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## The economic and environmental consequences of emergency situations in the system of accounting objects

### Abstract

**Introduction.** The management of economic and environmental security of industrial enterprises in emergencies is important in the current economic conditions. The control system of economic and environmental security should include the impact of enterprises' activity on the environment under usual conditions and in emergency situations. Both economic and environmental consequences can be the effects of emergencies. Moreover, they have an impact on the economic activity of industrial enterprises, and, therefore, should be considered in accounting. In accounting, this necessitates a study of ecological and economic consequences, in relation to a complex object management and account mapping.

**Purpose** of the article is to study the impact of emergencies on economic activity and determine their influence over the system of accounting objects.

**Methods.** The study was carried out on the basis of both general and special methods. In particular, we used statistical methods to foresee emergencies in Ukraine and assess their impact on economic activity. To justify the essence of emergencies, hazardous events and their interrelation with groups of objects we used accounting methods of analysis and synthesis, theoretical synthesis, methods of induction and deduction.

**Results.** The study has proved the interrelation between hazardous events in emergencies and both internal and external environment of industrial enterprises. On the basis of the proposed classification of emergencies we have structured accounting facilities depending on the types of emergencies which lead to dangerous events concerning functioning of internal and external environment of industrial enterprises. All objects are grouped into three categories: economic and environmental impacts, preventive measures and measures to overcome the consequences of emergencies.

**Conclusion.** The given approach is the basis of organizational and methodological provisions of the economic security and management of industrial enterprises in emergency situations. In particular, the identified areas of accounting facilities represent a qualitatively new approach to the development of accounting giving a tool for managing enterprises in emergencies.

**Keywords:** Economic and Environmental Security; Emergencies; Accounting; Consequences of Emergencies; Industrial Enterprise

**JEL Classification:** Q 51; M 41; M 11

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#### Економіко-екологічні наслідки надзвичайних ситуацій в системі об'єктів бухгалтерського обліку

**Анотація.** У статті обґрунтовано взаємозв'язок між поняттями «подія» та «ситуація», «небезпечна подія» та «надзвичайна ситуація», а також визначено їх місце у внутрішньому й зовнішньому середовищах функціонування промислового підприємства. На основі вивчення класифікації надзвичайних ситуацій було запропоновано структурування об'єктів бухгалтерського обліку залежно від видів надзвичайних ситуацій, до яких призвели небезпечні події внутрішнього та зовнішнього середовищ функціонування промислового підприємства. Здійснено поділ усіх об'єктів на три групи: економіко-екологічні наслідки, заходи превентивного характеру та заходи з подолання наслідків.

**Ключові слова:** економіко-екологічна безпека; надзвичайні ситуації; бухгалтерський облік; наслідки надзвичайних ситуацій; промислове підприємство.

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#### Экономико-экологические последствия чрезвычайных ситуаций в системе объектов бухгалтерского учета

**Аннотация.** В статье обоснована взаимосвязь между понятиями «событие» и «ситуация», «опасное событие» и «чрезвычайная ситуация» и определено их место во внутренней и внешней средах функционирования промышленного предприятия. На основе изучения классификации чрезвычайных ситуаций было предложено структурирование объектов бухгалтерского учета в зависимости от видов чрезвычайных ситуаций, к которым привели опасные события внутренней и внешней сред функционирования промышленного предприятия. Осуществлено группировки всех объектов в три группы: экономико-экологические последствия, меры превентивного характера и меры по преодолению последствий.

**Ключевые слова:** экономико-экологическая безопасность; чрезвычайные ситуации; бухгалтерский учет; последствия чрезвычайных ситуаций; промышленное предприятие.

**1. Introduction.** The control system of economic and environmental security should include the impact on the environment in relation to the usual activities of the enterprise and its activities in emergency situations. The consequences of emergencies can be both economic and environmental. Moreover, both have an impact on the economic activity of industrial enterprises, and therefore are recognized in accounting. This pre-determines the necessity to recognize the economic and environmental consequences of emergencies in accounting as an integrated management and reflection object.

