ASSESSMENT OF DAMAGES AS A CONSEQUENCE OF EMERGENCY SITUATIONS IN RAILWAY TRANSPORT

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Emergency- an event limited to a certain territory, which occurred in connection with an industrial accident or other disaster, which has negative consequences for human life, the functioning of various social institutions, which led to casualties and caused large material losses. The number of emergencies is increasing exponentially every year. This is due to the complication of the technology for the production of various materials and products, the expansion of production capacities, the decrease or increase in the requirements for the qualifications of employees of industrial enterprises.

All this also leads to an increase in the scale of man-made disasters and the harm they cause to the economy, market, society and the ecological state of the environment.

Figure 1. Consequences of man-made emergencies

Reference: economic losses from man-made emergencies have increased by about 10 times in the period from the middle of the last century to the present - from 60 to 700 billion dollars a year; their number increased by an average of 3 times, and the number of victims - up to two and a half times. Even more these days.

In emergency situations, the ratio of criteria for sustainability and vulnerability of the transportation process is as follows:

- high stability; - low vulnerability; sufficient stability - medium vulnerability; low resilience - high vulnerability. Vulnerability assessment of transport infrastructure facilities should begin with the identification of emergency risk.

The assessment of the risk of violations of traffic safety in transport should include two groups of indicators characterizing the consequences of accidents: material and social damage, and probabilistic indicators of the implementation of an accident [5].

The risk of an emergency is considered to be a measure of the danger of such a situation, combining the likelihood of an emergency and its consequences [6]. Most often, the risk is expressed in quantitative terms, which makes it possible to ensure the comparability of the degrees of danger of the objects and processes of the system at various stages of the risk analysis.

If we consider the risk in terms of the probability of a negative event, then it can be calculated using the formula:

$$R = \frac{n}{N},$$

where n is the number of completed events with negative consequences (ES); N is the maximum possible number of events that can be affected by negative consequences for the billing period.

On the other hand, the risk can be expressed in terms of damage from the occurrence of an adverse event, then it can be calculated using the formula:

$$R = P \cdot U,$$

where P is the probability of an adverse event; U - mathematical expectation of damage from this event.

At the same time, it should be taken into account that each factor has its own risk, and for each railway and each of its sections, the fixed parameters may differ significantly [7].

Based on the existing regulatory and legal framework, railway transport infrastructure facilities are classified as follows:

- objects of technical regulation (OTR) - frames, couplings, axles, wheels;
- hazardous production facilities (HPO) - locomotives, wagons, bogies, trains;
- critically important objects (CVO) - special trains for the transportation of special-purpose goods;
- strategically important objects (SVO) - bridges, tunnels [8].

Under the SVO understand the objects, the violation of the functioning of which takes the country out of a state of sustainable development, while the violation of the functioning of the CVO causes damage to the industry and regions.

For research, the most interesting are the KVO, namely, special-purpose cargo. They are goods that require special transportation conditions: oversized, live, perishable and dangerous goods. Let us dwell in more detail on the issue of transportation of dangerous goods, since the ability to harm the environment in the event of an accident, as well as the life and health of people, makes their transportation the most responsible process.

Forecasting the risks of emergencies, first of all, is aimed at minimizing possible adverse consequences. Consequences need to be identified [10]. Forecasting the scale of emergencies depends on the features of the location of the object, the causes and conditions for the occurrence of an accident [11]. It should be noted that the quantitative definition of damage, expressed in human casualties or in monetary units, can be used both to predict the scale of emergencies based on the classification of emergencies [12], and in the development of measures to prevent emergencies (risk reduction and mitigation of consequences - reducing damage to optimal values).

There are various methods for assessing damage from emergencies, their choice depends on the purpose of the assessment, as well as on the characteristics of the object under study. The chosen methodology should be developed in accordance with the current legislative and regulatory documents.

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It should allow organizing the conduct of actual and possible damage from emergencies, as well as ensure the accuracy, reliability, reproducibility, evidence and objectivity of the damage assessment results. It is necessary that its methodological provisions be based on the results of scientific research, the processing of a sufficient amount of statistical data, the analysis of information support and practical experience.

