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Discussion on Safety Design of Small Rural Hydropower Station

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ABSTRACT. *This article takes a small hydropower station in a mountainous area as an example. Through the analysis of the dangerous factors of the construction project, a specific explanation is given for the possible safety risk factors, and the safety design is carried out around the existing risk factors in order to provide a reference for similar projects.*

KEYWORDS: *Hydropower station, Efficiency expansion and transformation, Safety design*

1. Introduction

Hydropower is a kind of clean energy. At the present stage, with the progress of my country's economy and science and technology, hydropower and electrical energy have gradually become irreplaceable energy sources in the process of social development in my country [1]. A large number of small and medium-sized rural hydropower stations built in my country in the last century have entered a period of renewal and reconstruction. The efficiency and expansion of rural hydropower stations have economic, ecological, and social benefits [2]. Affected by various factors such as natural geographic factors and disturbances to the original buildings during the renovation process, the renovation of hydropower stations has certain safety risks. The study on the safety factors of the rural hydropower station's efficiency increase and expansion transformation provides an important theoretical basis and safety guarantee for the transformation process.

2. Overview of Construction Projects

A hydropower station's efficiency-increasing, capacity-expanding and reconstruction project is located in Yuxiakou Town, Changyang County. The main buildings include reservoir dam, diversion tunnel, pressure branch pipe, ground power plant and booster station, etc., with an installed capacity of 1 × 2800kw.

3. Analysis of Main Risk Factors

3.1 Natural Geographic Factors

The area of the hydropower station is well covered with vegetation, most of the Quaternary cover is not thick, and the Silurian strata are widely exposed. The lithology is mainly medium to thick quartz sandstone, siltstone, and sandy shale. A small amount of thin limestone, calcareous shale, and exposed rock layers have high overall strength, good integrity, and high stability. However, the shale sandwiched by the Silurian shale, sandy shale and related rock groups is a relatively weak engineering geological rock group, which is affected by the steep terrain and deep valleys in the area. Under the current situation of the survey area, there are some adverse geological disasters Developmental phenomenon.

Under the effect of regional folds and fault structure compression, the development of geological disasters in the region generally occurs along the steep sides of the river and the steep parts of the mountain, mainly with potentially unstable avalanches and dangerous rock masses. On both sides of deep-cut valleys and inside slopes of highways, local rock joints and fissures are more developed. Due to their cutting, there are a few collapse deformation bodies, which are not large in scale, or only cut and fractured in the surface rock, and blocks fall under the influence of self-weight. , Falling stones, etc.

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3.2 Construction Disturbance Factors

According to the analysis of hydropower construction accidents that have occurred over the years, the main hazards and harmful factors that may occur during the construction of this project are collapse, drowning, electric shock, fire, falling from height, object strike, mechanical injury, vehicle injury, lifting injury Poisoning suffocation, other injuries, etc.

3.3 Safety Production Factors

Dangerous factors such as dyke breaks, flooded workshops, fires, explosions, electrical injuries, mechanical injuries, object strike injuries, lifting injuries, high-altitude injuries, vehicle injuries, natural injuries, etc. and their possible casualties and property Serious consequences of loss.

3.4 Construction Influencing Factors

There may be noise, vibration, poor lighting, high temperature and low temperature, humidity, dust, toxic and hazardous substances, electromagnetic and ionizing radiation in the construction site, which may have serious consequences for the physical and mental health of the workers.

4. Engineering Safety Design

4.1 Environmental Safety Design

(1) The overall layout of the project should comply with the relevant industry standards formulated by the country, such as the “Code for Fire Protection of Architectural Design” and “Hygienic Standards for Design of Industrial Enterprises”.

(2) The overall layout of the project should take into account local hydrological climate, transportation conditions and other factors.

(3) Make reasonable use of hydropower resources and make full use of engineering waste residue.

4.2 Safety Design of Engineering Facilities

(1) Countermeasures for the accident of the diversion tunnel

A. The project is designed as a pressure diversion tunnel, and the construction should meet the requirements of the design specifications.

B. Tunnel construction leads to stress relaxation of the rock mass and weathering after the rock mass is exposed. The integrity is poor, and the top sheet is easy to fall. Attention should be paid to strengthening the lining support during construction.

C. In view of the fact that the diversion tunnel of this project is more complicated to pass through the stratum, special attention should be paid to ventilation and drainage management during the construction process, and measures to prevent poisoning and suffocation and drowning accidents should be taken.

(2) Countermeasures against metal structure accidents

In order to prevent the accident of metal structure equipment, the following countermeasures are mainly adopted:

A. Overall consideration and reasonable layout. Make, install and debug according to the specification.

B. Take reliable safety, anti-skid and other protective measures, and have a special person to supervise.

C. Strictly implement operation regulations, pay attention to insulation protection, and pay attention to regular maintenance.

4.3 Emergency Safety Design

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According to the identification, qualitative and quantitative safety evaluation results of dangerous and harmful factors, the emergency rescue plan of the project is recommended to be classified and compiled according to the following system:

(1) Comprehensive emergency rescue plan

(2) Special emergency rescue plan

A. Emergency rescue plan for preventing natural disasters

B. Emergency rescue plan for major production safety accidents

C. Emergency rescue plan for personal injury accidents

(3) On-site disposal plan

A. Disposal plan for drowning accident

B. Disposal plan for collapse accident

The construction unit shall formulate the company's emergency plan drill plan. According to the focus of accident prevention, at least one comprehensive emergency plan drill or reversal emergency plan drill shall be organized every year, and a site disposal plan drill shall be organized every six months. After the emergency plan exercise is over, the construction unit shall evaluate the effect of the emergency plan exercise, write an evaluation report of the emergency plan exercise, analyze the existing problems, and propose amendments to the emergency plan.

5. Conclusion

Safety design is the prerequisite for ensuring the personal safety of project construction personnel and ensuring that the project is completed on schedule. Only the principles of safety first and prevention should be adhered to, with equipment, people and management as the center, scientific organization and arrangement, and implementation of hidden danger prevention and control measures At every stage of power construction and production, we can avoid and reduce the occurrence of accidents and accidents to the greatest extent [3]. This article takes a specific transformation project as an example, analyzes the main risk factors of the project from four aspects, and then puts forward safety design suggestions. This design idea has important reference value for the safety design of similar projects.

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