**2. Brief Literature Review.** The impact of economic and ecological consequences of emergencies on economic activity of industrial enterprises in relation to their management and legal regulation has been studied by a number of domestic and foreign scientists, such as: Alymov A. N. (2000) [1], Balatsky O. F. (1976; 1979; 1994) [2; 3; 4], Brydun Ie. V. (2002) [5], Bykov A., Zemlianaia G., Solenova L., Furman V. (1999) [6], Veiber A. A. (1976) [7], Gusev A. A. (1980, 1977) [8, 9], Dzera O. V., Podkolzin I. V. (2008, 2009) [10, 11], Drozd I. K., Nazarova G. B. (2009) [12], Ilicheva M. V. (2005) [13],

Kislyi V. N. (2007) [14], Koff G. L., Gusev A. A., Vorobiev Iu. L., Kozmenko S. N. (1997) [15], Krysan T. Ie. (2008) [16], Onyschenko S. V., Samoilik M. S. (2012) [17], Revych B. A., Sydorenko V. N. (2006) [18], Semenenko B. A. (1990) [19], Sydorenko V. L., Azarov S. I., Ieremenko S. A. (2006) [20], Skydanenko Iu. P. (2007) [21], Khaldeev V. T. (1971) [22], Khlobystov Ie. V. (2004) [23], Fowlie M., Knittel K. R., Wolfram C. (2008) [24], Lvovsky K. (2001) [25], Viscusi W. K. (2006) [26].

**3. The purpose of the article** is to study the impact of emergencies on economic activity and determine their consequences on the system of accounting objects.

**4. Results.** The development of human society is integrally linked to different types of disasters, conflicts and crises which are caused by cyclical processes that take place in all spheres of life. In the recent years technogenic disasters occur more often, and their consequences affect the economic activity of humanity at all levels. According to the UN, in many countries natural and anthropogenic disasters cause damages that amount to 2-4% of their GDP. Thus, the natural disasters yield even anthropogenic losses in size. That is why, in recent years, considerable attention is given to researchers developing various methods of analysis of consequences of technological disasters and measures to prevent them [27].

According to the scale of production, the number of complex environmentally dangerous and potentially dangerous enterprises, Ukraine can be attributed to developed countries, and according to the scale of improvement of technology, natural capacity and withdrawals – to developing countries. These and many other factors of intensification of negative processes in the interaction between society and nature show that the traditional practice of environmental protection and the implementation of preventive measures of emergency environmental situations in the praxeological aspect are imperfect. The concept of vulnerability of the population and economic facilities to natural disasters and catastrophes is key to understanding the mechanism of interconnection of environmental emergencies and economic development through a form of probabilistic risk awareness of disasters in general. It turns out that the genesis and severity of economic damage from natural disasters and technogenic disasters depends primarily on the type of socio-political system and method of management. Recently, Ukraine formed the sharp differences between the regions in terms of accumulated economic potential scope and intensity of economic activity [28].

The primary area of research above problems should become an object of mapping study related to the management of the enterprise in emergencies as well as defining components of economic and environmental damage as an object of accounting. This will define directions of the organization and methodology of accounting the economic and environmental consequences of emergencies and operations to overcome them.

Statistical analysis of emergencies in Ukraine, points to a significant number of them and thus incurred losses. Figure 1 presents the dynamics and structure of emergencies in Ukraine and its regional distribution.

