Victor Grechaninov

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PREVETION OF EMERGENCY SITUATIONS AS THE MAIN TASK OF SINGLE STATE SYSTEM FOR CIVIL PROTECTION

ING. VICTOR GRECHANINOV, PH.D.
Ukrainian Research Institute of Civil Protection, UKRAINE

ABSTRACT

It has been demonstrated that it is possible to decrease the number of emergency situations (ES) and dangerous events (DE) and to lessen the impact them by concentrating efforts on prevention of their appearance. In order to do so it is necessary for the state to introduce a new system of anthropogenic hazards monitoring, recognition and management of risks, aimed at their minimization. Implementation of the risk-oriented approach in its substance represents the reform of the united state system of public Security.

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According to statistics, the number of people who died annually and were maimed as a result of emergency situations in the country over the past twenty years, unfortunately, almost failed to be reduce. Annual material losses from fires in recent years exceeded 2 billion UAH [1 UAH is about 0,0401 USD – ed.]. In particular, in 2011, it was 2 659 billion UAH, and in 2015 – more than 3 billion UAH.

The risks with which we have to deal in our state are different, and their scale is increasing constantly. Solution of the problem of anthropogenic security is one of the main directions of minimization of negative consequences of emergency situation. So, the purpose of the work is scientific justification of a new strategy creation for the prevention of ES in Ukraine.

Today, scientists have not yet proposed an unified approach to mathematical modeling of risk assessments. The concept of "risk" is often associated with a probability of unwanted event. Thus, the Law of Ukraine "On Extremely Dangerous Objects" gives the following definition: *risk – the degree of probability of a negative event that may occur at certain times or in certain circumstances at the territory of Extremely Dangerous Object and / (or) outside it*. In the Law of Ukraine "On the Main Principles of State Supervision (Oversight) in the Area of Commercial Activity" a following definition can be found: *risk – a quantitative measure of danger, taking into account the probability of negative effects from the economic activities and the size of possible losses from them*.

The analysis of existing mathematical definition of risk showed that despite intensive development in the last decade, methods of analysis and risk assessment, there is still considerable uncertainty regarding the "risk" term in Ukraine. The nationwide accepted system of terms in the theory of risk, that reflected as well as in scientific works and some regulations, is absent [1].

The risk is a category of market economy. The need for taking into account the contingencies and uncertainties in the analysis of danger is recognized not only by experts on industrial safety, but also by the employees of state agencies. The relevance and important practical significance of this problem certify numerous publications and recently adopted regulations on safety declaration of high danger.

Reducing anthropogenic risks should be a part of national security strategy. Analysis of the causes of ES of anthropogenic origin gives the base for conclusion that their reduction can be done by complex solution. This must include the creation of modern monitoring system of anthropogenic security of economic activity of entities, using the latest information technology and transfer the main efforts from the response and consequences liquidation of ES to their prevention.

We propose the following algorithm of risks management (Fig.1):

Figure 1. The algorithm of risks management

In modern practice, to formalize risk R is widely used a model that connects the likelihood of negative events *Pi* (accidents) and likelihood of possible losses *Wi* as a result of such events:

$$R=\sum_i P_i W_i \quad (1.1)$$

If $i = 1$, than $R = PW$. Note that $0 \le P \le 1$.

According to the formula (1.1) both a possible uncertainty of an event that leads to undesirable consequences and magnitude of these effects can be explained.

Risk assessment should include the development of unfavorable events for the different scenarios that require synthesis formula (1.1):

$$R=\sum_{ij} P_{ij} W_{ij} \quad (1.2)$$

where the index i refers to events, index j – appropriate continuity.

In the scientific literature, using an expression for a risk assessment as an integral:

$$R=\int F(W)p(W)dW \quad (1.3)$$

where F (W) – weight function of losses, through which the effects of various nature are reduced to a single (e.g. cost) damage assessment; p (W) – density of random variable W [1].

Risk Management is a risk-based targeted activity to implement the best possible ways to reduce it to an acceptable (small) level. Risk assessment must be in quantitative dimension. Risk analysis is realized by the scheme:
- identification of hazards,
- monitoring,
- analysis (assessment and prediction) of threats,
- analysis of possible effect on enterprise and personnel,
- risk analysis for population dwelling in the possible affected area,
- risk analysis of consequences of emergency for the surrounding environment.

