of loss or actual loss. The stage of control includes three stages: before, during and after. Risk transfer refers to the act of transferring the assignor's risk to the assignee through a contract. Risk retention, or risk taking. That is, if a loss occurs, the economic agent will pay with whatever funds are available at the time. Scientific risk control mainly includes risk control objective formulation, choice of risk assessment strategy, implementation of risk control strategy, risk management effect assessment. According to the characteristics of safety risk in electric power enterprises, risk avoidance and risk reduction can be used to control the risk.

Results and Discussion

This paper takes the safety production risk management of electric power enterprises as the research object, and firstly expounds the risk management theory. Through literature review, the necessity of introducing safety risk management in electric power enterprises is discussed. In this paper, the safety risk factors of electric power production site are identified, and finally, the key risk index system of electric power production safety is constructed, with technical risk, management risk and personnel risk as the main risk factors. Through this study, the main conclusions are as follows: (1) Safety risk management is an advanced risk control theory, which can effectively prevent risk accidents in advance if it is popularized and applied in power supply enterprises. Enterprises reduce the possibility of safety accidents in field operations, and then save a lot of production costs. Risk identification is the basis of risk control. Scientific and reasonable risk identification is helpful for enterprises to carry out maintenance work. (2) The promotion of risk management in electric power enterprises must establish an effective organizational structure system and clarify organizational responsibilities. Safety production risk is the integration of technology, management and personnel factors. Therefore, in the process of risk management, we should not leave any risk dimension and must implement comprehensive risk management. Therefore, it is necessary to establish a set of effective organizational structure system and divide responsibilities for different types of risk management, so as to realize the safety production risk management integrated with technology, management and personnel. (3) The safety production risks of electric power enterprises come from many aspects, and it is difficult to completely eliminate the unsafe factors. The safety of electric power enterprises is related to the healthy development of economy and people's livelihood as well as the smooth operation of national security work. It is necessary to constantly improve the construction of safety production risk management system based on actual work. With the development and expansion of national electric power enterprises, risk management needs to be further developed in the direction of lean, collaborative, standardized and intelligent.

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