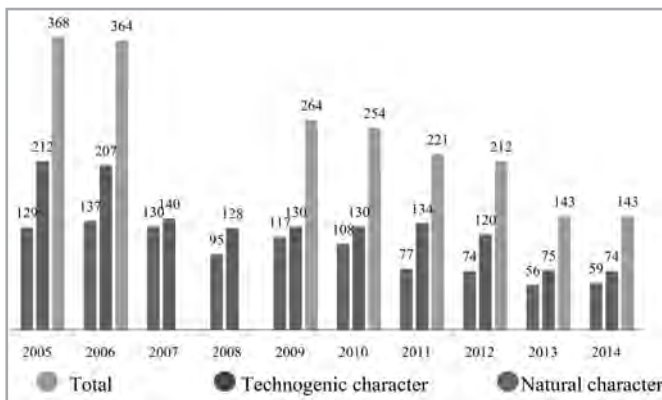


Fig. 1: Dynamics of emergencies by nature

Source: Own development based at [29]

Thus, the emergencies that arise as the fault entity or not, lead to negative economic and environmental consequences for the health of both present and future generations

Some of these emergencies caused economic and environmental damage that relied on the state and the entities affecting the level of economic and environmental security of industry. Managing economic and environmental consequences of emergencies is important not only for economic and environmental security of industrial enterprise, but there is a state concern in this direction. Bublyk M. I. and Koropetska T. O. on this occasion noted that «the destructive impact of human activities, which borders with notion of rather extraordinary, is characterized by unacceptably high level of fixed life-supporting natural resources, limit pollution of environmental systems, depletion of renewable capacity and a sharp deterioration in health, which poses a serious threat to national security of Ukraine. With Ukraine's transition to a market economy property issues, evaluation of its facilities in terms of money and the determination of the damage caused by economic activity and in Emergency Situations (ES) of technogenic and natural disasters have deteriorated. Therefore, the increasing need for assessing economic losses from industrial activities, of particular relevance is the problem of the choice of methods and approaches to their assessment, and the development of modern methods considering the achievements of evolutionary economics» [30, 32].

Taking into account the aftermath of emergencies, it is necessary to emphasize that they are complex, as there is a set of objects of accounting. Thus, emergency situations can be manifested in the accounting system in the form of economic and environmental losses, expenses and income, assets and liabilities. In order to prevent or overcome the consequences of emergencies the enterprise should carry out an appropriate action, which also takes place in the accounting system. Therefore, the aggregate data objects of management and accounting determine how to provide economic and environmental consequences of emergencies. In order to study all the characteristics and properties of the object, determining the specific organizational and methodological provisions of accounting reflection, consider their place in the economic management of industrial enterprise. To do this, we should define the essential contents of the concept of emergency and its importance for the industrial enterprise. In addition, it determines the level of impact on industrial environment, as well as its economic situation and investment attractiveness, which in its turn provides its continued operation.

The theoretical basis for organizational and methodological provisions of accounting of economic and environmental consequences of emergencies at industrial enterprises is limited to the definitions of terms such as «event», «situation», «dangerous event» and «emergency». It will generally determine the place of emergencies in the management of economic activities of industrial enterprises and the procedure of identification of risks associated with them. Regarding the concepts of «dangerous event» and «emergency» there is a number of inconsistencies in domestic legislation. Thus, the Code of Civil Defense of Ukraine provides interpretations of concepts such as «emergency» and «dangerous event». The classifier of emergencies interprets the concept of «the situation». Some legislation, such as the Law of Ukraine «On space activity» and the order «On approval of rules of search and rescue provision of flights in civil aviation of Ukraine», provide the concept of «extraordinary event». The term «extraordinary event» was also used in the first edition of P(S)BU 3 (which is Ukrainian accounting standard) «Income Statement» (of 31/03/1999) and Guidelines for the analysis and assessment of the financial situation of enterprises (of 28/07/2006).

Based on the interpretation of the concept «event» and «situation» in philosophy, we can say that the event is primary, which in turn leads to a situation in a certain system of relations. Thus, by the term «event» in this study we understand a thing, which has happened, any significant occurrence in a certain system of relations. In its turn, the term situation is a set of events, circumstances and conditions that create a particular state of the relationship.