Risks determination due to analyzing data obtained as a result of the monitoring enable to determine:
- what might be (will be happen) – which ES or DE,
- why, how and for what reasons this may occur,
- when and where this can happen,
- which consequences might be.

In its turn this makes it possible to take decisions and do the appropriate actions to risk reduction to avoid (prevent) possible undesirable ES or DE.

The next stage is Risk Prediction which is its assessment at the moment (time) and for the future, taking into account trends of changes in conditions of risk, by whole forecasting of potential ES of man-made origin and a hard work to prevent them. For this purpose it shall be conducted internal and external monitoring of objects, their technology, equipment and control of personnel training that has been already shown in Figure 1.

The current structure of emergency warning system inherited from the Soviet Union is not effective today. It does not meet current economic complexity of the state, demands of the time and legislation of the market economy [8]. Considering the single state system for civil protection (hereinafter – SSSCP) – we can observe imperfections in its structure with rudiment elements [2, 3]. It used to work well only in the USSR,

when there were sectorial ministries and one-party system. Currently, the company is not subject to any relevant ministries or state administration.

Supervision of anthropogenic hazard (risk) is assigned to the inspections of The State Emergency Service of Ukraine (hereinafter – SES of Ukraine) which are not able to perform its functions effectively due to lack of knowledge of technological processes and risks. The same inspector should check different types of enterprises with different technological industries: metallurgical complex, mining and processing plant, chemical plant, gas station, railway station, and so on.

Modern SSSCP in Ukraine and its components – prevention of emergency, it is necessary to build according to the realities of the economy, including the submission of enterprisers to owners – only juridical entities or individuals. It is essential to identify the place and role of economic activity in SSSCP correctly [11].

Any reform and activities in the field of population and territories protection will be extremely ineffective if they are not regulated by the state law. A special place in the protection of population and territories from emergency takes science and technology policy. Therefore there are two key directions of improving the prevention of emergency situations – the implementation of risk oriented approach (ROA):

- change of management structure and legislations, improvement of emergency situations risks passports of regions etc.
- development and implementation of methods, programs, models, i.e. the entire spectrum of information technology devices (Fig. 6).

This work has already begun by State Emergency Service of Ukraine and the National Academy of Sciences of Ukraine [4].

For whole scale, prediction of possible man-made risks in the country, a new single automate monitoring system of security management and ES prevention should be created. The most effective economical approach to improving the current system of state monitoring is the introduction of modern data processing and transformation of information. This provides changing of the shape of the accumulation and storage of information on the status of risk-carriers objects. On the basis of using of information technologies involves the construction of monitoring information system with multi-level conversion of information form in which conclusions about the state of objects made on the basis of heuristics multifactor models.

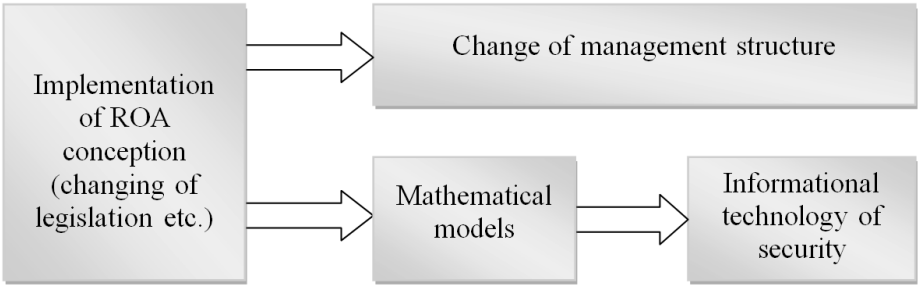

Figure 2. The algorithm of ROA implementation

For this purpose, it is necessary to create four-levels hierarchy of information transformation in technology of multi-level monitoring [9, 10]. Information technology of monitoring of anthropogenic security with multi-levels transformation of information will work reliably if only a system of monitoring (situational) centers at national, inter-regional, and regional levels are created and conduction of constant internal and periodic external monitoring on subjects (objects) – sources of risk, as shown at Fig. 3.

