



International Journal of Innovative and Information Manufacturing Technologies, SHEI "Donetsk National Technical University"; 58, Artyoma Street, 83001 Donetsk, Tel.: +38 062 305 01 04, Fax: +38 062 301 08 05, E-mail: [ij.iimt@gmail.com](mailto:ij.iimt@gmail.com), Skype: [ij.iimt](https://www.skype.com/name/ij.iimt), <http://ijimt.donntu.edu.ua>

## ASSESSMENT AND MANAGEMENT OF RISK IN THE MODE OF INSTABILITY OF NATURAL AND INDUSTRIAL SYSTEM OF DONBASS

**PRIHODKO Sergey, SEMCHENKO Alina**

The Department "Faculty of ecology and chemical technology"; SHEI "Donetsk National Technical University"; 58, Artyoma Street, 83001 Donetsk

*Corresponding author: PRIHODKO Sergey, e-mail [prihodko@mail.ru](mailto:prihodko@mail.ru)*

*Submitted 15.05.2015; accepted 19.05.2015*

**Abstract.** The author considers a problem of an assessment of industrial danger of fuel and energy complex of Donbass in article. Important aspects of observance of safe activity of the enterprises of fuel branch are specified, all analysis stages of risk are characterized. The author focuses attention to relevance of the presented problem, brings to argument in favor of development of new and more effective methods of an assessment of risk at the enterprises of fuel branch. In article the attention to practical introduction of estimates of an environmental risk is focused. The most complex and objective techniques of an assessment of ecological and economic damage are specified. The author points to a solution by development of new methods system the analysis and monitoring of a state of environment. Important quality of article is its relevance.

**Keywords:** Fuel and energy complex, risk, assessment, analyses, environment, efficiency, safety regulation, system analysis.

### 1. Introduction

Enterprises of the fuel and energy complex (FEC) of Donbass - the sphere of high risks and objects of the increased industrial danger which possess great potential opportunities for creation of accident of technogenic character, various accidents, threat to people and environment. A variety of risks which proceed from the FEC, specify on need of an integrated approach for minimization of possibility of accident and accident, and also need of the organization of system of a risk management which is aimed at the solution of a large-scale complex of problems of various character in which environmental risks take not the last place.

### 2. Contents of article

Optimization and administration of Donbass of dynamic natural system is the extremely important for the modes of instability of system. Taking into account position of FEC in relation to various industries value of works on the aforesaid problem has the extremely actual character. Safe activity of the enterprises of fuel branch

will be effective only if they meet the highest requirements of the international standards. In particular, it is standards of the ISO 9000 series (a control system of quality), ISO 14000 (system of ecological management) and ISO 18000 (OHSAS - a control system of industrial safety and labor protection) and other international documents concerning ecological management and audit. Problems of estimates of activity of the FEC in the context of environmental problems are represented extremely actual and serious. From the economic point of view of costs of ecological study of projects including on an assessment of environmental risks, are more effective if they are carried out at earlier stages of implementation of projects. These expenses pay off through ecological payments and more due to creation of effective control systems and decrease in risks in a production activity of the FEC. Nevertheless, at a predesign stage of study to calculations of the missed ecological benefits it isn't given due consideration. Active risk management has to have system character, however

now the greatest attention is paid to financial risks [1]. At the same time the last development of declarations of safety of dangerous industrial facilities allows to create system of the detailed analysis of susceptibility to environmental risks practically of all cycle of production on pre-investment, investment and operational phases of development of the energy industries enterprises. Nevertheless, in documents feasibility reports calculations of environmental risks, as a rule, are absent though in documents, by estimates of impact on environment performance of such researches is offered. Lack of estimates of environmental risks at pre-design and design stages in portfolios of the general and special risks of the companies in the future turns into substantial damages at emergence of the social conflicts and liquidating situations leading to catastrophic consequences.

In certain cases environmental risks at the energy industries enterprises carry to the operational. However by the nature environmental problems of power and use of fuel are ubiquitous and actual taking into account environmental pollution and causing damages to both separate components of ecosystems, and the person. Therefore the ecological component for the energy industries enterprises is present both in financial (market), and at strategic risks. The quality and quantitative standard of environmental risks on phases of life cycle of implementation of projects and life cycle of production has serious methodical and practical value. Need of researches such is caused by possible violations of the nature protection legislation and, in the second turn, risk of negative influence of climatic factors throughout all phases of implementation of projects. However in pre-investment studies the last factors are given a crucial role.