If we consider these relations in the light of the definition or the system of relations between the entity and the natural environment, we get the following interpretation: an event is a phenomenon within the environment or entity that affects their interaction with each other; a situation is a set of events, circumstances and conditions in the environment or the enterprise that define the condition and changes of the relationship between their interaction.

In general, if we speak about events and situations, we can divide them into ordinary, i.e. those that do not violate the normal relations, and emergency, which affect the normal conditions of interaction between the environment and the entity.

Thus, a set of events and situations which do not violate the normal conditions of interaction characterize normal activities of industrial enterprises, and those which violate – activities in emergency events. Moreover, these events can be triggered as events and situations in the external environment (natural, economic and social environment) and the internal environment, i.e. disruptions in the functioning of business processes of industrial enterprise economic activities resulting in a negative impact on the natural environment which is greater than under normal operations. Such disruptions in the functioning of business processes of economic activity, which lead to negative effects on the environment, can cause events and situations in the environment as well as within a particular area (a town, a village, a district, a region, a country) or at an industrial enterprise. Such events are determined as dangerous events and the situation caused by them in the relationship between the environment and industrial enterprise is considered to be an emergency. So dangerous events are primary and emergencies are secondary, i.e. the result of certain events in the external and internal environment can lead to emergency situations. The relationship between dangerous events and emergencies in the internal and external environment is shown in Figure 2. The essence of the concepts of «dangerous event» and «emergency» in this study will identify the conformity with the provisions of the Code of Civil Defense of Ukraine. Accordingly, we consider it necessary to harmonize these concepts in all legal acts. For the purposes of management of industrial enterprises and accounting security management of consequences of emergencies we offer to use the definitions given in the Code of Civil Defense of Ukraine.

According to the proposed definitions of «dangerous event» and «emergency» and the illustrated the relationship between them (Figure 2) we can identify the following characteristics of their manifestation in the economic management of industrial enterprise:

1) a dangerous event, which is caused by the environment of functioning of industrial enterprise causes an emergency both in the external and internal environments. This situation has relevant consequences that can have an economic, social and environmental nature for industrial enterprises and the region. In its turn, the industrial enterprise should take preventive measures to reduce the negative economic environmental consequences of such situations and measures to overcome them both at the national level, i.e. enterprises for their own purposes, and at external level, i.e. to ensure the proper functioning of the environment;

2) an emergency caused by dangerous events of the environment may lead to disruptions in the functioning of the business processes of the industrial enterprise, which in its turn may cause a negative increase of economic environmental consequences of emergencies or an emergency of the internal environment. This suggests that the emergency caused by a dangerous event of environment can become a dangerous event that caused the emergency of internal environment. That is a complex interrelationship between dangerous events and emergencies of internal and external environment. All the abovementioned causes management problems because there are special facilities which require certain business processes due to the operation of enterprises in emergencies;

3) dangerous events of internal environment lead to emergencies within both the internal and external environment. Such events may occur because of disruptions in business processes of economic activity of industrial enterprises caused by human activities or technological factors. Such events lead to negative economic and environmental impact both on private industrial enterprise and on the environment. Under such conditions the company incurs losses associated with damage caused to the environment or human health, while economic loss may be associated with damage to the property of a company, the failure to fulfill its contractual obligations because of force majeure.