In the Ministry of Emergency Situations of Uzbekistan, when assessing damage, the "Unified interdepartmental methodology for assessing damage from emergency situations of a man-made, natural and terrorist nature" is used [13]. This technique is an enlarged one and is designed to predict damage at all levels of the territorial subsystems of the Unified State System for the Prevention and Elimination of Emergencies (GSChS). It can be used in the following cases:

- determination of the amount of financial security for civil liability for damage caused as a result of an accident at a hazardous facility;
- insurance of civil liability of owners of hazardous facilities;
- emergency planning;
- substantiation of measures aimed at reducing the negative consequences of accidents;
- forecasting the amount of amounts necessary to compensate for damage from an accident at a hazardous facility, as well as to eliminate its consequences.

The essence of the methodology is to determine the total economic damage that accompanies emergencies. It is calculated by the formula:

$$U = U^p + AU^k,$$

where A is the reduction factor for multi-time costs (discount factor); Up - direct economic damage; U - indirect economic damage.

The components of direct economic damage, as a rule, are based on accounting data and other documents that have a fairly high reliability:
- rescue costs;
- the cost of evacuation and temporary accommodation, the provision of urgent medical care;
- lump-sum payments to victims;
- residual value of the property;
- the cost of disturbed natural resources.

The main components of indirect economic damage include:
- economic damage caused to "third" parties;
- profit lost due to termination or suspension of activities, loss of intangible assets, various documentation,software;
- moral damage;
- costs associated with the prevention and elimination of emergencies.

The components of indirect economic damage, as a rule, are not amenable to accounting, and can only be determined estimated, including using expert assessments, while having a high degree of uncertainty and insufficient reliability, which, in turn, reduces the reliability of full economic damage. .

The following is a classification of emergencies depending on the number of victims, the amount of material damage and areas of distribution of damaging factors (Table 1).

Further calculation is reduced to the analysis and forecasting of the level of change in the gross regional product from the socio-economic consequences of emergencies.

To calculate damage from traffic accidents, methodological recommendations for calculating damage from traffic accidents and other events associated with violations of the rules of traffic safety and operation of railway transport are applied. In accordance with these recommendations, the calculation of the damage caused by traffic accidents is carried out by determining the amount of costs according to the formula:

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$$Y = \sum_{i=1}^{21} Y_i \, ,$$

where Y1, Y2 - damages from damage to freight and passenger cars, respectively, sum.; Y3 - damage from damage to traction rolling stock, total; Y4 - damage from damage to multiple unit rolling stock, total; Y5 - damage from damage, total; Y6 - damage from damage to passenger high-speed and high-speed traffic, total; Y7 - damage from damage to the track and structures, total; Y8 - damage from damage to automation and telemechanics devices, total; Y9 - damage from damage to electrification and power supply devices, sum; Y10 - damage from damage to communication devices, sum; Y11 - damage from damage to other infrastructure facilities, total; Y12 - expenses for the operation of the recovery train, sums;

Table 1. Classification of emergency situations.

	Number of victims	Material damage	Borders of the emergency zone
Local	The dead and / or received damage to health - no more than 10 people.	No more than 240 million soums	Does not go beyond the organization (object)
Municipal	The dead and / or received damage to health - no more than 50 people.	No more than 120 million soums	Does not extend beyond one municipality
Intermunicipal	The dead and / or received damage to health - no more than 50 people.	No more than 120 million soums.	Affects the territory of two or more municipal districts, municipal districts, urban districts located on the territory of one subject of the
Regional	More than 50 people died and/or received damage to health, but not more than 500 people.	Over 120 million rubles, but not more than 1.2 billion rub.	Does not go beyond the territory of one subject of the Russian Federation
Interregional	More than 50 people died and/or received damage to health, but not more than 500 people.	Over 120 million soums, but not more than 1.2 billion rub.	Affects the territory of two or more subjects of the Russian Federation
By region	Over 500 people who died and/or received damage to their health.	Over 12 billion soums	

Y13, Y14 - damages from damage and loss of cargo and baggage, respectively, in total; Y15 - additional costs associated with train delays in total; Y16 is the component of damage associated with the carrier's fines for the delay of long-distance and local passenger trains, sum; Y17, Y18 - components of damage associated with the carrier's fines for violation of the terms of delivery of baggage (cargo luggage) and cargo to the recipient, respectively, in total; Y19 - damage from causing harm to life, health and property of third parties involved in a traffic accident, total; Y20 - environmental damage, total; Y21 - other components of damage, total.

The following is a detailed algorithm for calculating the types of damage.

Damage to the environment caused by a negative impact on the environment is determined by the amount of damage caused to natural resources and the costs of eliminating environmental consequences. Other components of damage include costs that cannot be planned in advance.

