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The Modern Strategy to the Process of Managing Complex Security of the Enterprise on the Basis of Rational Centralization

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Abstract: ***In the article the strategy that justifies the need for rational centralization of integrated techno sphere security management at the enterprise is developed, which allows to formulate a management process strategy, to develop measures to ensure the quality of the personnel security system, production process and material values, and to focus efforts on minimizing (eliminating) risks.***

Keywords : techno sphere, integrated security, centralization.

I. INTRODUCTION

One of the pressing issues that occupy the scientific community in the 21st century is the search for ways to protect man and his environment. To assess the possible state of human security tomorrow, today it is necessary to identify the nature of the threats and dangers that he may face in the long run. This requires the formation of a modern culture of production and consumption, the search for a way of rational human activity in the field of security through the application of scientific strategies. According to some estimates, in the near future there will be a number of new additional threats to human security [1].

Sustainable development of any enterprise producing goods for the livelihoods of the population of large cities and megapolicies is largely determined by its types of production of goods or services, and enterprises whose activities are aimed at providing livelihoods to water, heat, electricity, etc. The production process of the enterprises in question takes place in an environment of increased risk of various types of technological hazards, including those associated with the handling of explosive and fire hazardous substances and materials, which requires an integrated strategy to ensuring the safety of objects of protection. The need to implement a comprehensive strategy to the formation of a system of protection against hazards at the enterprise has been on the agenda relatively recently - since the introduction of definitions and concepts of "objects of protection" in the content of the requirements of documents [2, 3].

The objects of protection in these regulatory documents are products (including property of citizens or legal entities, state or municipal property, including objects located in the territories of settlements, as well as buildings, structures, vehicles, technological installations, equipment, aggregates, products, etc. property) for which fire safety requirements are established or should be established to prevent fire and protect people in case of fire. In addition, the objects of protection include premises, processes, technological installations, substances, materials, products, as well as their elements and aggregates, and a person is a part of the object of protection.

II. ANALYSIS

The presented definitions cover the completely tangible surrounding world of technogenic space in interaction with a person (working personnel) and indicate the presence of a wide range of tasks related to integrated safety at the enterprise. The new direction of ensuring safety selected for the examination is a project in which an attempt is made to encompass the practical implementation of separately taken directions (anti-terrorism security, industrial and fire safety, civil defense and emergency situations, labor protection, environmental safety, etc.), which certainly requires the implementation of an integrated strategy (Fig. 1). The content of the project should provide for an increase in the level of all types of emergency prevention and response, it is necessary to solve the problems of developing and forming a model for managing an integrated security system (SOKB), and relevant information and analytical support.

Obviously, an integrated strategy to the safety of the technosphere will require research aimed at developing:

- process model of the safe operation of the technosphere;
- technosphere security policies and strategies, taking into account existing restrictions;
- strategies to the choice of means and methods for ensuring integrated safety of the technosphere.

The concept of "technosphere" is currently undergoing a stage of rapid evolution and is being considered as a set of environmental elements within the geographic shell of the Earth, which have no analogues in pristine nature, but are created from natural substances - by human labor and conscious will. Yu.A. Kovalev wrote about the evolution of the technosphere: "The evolution of the technosphere is much faster than the evolution of the biosphere.

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Another great advantage of terrestrial technology over protein organisms is the fact that technology is very mobile in terms of changing its structure and organization. Therefore, terrestrial engineering can become an auto-evolutionary system much faster than protein organisms. The terrestrial technosphere must sooner or later can be turned from a controlled system into an auto-evolutionary system "[4].

- possible.