At the same time, requirements of the legislation can change, and for ecological - especially, towards toughening. So, signing of the Kyoto Protocol caused essential toughening of nature protection requirements, first of all in the FEC. Thus the probability of violations of ecological requirements also obviously increases. For the FEC already now it is necessary to get to work on cataloguing and creation of system of the reporting under risks on the basis of what management will be carried out by them. From these positions the risk management will be presented by some integrated function which needs to be introduced in all divisions and in all kinds of activity of the FEC. Not the last part in this integrated function has to be assigned to environmental risks. It is connected with that unlike other types of production and design risks for creation of a control system of environmental risks the real foundation - transition to standards of the ISO 14000 series is already laid. In general, considering separate stages risk analysis

for the energy industries enterprises, it is possible to allocate the following main problems:

I (exposition of risks and identification of dangers). The risk analysis is one of key problems a quantitative assessment of importance of the adverse factor operating in a complex with several factors. In case of the accounting of set of factors of difficulty appear in definition of a role or degree of importance of this or that factor for correct calculation of risk as the share with which one factor influences, defines its priority. Also the account their emergent properties. In technogenic systems in certain cases (for example, when using technologically new equipment where its reliability is authentically unknown, and in the passport there are no data of a time between failures, or at scanty statistical information about its refusals) it is difficult to build "a tree of refusals", and sometimes at all it isn't possible. Also technological complexity of the process which underwent risk analysis creates difficulties.

II (a dependence assessment "a dose - the answer"). At detection of quantitative dependence between an exposition of the studied factor and the harmful effects caused by it there is following methodical uncertainty:

1. Application of the majority of methods of calculation of risks is impossible in case of a remote site of the studied object from a residential area. In such situation the risk analysis concerning health of the population (it is one of major factors) becomes senseless.

2. Establishment of communication between an exposition and the actual indicators of a state of health of the population ("a dose - the answer") is in many respects complicated as ideas are had only of unicomponent communications, and for combinations of several factors the mechanical summation of risks (without their emergent properties) becomes the only opportunity. It creates methodical uncertainty at estimates of quantitative indices of risks and, respectively, sizes of rates of insurance.

III (the characteristic of risk) is the final stage and an initial phase of risk management. Within this stage the data obtained earlier are generalized, the assessment of reliability of results is carried out, risks for separate factors and their combinations pay off, development of the rational actions allowing to minimize the received values of risks is estimated probability and weight of possible adverse effects on health of the person and environment, relative deposits to the established risk levels of the separate polluting substances.

The risk count off on a formula:

$$R = P \cdot X \quad (1)$$

where R - size of environmental and economic risk;  
P - probability of approach of the adverse moment or a

condition which will cause material inputs and losses – X.

At calculations for this formula there are certain difficulties. First of all is a lack of the standard formula for calculation of probability of an event. More often calculation of probability is carried out with application of the binomial law, law of distribution of Bernoulli, laws of distribution of Veybull, Pareto, the logarithmic and normal law of statistical distributions of random variables, etc.

Thus often use short series of observations at which parameters of distributions are extremely unstable that demands certain assumptions and compromises of application of the listed above distributions to empirical information. From here uncertainty and inadequacy in estimates of probability of events by various methods.

The assessment of environmental risks and, therefore, management of them assumes not only the analysis of probability of emergence of an adverse event (that in practice becomes during identification of sources of risk, expert estimates, creation of "refusal trees" and other operations). The second major component of the analysis of risk is the economic assessment of consequences of adverse events.

For environmental risks these estimates represent determination of sizes of environmental and economic risk. Thus the problems peculiar for estimates of environmental and economic risk, become obstacles not only for calculations of size of environmental and economic risk, but also for practical introduction of estimates of an environmental risk, in particular, of ecological insurance and other approaches to risk management. The part of the existing problems is discussed already for a long time, others are specific to area of estimates of environmental risks and ecological insurance. First of all, it is problems of correlation of ecological consequences of damage and monetary value of these losses. So, obvious (and hardly completely solvable) a problem is the assessment of moral damage at any violations in a condition of environment. Perhaps, any estimates will be always perceived as disputable here. However except difficulties with estimates of moral damage there is a mass of difficulties with identification such accurately defined, but the remote consequences of adverse ecological events, as well as with a cost assessment of obvious changes in ecosystems as a result of negative impacts. The latent and remote consequences which occur and will occur in ecosystems and, respectively, are reflected on health of the person, most difficult give in to an assessment.

One more extremely difficult moment - obsolescence of the existing method of calculation of environmental and economic risk. The most complex and ob-

jective techniques assume an assessment of environmental and economic risk on the basis of price indicators of the 80-90th years of the last century that practically nullifies any efforts on increase of accuracy of calculations: inflationary processes quite difficult give in to an assessment and the account, and mechanical increase of values of damages will hardly adequately reflect a picture of change of value of separate components of environment.