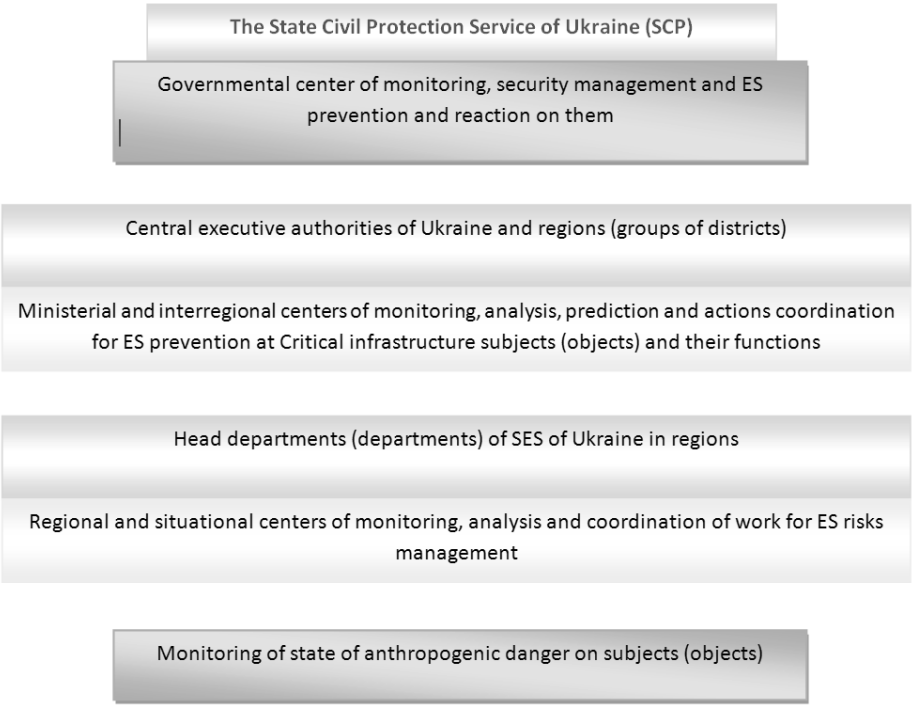

Figure 3. The system of monitoring of anthropogenic dander in the country

For realization of mentioned approach it is needed to create new methods of forecasting and preventing, first of all, a method of monitoring as the assessment of the risks of danger on different objects and their management that is to say ROA [5]. The monitoring results allow managing risks namely track them and, if necessary, adjust (Figure 4).

For the purpose of objective evaluation, it is important to create an institution of risk estimators companies which get licenses and work on methods consistent with SES of Ukraine. They will give the information about risks to insurance companies, agencies of SES of Ukraine and local authorities.

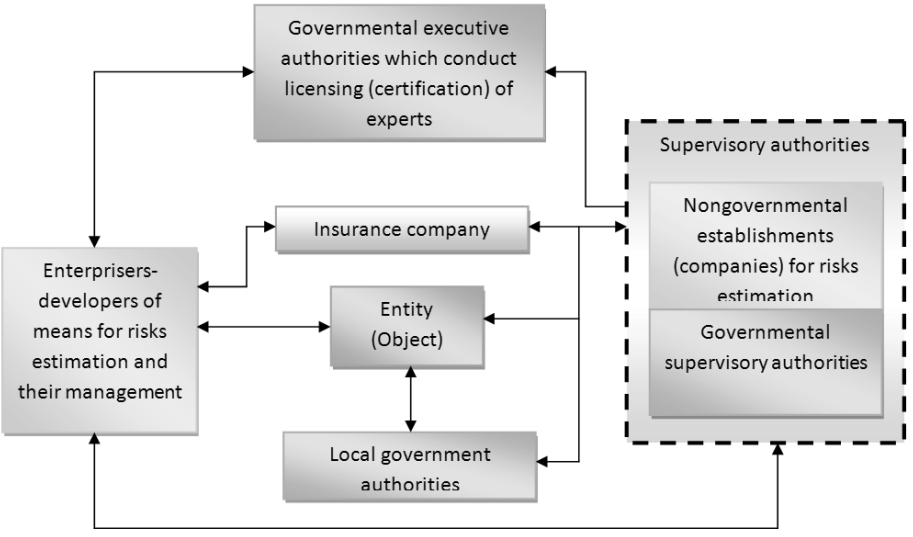

Figure 4. The system of anthropogenic risks determination of enterprises and their management

The principles of proposed ROA:

- estimator company gets a license for specific types of objects,
- identifies risks of an object, about which reports to the responsible executives of object, SES of Ukraine, local authorities and insurance companies,
- risks must be insured; the level of premiums depends on the risk level defined by estimators company,
- company employees are held criminally responsible for the correctness of the risks (in accordance with approved procedures).