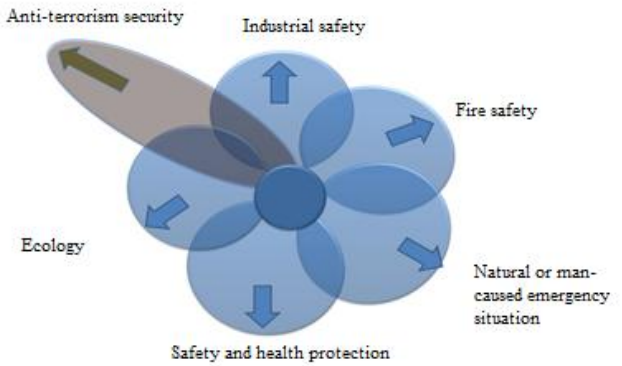


Fig. 1. Directions for ensuring integrated security implemented at the enterprise

The assessment of research materials describing theoretical strategies in the safe functioning of the technosphere allowed us to establish that:

- to date, a unified strategy to the definition of the concept of "technosphere security system" has not been formed;
- the scientific theory of the safety of the technosphere is in the process of formation.

In the legislation of the Russian Federation, the concept of "security" was formulated in Art. 1 of the Law of the Russian Federation previously in force No. 2446-1 dated March 5, 1992 "On Security", where "security" was considered as a state of protection of the vital interests of the individual, society and the state from internal and external threats.

In the content of document [3], "security" is considered as a state of protection of the rights of citizens, natural objects, the environment and material values from the consequences of accidents and disasters at the industrial facilities. Supplementing the concepts with the term "security" significantly expands their meaning, emphasizing the activity of responding to threats of dangers, considered as potentially or realistically possible events, actions, processes or phenomena that could disrupt the production process of the technosphere, its stability and development, lead to a halt.

Currently, researchers have presented a classification of threats to hazards on various grounds, presented justifications for strategies in the selection of different impact parameters on the objects of protection of the enterprise, methods of quantitative measurement of these parameters. One part of the researchers focuses on protecting the enterprise from environmental hazards in the form of economic, informational or physical security. Another part of the basis of security is the social component, aimed at maintaining the stability of social and spiritual-cultural systems.

In this work, the object of the examination is not the whole range of issues covered by the concept of "security", but only the problems of the integrated security of the enterprise, which require solving in the internal environment of the enterprise's functioning through the development of preventive measures for hazards of a deterministic nature.

Presented in fig. 1 direction "Anti-terrorism security" in the content of the internal environment of the enterprise's functioning will not be considered due to the stochastic nature of the emergence of dangers of a terrorist nature. It is this restriction that will allow us to characterize the functional content of individual areas (industrial and fire safety, civil defense and emergency situations, labor protection, environmental safety, etc.), to select the most conceptual ones in terms of information and analytical security.

Taking into account mentioned above, the term "integrated enterprise security" will mean the state of functioning of the enterprise's production process, considered as a set of interacting functional areas of safety (industrial and fire safety, civil defense and emergency situations, labor protection, environmental safety, etc.), united by a single decision concept aimed at minimizing (eliminating) the probability of emergency situations. Achieving the main goal of integrated enterprise security - minimizing (eliminating) the conditions for the occurrence of hazards arising in the internal environment of an enterprise's functioning, is inextricably connected with the improvement of the enterprise's integrated security (IS) management methods.

IS management of the main link of the economic mechanism should become an integral part, a subsystem of the enterprise's overall management system, since only the implementation of an integrated strategy to ensuring security will solve the problems associated with the primary life support of the population with water, heat, electricity, etc. (fig. 2).

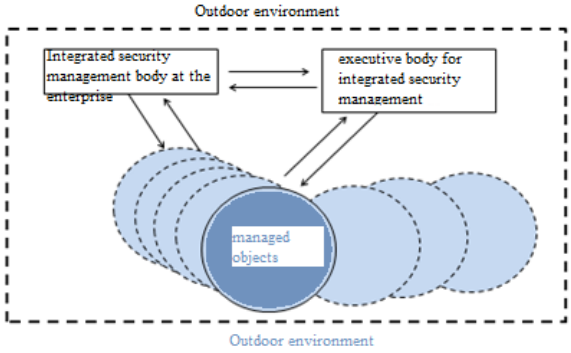


Fig. 2. Enterprise Security Management

In general, the enterprise security management is defined as a set of actions selected on the basis of certain information and aimed at maintaining or improving the functioning of the protected object in accordance with the existing program (algorithm) or purpose of functioning.