Considerable difficulties when determining economic estimates of ecological damages are connected with imperfection or insufficient accuracy (adaptedness to a concrete situation) the operating techniques. The majority of them is based on indirect methods of definition of damage that in itself assumes use of more or less successful "sample" estimates. So, the most widespread, the "Temporary standard technique" which became a basis for the subsequent development assumes 1986 that the value of various types of territories can be considered by means of coefficient which depending on population density and a type of use of a site changes from unit shares to 10. In practice it can be expressed that the area which isn't carried, for example, to the sanatorium territory will be less valuable by at least 10 times, than the sanatorium area (the damage size determined for two such sites will differ not less than by 10 times). Thus both territories will be located in close proximity, with identical degree of probability to be exposed to risk and to experience identical strain in case of adverse events. Thus both territories will be located in close proximity, with identical degree of probability to be exposed to risk and to experience identical strain in case of adverse events.

In many respects insufficient "the ecological accuracy" is connected with that the received estimates are guided first of all by the person as the recipient of influences. Thus the admissible limits of influences considered in a damage assessment are defined first of all for the person, but not for other components of surrounding environment (perhaps, more sensitive), or economic objects. This problem is connected with lack of price expression for many representatives of a plant and animal life taking into account their territorial "value", and also absence of uniform territorial inventories of natural resources and calculations of ecological capacity of certain territories.

It is obvious that for cases of identification of environmental risks and their economic assessment the greatest interest is represented by the techniques used for specific certain recipients of negative impact (unlike "gross" techniques when the amount of damage is determined by the mass of the made emissions, dumpings, etc.). Such kinds of estimates are more adequate for

calculations of environmental and economic risk if negative events already occurred.

Thus, problems of estimates of environmental and economic risk (so, and insurance events) have to be solved by formation of new techniques of calculations of damage. Such techniques have to be based on modern approaches to an assessment of natural resources, modern methods of definition of changes in environment (including remote consequences) at negative impacts on its components; to be guided not only by harm to health of the person, but also by other "responses" of environment. Expediency of such works is caused also by need of exact economic estimates of negative ecological consequences. It is obvious that effective management of risks has to lead to their decrease finally. However for this purpose it is necessary to compare results of the carried-out economic activity with the gained income and costs of elimination of negative consequences ("ecological expenses"). In that case effective management of environmental risks just will also be estimated by comparison of possible investments at preventive actions and costs of compensation and elimination of damages. Risk management isn't settled only by insurance and reinsurance. More it has to be focused on minimization of financial risks as derivative financial instruments of management of environmental management at the enterprises. A main goal of such approach - ensuring predictable financial results, including - on accident elimination and compensation of damages to environment. In other words, formation of ecological insurance funds shouldn't be spontaneous, and is obliged to be allocated in the separate line in nature protection expenses.

Objects of FEC in the conditions of market system first of all count the economic risks, at the same time technological, environmental (natural) hazards are most often ignored. However representation of such categories in itself of risks in terms of money can change radically the relation to environmental problems at the FEC. Therefore the basis of regulation of safety in the technogenic sphere has to be based on economic estimates, after all in the conditions of the market relations the major role is played by interaction of criteria "cost - efficiency".

In Donetsk national technical university work on the 4D REGION project is conducted. In figures 1-3 the structure of the project, novelty and universality of a technique are shown.

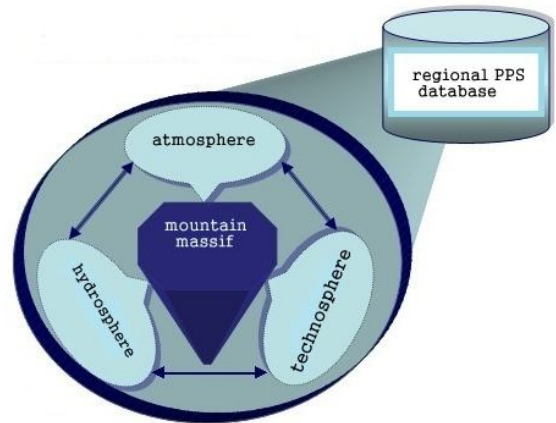


Fig. 1. General image of regional PPS database

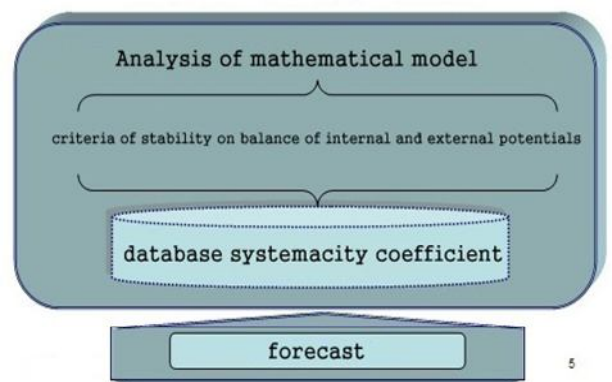


Fig. 2. Research of stability and reliability of the forecast

On the chart 3 it is possible to see interrelation between all elements which are anyway susceptible to influence of risk and can create danger.