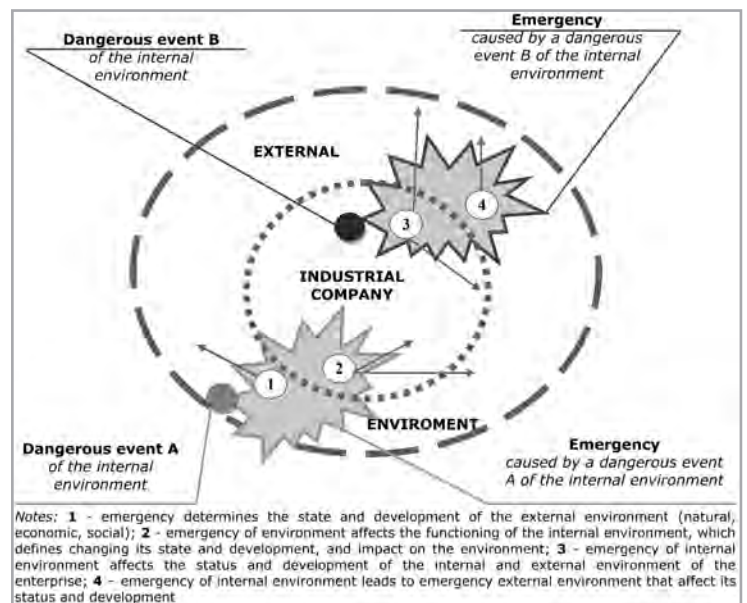


Fig. 2: The interrelation of dangerous events in emergencies of internal and external environment of the industrial enterprise

Source: Own development

Thus, to ensure the economic and environmental security of the industrial enterprise in emergencies it is necessary to establish effective management of economic and environmental consequences and their accounting and to install analytical software. This requires a structured system of economic activities in emergencies. It is necessary to define the types of emergencies and their impact on the internal and external environment of enterprise and industrial areas management. Depending on the type of emergency, preventive measures to reduce the negative economic and environmental consequences as well as measures to overcome them should be taken.

To identify areas of economic management of industrial enterprises in emergency situations by their individual types, it is expedient to take the National Classification DK 019: 2010 «Classification of emergencies» as a basis. According to the document, emergencies are classified into two main groups. Depending on the nature of their origin, there are events that may lead to emergency situations (technogenic character, natural disasters, social issues, military nature) and events which depend on the volume of consequences caused by emergency situations (state, regional, local). These classification criteria are interrelated, and within each group classifiers are correlated with an emergency.

If the classification is applied to the proposed approach to understanding the interrelationship of dangerous events and emergencies of the internal and external environment, we can state that the internal environment of dangerous events can lead to emergency situations only of technogenic disasters, which are interpreted by the Classifier as «disruption of normal living conditions and human activity in a specific area or object in or on water due to transport accidents (disasters), fire, explosion, accident with ejection (ejection threat) of dangerous chemical, radioactive and biohazard substances, sudden destruction faci-

ilities; accident in power systems, life support systems, telecommunications systems, at treatment facilities in the oil and gas industrial complex systems, hydrodynamic accidents, etc.» [31].

Emergencies of natural origin are caused by dangerous events of purely external environment. It should be emphasized that emergencies may arise through the dangerous developments in both external and internal environments of industrial enterprises. The structure of objects of management of economic and environmental security of industrial enterprises in emergencies caused by internal environment (technogenic character) according to the Classifier is shown in Figure 3.

Economic activity of the industrial enterprise can lead to a number of emergencies. According to the current Classifier, emergencies affecting the process of acquisition and implementation, in terms of transportation are those caused by accidents or disasters and transport (10100). In handling a part of the acquisition and implementation, may affect emergencies due to: fire and explosions (10200), sudden destruction of buildings and structures (10600), accidents in electrical systems (10700), failures in the systems for mining (10800), accidents at wastewater treatment buildings (11000). In the production process or as a result of this process, emergencies may occur due to: fire and explosions (10200) accidental emissions (the threat of ejection), minerals and other objects (10300), the presence in the environment of harmful (polluting) and radioactive substances over the maximum allowable level (10400) accidental emissions (the threat of ejection) (10500), sudden destruction of buildings and structures (10600), accidents in electric power systems (10700), failures in the systems for mining (10800), failures of telecommunications (10900), accidents at wastewater treatment plants (11000), hydrodynamic accidents (11100), failures in the systems of oil and gas industrial complex (11200).