The assessment carried out in the implementation of safety management tasks in the form of separate industry areas (industrial and fire safety, civil defense and emergencies, labor protection, environmental safety, etc.) indicates the presence of the following existing problems associated with the formation of the enterprise safety management system.

1. Mission, common goal, policy and strategy of integrated enterprise security are not always clearly formulated.
2. As a rule, there is no single idea of the object and subject of the integrated security system, the mechanism for implementing the management tasks is not well developed, and strategic actions for managing this system are not defined.
3. The management system uses information with elements of inconsistency, which is a problem for developing an adequate assessment of the current situation and preparing managerial decisions.
4. There is no scientific, methodological and technological elaboration of models and methods for the formation of integrated security at the enterprise, the unity and consistency of information coming from individual areas of security.
5. The unified strategy to the formation of resources for building an integrated security system and maintaining it at the required level has not been developed.

The results of the test in the regulation of integrated security in the countries of the European Union and Russia indicate different strategies to the implementation of the supervisory and control functions in managing the security at the state level (Fig. 3).

The confrontation of security regulation in the countries of the European Union and Russia indicates an additional impact on business in Russia from the part of supervisory authorities, which represents a significant burden on the production activities of enterprises. Moreover, the requirements of the instructions of the President of Russia on measures of reducing the administrative burden on business are not fulfilled [5].

The presented additional administrative pressure on business structures from the oversight bodies of the Russian Federation (Fig. 3), paradoxically, does not allow ensuring a high level of the security at the enterprises. At the facilities of industrial and agricultural production protection, incidents, accidents, fires, industrial injuries with severe consequences for personnel continue to occur, fires and emergencies of an anthropogenic nature occur. The same thing happens in the operation of residential facilities. In relation to fires, the data given in [6–8] are indicative in comparison with foreign statistical and methodological materials.

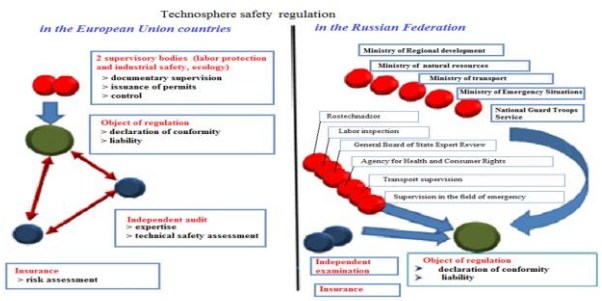


Fig. 3. The result of the assessment of strategies to the regulation of integrated safety in the countries of the European Union and in the Russian Federation

The existing integrated security system (SOKB) at enterprises is characterized by the presence of fields with gaps and intersection areas (fields No. 1 and No. 2 in Fig. 4). The assessment of the statistics of the occurrence of technogenic incidents indicates the presence of dangers attributed to others (8-12% of the total) and belonging to fields No. 1. These dangers arise due to fuzzy interaction in intersectoral directions (Fig. 4). Intersection areas No. 2 are characterized by duplication of requirements of the bodies of supervision and control of industry areas; they are oversaturated with the need to fulfill the relevant organizational and technical tasks.

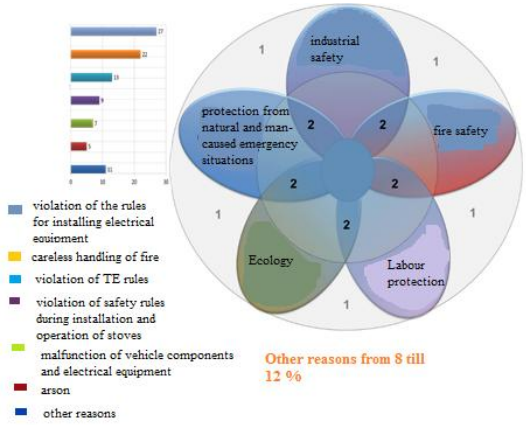


Fig. 4. The result of the assessment of statistics on the technological hazards

These shortcomings made it possible to formulate the target direction of the IS of enterprises related to the development and implementation of measures to minimize (exclude) the conditions for the occurrence of hazards in the internal production and technological environment. To do this, the following tasks were required:

1. To develop proposals for the formation of a unified strategy to the management of enterprises IS,
2. To prove the need for centralization of IS management,
3. To develop proposals for the formation of a concept in providing IS for protection objects.