Analysis of the existing state and propositions regarding an improvement of the monitoring of potentially dangerous objects to determine the

degree of risks and their management were published in several works [5, 7, 8, 9]. Currently, there are several types of models and software to detect risks of man-made origin. Some models of ES and the development of their potential effects have been described in given publications [7, 9, 10].

According to the World Health Organization methodology, risks are divided into:

- Small (low premium),
- Acceptable (large premium),
- Large (very large premium + commitments to reduce to acceptable one).

It is shown on fig. 5.

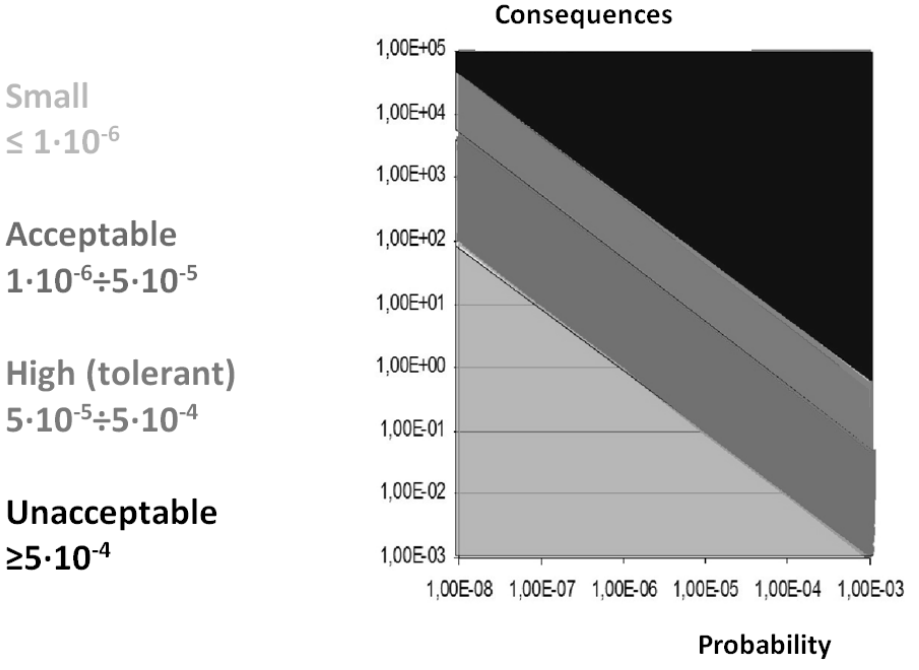

Figure 5. Distribution of risks by method of World Health Organization

Inspection of SES of Ukraine, if necessary, checks fulfillment of enterprise the requirements of an estimator company to reduce a risk. At the same principle a system of emergency prevention in most European countries and the USA is built. Currently, the EU is developing unified rules for ROA for all member countries. Even in Russia since the last four years a system of ROA has been implemented.

All enterprises are business entities of all forms of ownership during getting permits and licenses sign an obligation to prevent security risks to an unacceptable level and their reduction in cases of high level.

Conversion to the ROA will reduce significantly budgetary spending on prevention of emergency situations, shifting the costs to enterprises-sources of risk and insurance companies. It will allow increasing significantly the effectiveness of emergency situations prevention while reducing the number of people in managerial apparatus.

Conclusions

1. The reform of anthropogenic security management is needed in the country.
2. Monitoring of anthropogenic security of business entities, risk oriented approach in the management of hazard – this is the reform of emergency prevention.
3. It should be created a four-level hierarchy system of monitoring technology of anthropogenic danger.
4. Effective monitoring of anthropogenic hazard, objective analysis of its status and management of emergency situation prevention are possible only within the implementation and application of modern information technologies.

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Author:

Victor Grechaninov – Head of the department of civil protection development, Ukrainian Research Institute of Civil Protection (UkrRICP)

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