These technogenic character emergencies can have negative consequences both economic and environmental. To ensure the management of industrial enterprise in the conditions of emergency situation appropriate measures are to be taken. Such measures may have preventive character and be aimed at overcoming the negative economic and environmental consequences of technogenic character emergencies. Real identification of economic and environmental consequences and measures to overcome them will depend on their volumes. According to the classifier such amounts can have the following levels: 1) an object (the economic and environmental consequences apply only to industrial enterprises, i.e. at the level of the internal environment); 2) local, when an emergency situation that occurred at the plant leads to improper functioning of economic and natural systems of the town or village; 3) regional, when economic and environmental consequences of man-made emergency spread to the area or region; 4) state, when economic and environmental impacts have national significance. Overall economic management system of industrial enterprise in emergencies, to ensure its economic and environmental security, will have the following components that define a set of objects of accounting: identification and evaluation of economic and environmental consequences of emergency situation. Purely economic effects may include: lost or damaged current and non-current assets, such as buildings and structures, production lines, raw materials; obligations to economic agents (government, enterprise, public), resulting from damage to emergencies; lost economic benefits industrial enterprise could get provided in normal operation conditions; economic losses at the result of emergency. Environmental consequences that can be economically evaluated, reflected in accounting and can be identified in the following areas: severe economic damage caused to the environment; severe economic injury to public health, waste formed as a result of emergencies; implementation of measures of preventive nature to prevent or reduce the economic and environmental consequences of technogenic character emergencies. In this group of objects we have selected accounting measures and objects of capital and current nature. Measures of the capital nature should be directed at improving the processes that prevent or reduce the likelihood of technogenic character emergencies. Implementation of these measures related to the implementation of capital expenditure, aimed

to overhaul existing equipment or processes purchase of new equipment, which is aimed at avoiding emergency situation. Measures related to current expenditures aimed at the formation of the current assets that are used to overcome the effects in the future, and the costs of training. A particular object in terms of preventive measures is the creation of financial security to overcome the economic and environmental effects which may be achieved by the formation of the reserves or insurance risk of emergency situation; implementation of measures to overcome the consequences of emergency situation. In this group two subgroups of objects, measures to overcome the consequences of reduction area and distribution of emergency were identified. Within these subgroups the following groups of objects were identified: use of non-current assets (depreciation), use of working assets (tangible costs), service of harmed (other expenses), use of labor (labor costs and social measures).

A set of accounting of objects related to economic activity in conditions of emergency situation was defined. Recording these facilities will form the information space for decision making in the area of economic and environmental security of industrial enterprises in the emergency situation. An important part in ensuring economic and environmental security of industrial enterprise management system lies on business activities of industrial enterprises in emergencies, which caused dangerous event environment. These situations can be natural, social and technogenic. Each type of emergency determines the impact on a given business process of economic activity of industrial enterprises, which is presented in Figure 4.

The research of the Classifier of emergencies in environment includes natural, social and military emergencies. Within emergencies of natural origin the greatest impacts on the economic and environmental security of industrial enterprises are the following:

- geophysical emergencies (20100) related to earthquakes and geological (20200) that are associated with volcanic eruptions, landslides, avalanches, subsidence, etc., can cause considerable damage to industrial enterprises of Ukraine. This type of emergencies is not common in Ukraine, but some territories are seismically active. They are: Western Ukraine, Crimea and Odessa region, in which earthquakes are felt if they happen on the territory of Romania. Over the last few years in Ukraine, earthquakes that occurred have not lead to significant economic and environmental consequences, but at the global level of management of industrial enterprises in terms of geophysical emergencies they can be very devastating, particularly for Japan, the USA and other countries located in seismically active areas;
- meteorological emergencies (20300) determine weather conditions in terms of precipitation. As a result of weather emergencies industrial assets can be damaged or destroyed at all stages of business processes including acquisition, production, sales. In addition, damage to technological business processes can be a dangerous event that may lead to a technogenic emergency situation that requires taking appropriate measures to ensure the economic and environmental security of industrial enterprises;
- hydrological marine emergencies affecting the business processes of acquisition and implementation. Thus, under conditions of emergency, if a ship is damaged, it must have the corresponding status. The status of lost cargo is determined according to the contractual terms of force majeure, i.e. damages for lost cargo may carry both the buyer and the seller or they may be subject to insurance, whereas the insurance company is to pay insurance;
- hydrological surface water emergency (20500) shows the state of economic and environmental security of the industrial enterprise as follows: when water is high it may mean a threat of flooding, submergence, and at a low level it may lead to a lack of water if surface water is used for technological purposes. To avoid or reduce this type of damage, the industrial enterprise conducts precautionary measures which may relate to repairing dams, building fortifications, etc. All this requires incurring the associated costs, which can be both capital and current. In addition, the company may insure the