In the process of developing and implementing the above directions, additional reasons were identified for centralizing the management of enterprise IS.

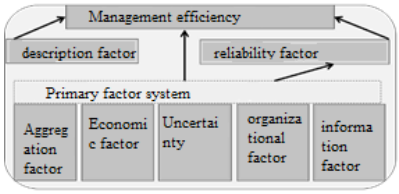
So, in the work [5] at the end of the last century a number of factors were presented that had a direct impact on the management efficiency in multilevel active systems (AS). These factors include:

- aggregation □ reduction of the information load for the participants of the control system (CS) due to the centralized processing of “general” information for all active elements (AE) based on the results of activities in neighboring subsystems;
- economic factor □ change in financial, material, organizational and other resources of the system when making changes to the existing management system;
- uncertainty, which depends on the knowledge of the system participants about the significant internal and external parameters of their functioning from the control mechanism used, i.e.

operational exchange of information on the situation in the control system and interacting subsystems;

- organizational factor is the definition for the CS of the conditions of activity of a managed process;
- information factor is a qualitative representation of the required information for all AEs included in the control system.

The presented factors of influence on the management system efficiency will allow a comparison to be made to confirm the advisability of centralizing or decentralizing the considered IS enterprise (Fig. 5).



$$\varphi(\pi_1) = \min_{\pi \in P(\pi_0)} \varphi(\pi) \quad (1); \qquad \varphi(\pi_k) = \min_{\pi \in P(\pi_k)} \varphi(\pi) \quad (2);$$

$$\tilde{P}(\pi_k) = \bigcup_{\pi \in P(\pi_k)} \varphi(\pi) \quad (3);$$

Fig. 5. The specifics in the implementation of IS at the enterprise

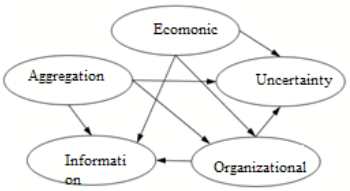
Due to the complexity and multicomponentness of a multi-level IS, the problem arises of finding the possibility of its optimization. To solve this problem, it is most preferable to use the local optimization method. The procedure for using the proposed method is to select the most appropriate solutions variants in the set P (π) - the so-called neighboring solutions (neighborhood of the solution π) [10,11].

In the neighborhood P (π_0) of any known solution π_0, the best solution π_1 is determined by formula (1) in Fig. 5. Here φ is the objective function corresponding to the selected factor. If $\varphi(\pi_1) < \varphi(\pi_0)$ then we consider the neighborhood P (π_1) and determine the best solution π_2, etc. until we obtain the solution π_k according to formula (2) in Fig. 5. Such a solution is called locally optimal.

Next, we expand the neighborhood with the following conditions, if π_k is a locally optimal solution, then we determine the neighborhood using formula (3) in Fig. 5.

The obtained result $\tilde{P}$ (π_k) is the union of all neighborhoods of solutions belonging to a neighborhood of a locally optimal solution. The advantage of the method under consideration is the simplicity of the corresponding algorithms, but when using this method, it is necessary to set the parameters for abstract objects (neighborhoods) and the conditions of the controlled process to select the optimal solution.

The assessment of the influence of factors on the management effectiveness of the enterprise IS and their interdependence in the centralization (decentralization) of management is presented in (Fig. 6). The symbol "↑" indicates an increase, and the symbol "↓" indicates a decrease in management efficiency. The symbol "↑↓" in the line of one or another factor indicates that with a corresponding change in the direction of centralization (decentralization), in the absence of the action of other factors, the effectiveness as a result of the action of this factor can both increase or decrease.