One of the key tools for environmental protection is the assessment of damage from the manifestation of environmental hazards.

A feature of environmental risk assessment is that it is complex, most often based on heterogeneous data. Therefore, to calculate risks, all indicators should be reduced to a single normalized rating scale [15]

In the work of Russian scientists prof. E.N. Belskova, prof. O.V. Brazgovkova, Prof. E.V. Sugak [16] presents a methodology for environmental risks, which considers an approach to determining risk both in terms of the probability of an adverse event occurring and in terms of its possible consequences. The author proposes to calculate risks based on the assumption that several hazardous events may occur during the reporting period (year), then the risk will be calculated using the formula:

$$R = \sum_{i=1}^{n} p_i U_i \,,$$

where n is the number of possible damage options in the event of an adverse event; Pi is the probability of an unfavorable event; Ui

- the amount of damage (rubles), which is determined by the formula:

$$U = \sum_{i=1}^{n} W_i C_i \,,$$

where Wi is the generalized component of harm by the components of the natural environment; C, - the price of the i-th component of harm per unit of measurement.

In accordance with the law of probability distribution for a continuous dependence of Pi on U, we represent expression (1) by formula (2):

$$R = \int_{-\infty}^{\infty} u P(u) du \,.$$

When damage can occur due to different adverse events independent of each other, the average risk can be determined by the formula:

$$R = \sum_{i=1}^{n} \sum_{j=1}^{m} P_{ij} U_i \,,$$

m

where Py is the probability of damage U when an event j occurs, determined by the formula:

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$$P_{ij} = P_j P_i(j),$$

where Pj is the probability of occurrence of an unfavorable event j.

When determining the value of the average risk, formula (3) can be used provided that the damages from various events are measured on the same scale, where Pj expresses the law of distribution of the probability of the occurrence of adverse events, and Pj are the laws of distribution of damages from each of these events:

$$R = \sum_{i=1}^{n} \sum_{j=1}^{m} P_i P_j(j) U_i \cdot$$

When calculating the environmental risks of large-scale accidents and catastrophes, it is advisable to use the concepts of complete, direct and indirect environmental damage. At the same time, direct damage is caused by a negative impact on the main components of the natural environment, and its estimates are associated with a negative impact on people in the present. While indirect environmental damage is global in nature and has a negative impact on future generations of people.

CONCLUSION

Risk management is based on determining the optimal ratio of benefits and harms. The choice of methods for assessing damages depends on the goals and objectives of the assessment, the conditions in which a hazardous event occurs, and also on the characteristics of the object under study.

Existing methods for determining damages have both their advantages and disadvantages.

Thus, in accordance with the Unified Interdepartmental Methodology for Assessing Damage from Emergencies of a Technogenic, Natural and Terrorist Nature, as well as for classifying and accounting for emergencies [13], damage is assessed in economic terms, although it notes that the activity to determine economic damage is secondary to relation to the definition of physical damage to emergencies. It quite fully discloses the concept of full, direct and indirect economic damage. Based on the algorithm for calculating indicators, we can conclude that its main goal is to determine the impact of the entire set of losses by sectors of the national economy on the sustainable development of the country as a whole. Thus, there is a need to develop methods for determining damage indicators for individual industries, based on the presented methodology.

The methodology used in the railway is the simplest and most accessible, all economic indicators used in it are amenable to documentary confirmation and are mainly accounting indicators. However, at the same time, it does not fully reveal the essence of the calculation of damages in emergency situations, namely, in it, unlike the previous methodology [13], there is no division of damages into direct and indirect. When it is finalized, indirect damages from emergencies can be attributed to the indicator of other damages.

The particular complexity of risk assessment in emergency situations in railway transport lies in the fact that the railway with all the elements and objects of its infrastructure is not just a complex technical system, but a dynamic system. Risk assessment here is accompanied by a high degree of uncertainty, which also requires numerical expression.

The methodology presented in [16] mentions the insufficient development of methods for assessing the impact of large-scale accidents, however, it allows for a quantitative assessment of environmental risks, which contributes to the development of options and the choice of optimal

risk management solutions that minimize both the likelihood of negative factors and and damage in case of their implementation.

Thus, the choice of a damage assessment method depends on the goals and objectives of the assessment, the conditions in which a hazardous event occurs, the availability of the method itself, and also on the characteristics of the object under study.

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