risks related to hydrological emergencies;

- emergencies associated with fires in natural ecological systems, could lead to economic and environmental consequences for all business processes of economic activities of industrial enterprises. At their occurrence industrial enterprise uses material, labor and financial resources to overcome them, which requires an appropriate reflection and formation of information for decision making.

Under modern conditions of social development, criminogenic factors are weighty important because the probability of capture of sea (river) vessels by pirates is growing every year. Piracy belongs to emergencies of social character (30300) which is characterized by attack attempts on the life of crew members of air or sea (river) vessels, kidnapping (abduction attempt), destruction (an attempt to destroy) such a ship, capture of hostages from the members of the crew or passengers. In recent years, ships under the Ukrainian flag were objects of pirate capture, with Ariana, BelugaFortune, Lehmann Timber, Lugela, Panagia, Faina among them [31, 87] In case of such emergencies, the company may suffer economic and environmental damage that appears on the state of economic and environmental security. Among the preventive measures additional navigation systems, security, satellite communications may be established. Also, training of seafarers will have a weighty value in case of pirate capture. Another type of emergencies of social issues that have an impact on the economic and environmental security of industry are those related to accidents with people (30600). Extraordinary situations of this type have a deeper economic impact and damage caused to human health. As a result of such situations, industrial enterprises have obligations to employees. Measures of preventive nature may improve the processes of training employees and other staff. For an industrial enterprise management of such situations has significant importance in view of economic factors and in terms of improving the company's ranking and image.

Another type of emergencies that have an impact on the system of economic and environmental security of industrial enterprise are military emergencies. This type has been typical of Ukraine since the beginning of the antiterrorist operation in Luhansk and Donetsk regions. For the past year and a half, a large number of different industries have been destroyed in some areas of these regions because of the use of heavy

