UDC 351.862.4

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METHODOLOGICAL PRINCIPLES OF STUDYING THE PROBLEMS OF CRITICAL INFRASTRUCTURE PROTECTION

The relevance of the issue of researching the methodological foundations for studying the problems of critical infrastructure protection is determined. An expert survey was conducted on current problematic issues in the field of critical infrastructure protection in Ukraine. The necessity of developing models for responding to threats to critical infrastructure facilities in different conditions: in a special period and in peacetime is proved. Based on the results of the expert survey, proposals for improving the security of critical infrastructure facilities are formulated. The role and place of the National Guard of Ukraine in the performance of tasks related to the protection of critical infrastructure is defined.

Keywords: *critical infrastructure, security and defense sector, crisis situations, state security, defense system, expert analysis, National Guard of Ukraine*

Statement of the problem. Global trends towards increased natural and man-made threats, an increase in the level of terrorist threats, an increase in the number of cyberattacks and their complexity, as well as damage to infrastructure facilities in the eastern and southern regions of Ukraine as a result of the large-scale armed aggression of the russian federation actualize the issue of protecting systems, facilities and resources that are critical for the functioning and sustainable development of society, increasing socio-economic stability and, in general, for ensuring national security.

Almost all developed countries have established national critical infrastructure security systems. Until 2014 Ukraine was in a state of gradual degradation in the country's security and defense sector, which led to a 10–15-year lag in this area compared to most European countries and a much greater one compared to such leading countries as the United States, the United Kingdom, and Germany.

The international practice of developing critical infrastructure protection systems in different countries of the world proves that this issue is recognized as a key one for ensuring national security. Ukraine is also actively working to ensure the protection of its critical infrastructure, as evidenced by the adoption of a number of regulations [1–3]. In this aspect, the task of forming a system for the protection of critical infrastructure in Ukraine is emerging.

Analysis of recent research and publications. The issue of critical infrastructure protection has been considered in many scientific studies by both representatives of the scientific community and practitioners. The concept of critical infrastructure protection as an element of the European security policy was developed by D. S. Biriukov [4]. The methodology for assessing the level of criticality of critical infrastructure facilities was developed and the criteria for assessing and threats to critical infrastructure were determined by D. H. Bobro [5, 6]. Within the framework of his dissertation research on the topic of public administration of critical infrastructure security in Ukraine [7], M. B. Domaratskyi raised the issue of ensuring the safety and improving the efficiency of protection of critical facilities at the state level [8], regulatory and administrative support for state regulation of critical infrastructure in Ukraine [9], etc. The essence and content of the concept of "infrastructure" in the context of critical infrastructure protection was defined by O. P. Yermenchuk [10]. An analytical report on ensuring coordination, interaction and information exchange in the process of creating a state system for the protection of critical infrastructure was compiled by S. I. Kondratov [11]. Problems and priorities of the state policy on the protection of critical infrastructure in the conditions of hybrid warfare were studied by O. M. Sukhodolya [12].

Thus, scientists and practitioners have considered a significant amount of problematic issues of critical infrastructure protection, but the issue of researching the methodological foundations for studying the problems of critical infrastructure protection has not been given due attention, which has led to the relevance of the study.

The purpose of the article is to identify the problematic issues of protection of critical infrastructure facilities in Ukraine, to highlight the most important ones and to provide recommendations for their further resolution.

Summary of the main material. To study the current problematic issues in the field of critical infrastructure protection in Ukraine, the author uses the method of expert evaluation, which is a type of survey where the respondents are experts – specialists in a particular field of activity. The main purpose of the expert evaluation method is to identify the most difficult aspects of the problem under study, to increase the reliability of the information and conclusions obtained. Expert methods are used to predict qualitative and quantitative characteristics, the development of which is not fully or partially subject to mathematical formalization due to the lack of sufficient and reliable statistics. Currently, expert surveys are used in the study of all areas of activity for diagnosis and prognosis, design, assessment of the state of the research object, and decision-making [13].

The form of the expert survey was a one-time individual survey (questionnaire). The survey involves obtaining information through written responses from respondents to a system of standardized questions on pre-prepared forms – questionnaires [14]. The survey was based on a careful selection of a sample of respondents – specialists in the field of critical infrastructure security. These respondents were employees of the Security Service of Ukraine, the National Guard of Ukraine, the State Protection Department of Ukraine, the Armed Forces of Ukraine, the State Border Guard Service of Ukraine, the State Emergency Service of Ukraine, and the National Police of Ukraine who had practical experience in organizing the implementation of tasks to protect critical infrastructure. The total sample amounted to 409 respondents, with questionnaires distributed proportionally among representatives of the security and defense sector.