Factors	impact on management effectiveness in decentralization	impact on management effectiveness in decentralization
Aggregation	↓↑	↑
Economic	↓↑	↓↑
Uncertainty	↓↑	↑
Organizational	↓↑	↑
Information	↓↑	↑

Factors	Aggregation	Economic	Uncertainty	Organizational	Information
Aggregation	–	o	•	•	•
Economic	o	–	•	•	•
Uncertainty	o	o	–		•
Organizational	o	o	•	–	•
Information	o	o			–

Fig. 6. The result of the influence of efficiency factors in the centralization of management

Aggregation factor has a direct impact on information and organizational factors and the uncertainty factor. The influence of this factor on information and organizational factors in the centralization of management is positive due to the increased influence of the management body on managed objects. The influence of the aggregation factor on the uncertainty factor is also positive due to the on-line processing of information for system participants about the significant internal and external parameters of the functioning of the control subsystems.

The economic factor does not directly affect the aggregation factor, but affects the uncertainty factor, with centralization this effect can be positive due to the fact that the future CS will be created from among the operating controlled nuclear power plants with promising optimization of their structure and content.

The organizational factor does not directly affect the aggregation factor and the economic factor. At the same time, with the centralization of management, it can positively influence the factor of reducing uncertainty (changes in the organizational structure and the influence of OS on managed objects can help improve awareness).

The information factor is a consequence of all other factors, without directly affecting any of them.

The interdependence of the considered factors is presented in the table in Fig. 6. The rows of the table contain factors whose influence is investigated in relation to the factors located in the columns. If at the intersection of the i-th row and the j-th column there is a symbol “o”, then the i-th factor does not directly affect the j-th one, if there is a symbol “•”, it does.

Thus, having an idea of the qualitative relationship between various factors and obtaining the results of the assessment of their influence on management efficiency, it is possible to prove the need for rational centralization of the enterprise IS.

In the format of conceptual solutions for the formation of an effective operating IS will be designated as the coordination control object, which is part of the IS system, a kind of basic superstructure for organizing interaction between managed subsystems [12-15].

As a simple but illustrative example of the refusal to use an enterprise IS, one can cite an accident at a domestic thermal power plant, in the examination of the causes of which one of the authors of this article took part.

Most of the electric energy produced in Russia (about 66%) is generated by thermal power plants. These facilities are classified as hazardous production facilities (hereinafter - HPF) due to the presence of danger signs set forth in Appendix 1 to Federal Law No. 116-ФЗ On Industrial Safety of Hazardous Production Facilities, the main of which are:

- with the use in production activities of emergency chemical poisonous substances;
- accumulation and possible loss of emissions, huge discharge of huge kinetic, thermal, acoustic, and vibration reserves due to high pressure in the water supply pipelines;
- use of hydrogen to cool the turbine field winding;
- storage of significant reserves of fuel oil for use as fuel in emergency situations, etc.

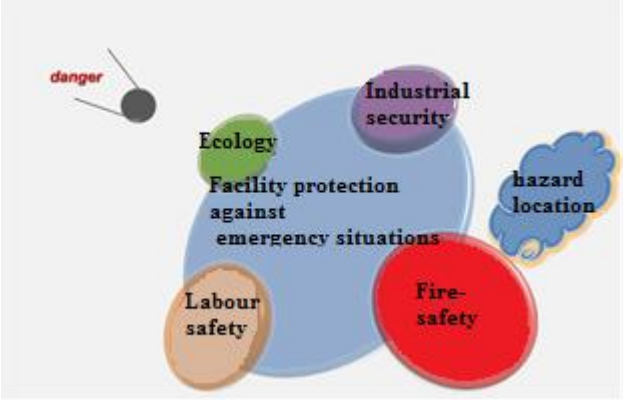


Fig. 7. The conceptual model of integrated security of enterprise protection facilities

From the point of view of classification features, the above hazards, according to certain criteria, belong to class 3, however, for Central Heating and Power Plant using natural gas methane as the main fuel, due to the gas supply pressure that can reach 2.5 MPa in the pipeline, on request of Decisions of the Government of the Russian Federation [16], such a hazardous production facility belongs to class 2.