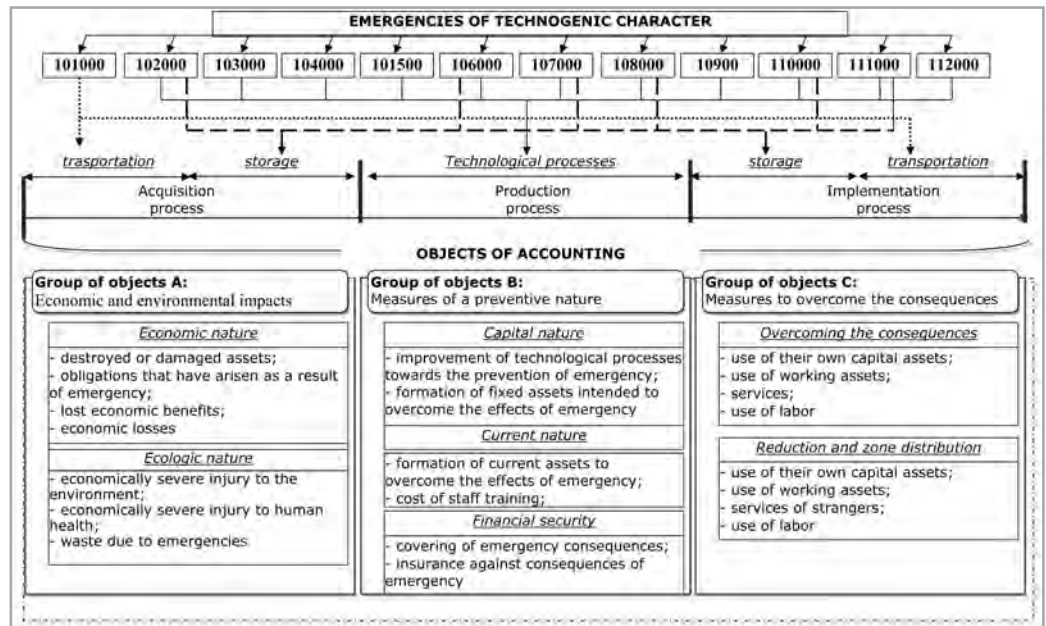


Fig. 3: The proposed structuring of objects of accounting and analytical maintenance of economic and environmental security of industrial enterprises in emergencies of the internal environment  
Source: Own development

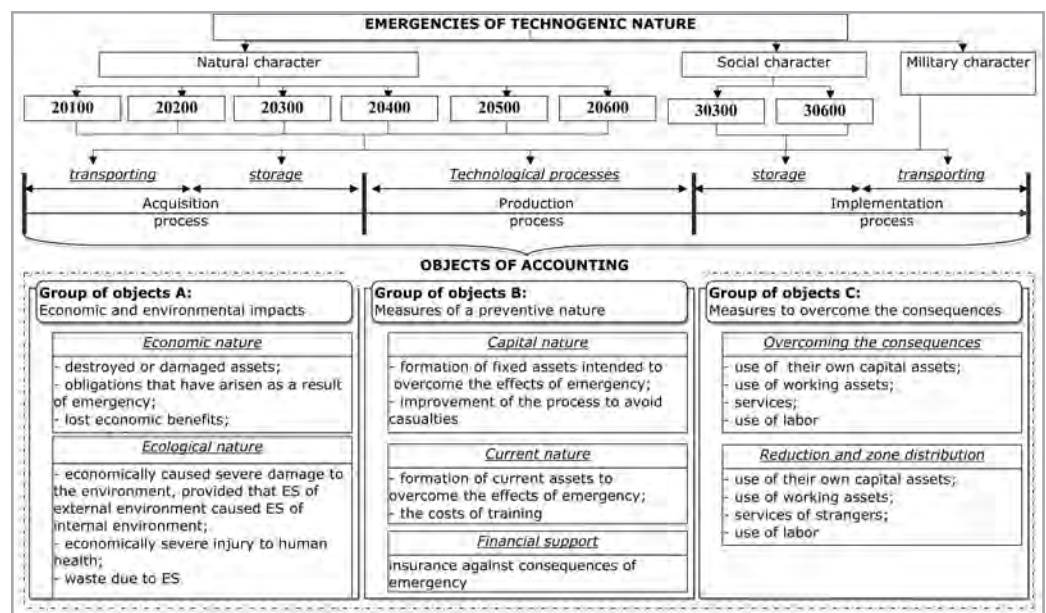


Fig. 4: The proposed structuring of facilities of accounting and analytical maintenance of economic and environmental security of industrial enterprises in emergencies environment  
Source: Own development

weapons. Some enterprises have been registered in other territories or lost their branches and production lines. Fighting in these areas has led to a number of economic and environmental consequences for both individual and regional entities.

**5. Conclusions.** The study has proved the relationship between the concepts of «event» and «situation», «dangerous event» and «emergency», defined their place in the internal and external environments of functioning of the industrial enterprise. On the basis of the classification emergencies structuring facilities accounting depending on the types of emergencies, which led to dangerous events internal and external environments functioning of industrial enterprise were proposed. All objects are grouped into three categories: economic and environmental impacts, preventive measures and measures to overcome the consequences. This approach is the basis of organizational and methodological provisions of an economic and security management of industrial enterprise environmental safety in emergency situations.

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