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## RISK ANALYSIS OF EMERGENCIES AT HYDRO ELECTRIC POWER STATIONS

In modern production and economic activity hydropower is faced with the risks of exceeding natural and climatic loadings over calculated, emergency shutdowns in energy supply systems, violation in terms and supply volumes of technical-material resources and unforeseen changes in prices concerning them, etc. [1]. One of the most important areas of enterprise performance is analyzing and evaluating the risk of accidents and emergencies. Therefore, the security management system of the production operation is being developed. It is based on the determination of the risk level with further development of security measures, that are implemented. Technogenic accidents or emergency situations are the main causes of economic loss and deterioration of enterprise security (HPS) [2].

In the work [3] authors consider 'risk' to be an important category of the modern concept of technogenic safety. The risk is understood as the quantitative measure of safety, predictable vector loss value, which may be the result of decisions made under conditions of uncertainty and threat realization [4].

The acute issues concern analyzing and assessing the risks of accident occurrence, depending on hydropower structures. The results of such researches are used for documentation development which determines the degree of danger of the corresponding objects, making reasonable decisions as to the reduction of danger risk, prevention of emergency situations and timely response in case of their occurrence [2]. But it is not always possible to provide quantitative assessment of risks in advance, in addition, there undergo testing methods of determining the degree of quantitative estimation. This causes some difficulty in minimizing risks and assessing costs. Risk assessment is a complex of quantitative and qualitative analysis of identified risks, that is a subjective assessment of risks, impact of risks (determining critical risks) and the consequences of risky events, making decisions as to the termination or subsequent implementation of the scenario [5].

According to the expert evaluation (statistical data) the priorities of the risk group are established, i.e. qualitative analysis is conducted. The results of quality evaluation are used to form the list of inadmissible risks, their quantitative analysis, and the planning of response measures [6]. An example is provided in table 1.

Table 1

**Qualitative risk assessment**

| № nn | Risk group name | Averaged likelihood of emergencies (0 ÷ 1) | Average impact on the situations of emergency scenarios (0 ÷ 1) |
|---|---|---|---|
| 1. | The risk of "human factor" (non-conscientious execution of professional responsibilities, violation of safety standards) | 0,4 | 0,5 |
| 2. | Technological risks (failure, outage of major equipment) | 0,6 | 0,7 |
| 3. | Investment risks (refunds) | 0,7 | 0,6 |
| 4. | Industrial risks (supply, violation of planned deadlines) | 0,5 | 0,6 |
| 5. | Political risks (instability of legislative framework, possible error decisions in the issues of area reformation, liberalization of power supply market) | 0,8 | 0,8 |
| 6. | Social risks (social crisis) | 0,1 | 0,2 |
| 7. | Market risks (fluctuation of market interest rates rates in the stock market and currency exchange rates) | 0,6 | 0,5 |
| 8. | International risks (actions of international organizations that introduce new conditions, international standards, regimes prohibited or incentive activities) | 0,7 | 0,7 |
| 9. | Force-majeure risks (natural disasters, destruction of dams) | 0,8 | 0,8 |

*Source: worked out by authors*

Estimation risks importance, i.e. priority for processing, is carried out by means of probability matrix and influence of risky events occurrence, table 2.

Table 2

**Matrix of probability and impact of occurrence of the risky events**

| Impact | Probability | | | | |
|---|---|---|---|---|---|
| | **0,1** | **0,3** | **0,5** | **0,7** | **0,9** |
| 0,8 ÷ 1,0 | | | | 5, 9 | |
| 0,6 ÷ 0,8 | | | 3, 7 | 2, 8 | |
| 0,4 ÷ 0,6 | | | 1, 4 | | |
| 0,2 ÷ 0,4 | | | | | |
| 0,0 ÷ 0,2 | 6 | | | | |

*Source: worked out by authors*

According to table 2, it is clear how the risks were distributed over the influence zones:

- Critical risks – 2, 5, 8, 9;
- Major risks – 1, 3, 4, 7;
- Minor risks – 6.

Thus, there is a high occurrence probability of such risks as technological, political, international, force-majeure.

Analysis and evaluation of the risk of accidents occurance at HPS is a crucial step in the safety management of object functioning. Unaccounted hazards are searched for, their likelihood occurrence is determined, possible scope and consequences are evaluated. The risk estimation for accidents and/or emergency situations and its analysis are the basis for the development of measures for the safety of HPS functioning.

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