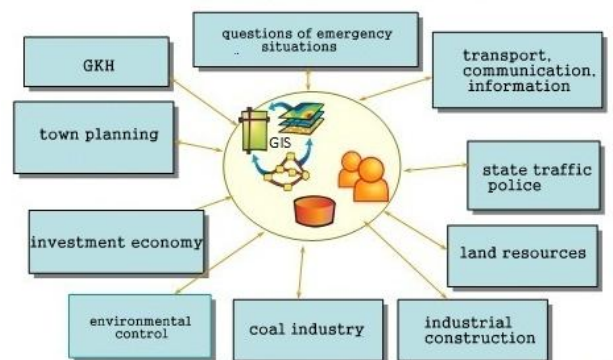


Fig. 3. Universality of a technique

On the chart 4 it is possible to see structure of divisions. each stage needs the assessment.

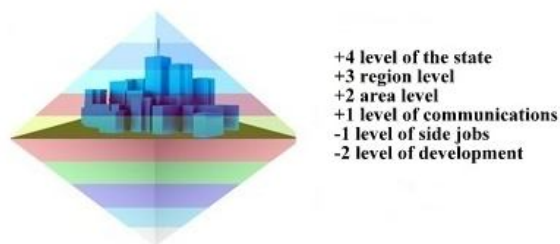


Fig. 4. Structure of the project on levels

### 3. Conclusion

Article is devoted to a hot topic: to research of stability of fuel and energy complex at the level of the region that in many respects defines its energy security. It is offered to be carried out by creation of formal model of FEC and its research on stability. However, creation of such model represents certain difficulties because of big dimension of data, their incompleteness, high dynamism of subject domain in the conditions of an economy in transition. The solution of this problem possibly by development of methods of the system analysis for ensuring stability of functioning of natural systems.

### 7. References

1. Volkova V.I., Denisov A.A. Osnovy teorii sistem i sistemnogo analiza/ V.I. Volkova, A.A. Denisov.- SPb.: Izd. SPbGTU, 1997 - 510 p.
2. Xaustov A.P. Problema ocenok i upravleniya e'kologicheskimi riskami na predpriyatiyah TE'K.// "E'nergobezopasnost' v dokumentax i faktax. №6. – M, 2008.– p.25-28.
3. S.Yu.Prixod'ko, P.I.Polyakov. K teorii ustojchivosti regional'nyh prirodno-promyshlennyh sistem //Problemi ekologii.-Donec'k: DonNTU, 2009, №1-2, p.70-74.
4. Prixod'ko S.Yu., Skazhenik V.B., Polyakova L.P. Perspektivy primeneniya GIS- texnologij v regional'nom upravlenii Donbassa. / Zbirnik naukovix prac' Donec'kogo derzhavnogo universitetu upravlinnya.-Donec'k-2010, t.XI? seriya "Texnichni nauki", v.158 – p.178-187.
5. Prixod'ko S.Yu., Polyakov P.I., Polyakova L.P. Konceptual'nye aspekty razrabotki informacionno-telekommunikacionnoj sredy sistemy zhizneobespecheniya regiona (na primere Donbassa)/ Mezhdunarodnyj nauchno-prakticheskij simpozium «E'kologicheskie, inzhenerno - e'konomicheskie i pravovye aspekty sistemy zhizneobespecheniya».- Gannover- 2010, p.21.
6. S.Yu.Prixod'ko. Informacionno-telekommunikacionnaya sreda sistemy zhizneobespecheniya regional'nyx prirodno-promyshlennyx sistem / Trudy VI-j Mezhdunarodnoj nauchno-prakticheskoy konferencii “ Obespechenie be-

zopasnosti v chrezvyčajnyx situacijax”- Voronezh-2010 –s.89-94.

7. Prixod'ko S.Yu., Skazhenik V.B., Polyakova L.P. Primenenie GIS-texnologij v regional'nom upravlenii Donbassa/ Materialy VIII Mezhdunarodnoj nauchno-prakticheskoy konferencii “Sostoyanie i perspektivy informacionno-innovacionnogo razvitiya rynka turistichekix uslug”.- Doneck-Svyatogorsk-2010, 250 p.