The accident at the Central Heating and Power Plant under consideration occurred due to leakage and subsequent ignition of the gas. Fortunately, we managed to avoid massive deflagration combustion and, especially, detonation of the gas-air mixture, the matter was limited to a strong fire. The fire was preceded by puff (local deflagration) on the highway supplying gas to the power plant. The rupture of the high pressure pipe led to gas flaring. This is confirmed by the words of eyewitnesses of the incident, who observed a column of fire about 80 meters high.

According to the Russian Emergencies Ministry, the fire was assigned the third number (rank), more than 150 people and more than 50 pieces of equipment were involved in its localization. In addition, two fire trains and two helicopters were dispatched to eliminate the fire. The fire was completely eliminated over the entire area only in 30 hours.

As a result of the fire, 1 was killed and about 20 people were injured, preliminary damage from the fire caused multimillion-dollar losses.

It was possible to avoid the increase in the number of victims and fatalities in the event of an emergency on the gas supply line to the Central Heating and Power Plant, thanks to the emergency evacuation of personnel from nearby production facilities, buildings and structures of which were ignited by the heat of the gas torch.

When conducting a fire test, the fact of competent actions by the management staff and specialists of the CHPP, the coordinated actions of its dispatching service aimed at carrying out a trouble-free regime when executing the algorithm to stop the station, was able to switch to other electricity and heat producers in order to provide consumers. The cause of the fire was the unauthorized conduct of surveying related to the drilling of land above the passage of the gas supply line to the CHPP.

On the basis of the information provided on the occurrence of an emergency that caused the accident and the victims, it was established that the immediate factors for emergencies relate to the following industry safety areas: industrial and fire safety, directions related to the prevention and elimination of technogenic emergencies (Fig. 4). These three safety subsystems in the cases under consideration did not work in the complex, although each of them individually could create the appearance of effective functioning.

A detailed explanation of the causes of the situation requires scientific research to assess the condition, technical support, the degree of interaction. Moreover, since the life support facility of the whole region was endangered, comprehensive research is required to develop a unified strategy approved at the State level for the interaction between existing industry safety areas presented in the form of a system, the assessment of which will need to be built based on a risk-based strategy.

Until now, in Russia, in the integrated safety of enterprises' technosphere protection facilities, a departmental (industry) regulatory and statistical version of risk test and assessment has been applied, which is aimed at maximizing the development of regulatory requirements for its minimization (exclusion) by each of the industry safety areas (Fig. 4) .

Until now, when establishing safety standards and other decision-making levels in industry-specific security areas, different strategies and different risk or “factor” indicators have been used. They are difficult, if possible, to compare with each other. For this reason, due to the lack of practically developed models for the interaction of individual industry subsystems that are part of the enterprise’s integrated security system, it is difficult or almost impossible to compare safety standards and other decision-making levels on the safety of technosphere protection facilities.

In such a situation, optimality calculation is useless. The reason for this situation (the mismatch between practical need and the possibility of using risk test) is the insufficient development of the scientific, methodological and regulatory framework for interaction between industry safety areas, as well as modern computer systems (databases, settlement and other programs).

Due to the lack of development of models for the connectivity between the safety subsystems of the enterprise included in the safety management system, in practice there is a completely different understanding when analyzing and assessing risk, which can be seen from the given practical example of flaring at the Central Heating and Power Plant.

The management team and specialists of the company, which is responsible for ensuring and uninterrupted gas supply to the consumer, and in particular, is responsible for supplying gas through the mains to the CHPP, guided by the requirements of the Government decree [16] and the order of Federal Service for Environmental, Technological, and Nuclear Supervision [17]. When conducting measures to assess the risk of transport the gas line it was established by calculation that the risk of an accident with gas outflow from the line would be minimal.

The services responsible for the operation of gas transport pipelines have a long-established rule: “When the gas runs out of the piping, close the valves, purge the defective pipe with air, eliminate the malfunction, and check that the pipe is ready for operation by crimping.” Carrying out such work has become the norm for the organization responsible for the quality operation of the gas consumption network under pressure [18].

In case of an accident or flare burning the fulfillment of this rule allows firefighters to localize the fire source, pouring water around the torch with water or fire-extinguishing (cooling) liquids [19], restricting the radiant heat transfer in the horizontal direction due to evaporation of the liquid and not allowing the torch to heat nearby objects by thermal conductivity through the soil.

In the case under consideration, due to the fact that the gas supply pipe to the CHPP was laid underground and due to the assertion that the risk of gas leakage from the pipe would be minimal; non-capital construction objects on the surface were installed above the underground gas pipe, unauthorized landfills, works on the development of the soil surface were started without examining the project of the geo-basis of the land plot.

Specialists in charge of ensuring fire safety and relating to the unit for the prevention of dangers associated with fires at the fire protection facility know that the fact of gas leakage from the main pipeline is the highest indicator of the risk of an explosion or fire both in confined spaces of rooms and in open areas. When categorizing rooms, buildings, and outdoor installations for explosion and fire hazard for premises in which natural gas-methane is stored, processed and transported, category “A” is assigned - increased explosion and fire hazard.

The presence of a plate on the door of a production or warehouse with the letter designation “A” requires additional measures to be taken to comply with the safety requirements, namely:

- compliance with space-planning decisions for such premises;
- use of equipment in explosion-proof execution;
- use of a tool that excludes sparking;
- using an appropriate ventilation system.

In this example, all of the above was ignored in relation to the surface of the earth above the gas pipeline, which became one of the decisive factors in the development of the accident.

On the other hand, this same example indicates the availability of qualified management at the CHPP, trained specialists in the field of safety and who are responsible for the prevention and elimination of natural and man-made emergencies (blocks for the prevention and prevention of dangers associated with fires and rapid response). In the process of their activity in critical accident conditions, models are used that are built based on a scenario-process strategy implemented by the regulatory and regulatory documents of the Ministry of Emergencies of Russia.

The described example and practical experience in conducting assessments, risk test in industry safety subsystems, and carrying out preventive measures to reduce (eliminate) the probability of emergency situations show that there are a number of reasons for which it is necessary to go beyond the limits of risk assessment and test in each individual industry security subsystem and consider risks on the basis of connectivity between all areas of the security system that are a part of the system based on the centralized risk - based strategy.

III. CONCLUSION

In conclusion, we note that the dangers that threaten the activities and the very existence of the enterprise include the economic component, which arises because of purely sporadic events, which are especially difficult to predict due to the strained relations of mankind with chance, and because of competition, contradictions within the business, between power and business. It seems that the modern domestic business environment has such characteristic features that the integrated safety of the enterprise will only benefit from the inclusion of economic events in the dangers. Foreign studies also play a significant role in this area. A unique example is illustrative [17], when an enterprise whose management considered itself protected from any risks up to an earthquake suffered from the fact that one of the employees, for an unclear reason, put tax returns in a drawer of his desk for several years instead of handing over them to the fiscal authority. Impressive fines led to the ruin and closure of the enterprise. Neglect of economic issues, coupled with the human factor in the existing conditions, can obviously lead to a crash faster than any natural or man-made disasters. However, despite all the importance, in order to simplify the present work, economic topics were not considered.

Its inclusion in the composition of hazardous factors can be carried out later, based on the above methodology.

Thus, in this work, which can be regarded as an attempt to systematize IS management at the enterprise, evidence was presented about the need for centralized management in the IS system under consideration in order to develop a clear interaction between the managed subsystems.

Obviously, the solution of the problems of quality management of the enterprise safety system will require further improvement of strategies to the organization of supervision (control) at the state level.

A positive decision to improve the management of the design bureau system in enterprises, as well as changing strategies examining to the organization of supervision (control) by the supervisory authorities in relation to the functional areas included in the IS, will allow changing the face of the Russian Emergencies Ministry system, making it even more flexible and efficient.

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