At the beginning of the expert survey, the level of qualification of the respondents was analyzed, and the results of the analysis established the professional relevance of the respondents to the field of critical infrastructure security. Length of service: the largest number of respondents (37 %) have more than 16 years of experience; 27 % – from 11 to 15 years; 24 % – from 6 to 10 years; 12 % of respondents have up to 5 years of experience. Age breakdown: the largest share of respondents (39 %) is over 36 years old; 28 % – 31 to 35 years old; 25 % – 26 to 30 years old; 8 % – under 25 years old. Theoretical level of training of respondents in the field of critical infrastructure protection: the majority has a university degree (67 %), the rest have secondary and relevant professional training. A questionnaire containing 27 questions was developed for the expert survey. Let's take a closer look at the survey results.

When asked the question "How did you acquire knowledge of the nature and specifics of performing tasks to protect critical infrastructure?" 28 % of respondents indicated educational institutions. A significant portion (28 %) of respondents – critical infrastructure protection specialists – acquired basic security knowledge and skills during their in-service training at various institutions and directly during their assignments. Educational institutions also played an important role in providing knowledge on critical infrastructure protection.

The majority of respondents answered "Yes" to the question "Did you have enough knowledge to perform tasks related to the protection of critical infrastructure?" (65 %). Thus, a significant number of specialists from various components of the security and defense sector who perform tasks related to the protection of critical infrastructure believe that their knowledge is sufficient to fulfill their responsibilities in this area. This may indicate the effectiveness of the education and training process, as well as the stability of the level of qualification of employees in the field of state security.

When asked in the questionnaire "What difficulties have you encountered in performing tasks related to the protection of critical infrastructure?" respondents reported a number of difficulties in performing their tasks. In particular, they mentioned the following: insufficient legal support for activities (17 %); lack of interagency cooperation (26 %); lack of information about the phenomenon (19 %). Professionals responsible for the protection of critical infrastructure face real problems and challenges in the course of performing their tasks. Insufficient legal support, lack of interagency cooperation and information – all these aspects can complicate the work of specialists and reduce the effectiveness of critical infrastructure security measures. This should be considered to further improve the critical infrastructure protection system.

Answering the question "In your opinion, what principles should govern the management of critical infrastructure protection?", respondents expressed different opinions on the management principles, namely: legality was identified as the most important principle by 18 % of experts; advance preparation for actions in

special conditions – 17 %; efficiency – 15 %; organization and rationality – 14 %; internal and external interaction – 11 %. These results indicate a variety of approaches and perspectives in the field of critical infrastructure protection management. Representatives of the security and defense forces have their own vision of the principles that they consider most important in ensuring effective management of these facilities. At the same time, this diversity may indicate the need for a comprehensive approach to managing the protection of critical infrastructure that considers various aspects and interests of all stakeholders.

In response to the question "In your opinion, does the existing legislation meet the requirements for the protection of critical infrastructure?", the majority of respondents (56 %) said that the legislation does not fully meet the requirements for the protection of critical infrastructure. This situation is caused by changes in technology, growing security threats, or gaps in the legislation itself that do not consider current challenges. Respondents' answers can serve as a basis for further reforms in the legislation on the protection of critical infrastructure to improve its security.

Answering the question "What principles should critical infrastructure protection training be based on?", respondents indicated different principles: 21 % of experts identified timeliness as the key principle; continuity – 16 %; systematicity – 15 %. The diversity of answers reflects the specifics of the work of the components of the security and defense sector, their tasks, and capabilities in the context of critical infrastructure protection. For example, the greater emphasis on timeliness, continuity and systematicity may be related to the need to anticipate potential threats and develop effective defense strategies.

To the question "What problems do you see in the training of personnel in the field of critical infrastructure protection?" respondents answered that there is a need to improve the qualifications of personnel and noted this aspect as problematic (45 %). Given the importance of this area for national security, ongoing training and professional development of personnel is critical.

To the question "How often does your unit (governing body) conduct training on the protection of critical infrastructure?" among the proposed answers with a specific number of classes, the majority of respondents answered "Other" (41 %). This indicates that different departments or governing bodies have different approaches to organizing training on critical infrastructure protection. For example, in some units, classes may be held weekly, i.e., regular intensive training, while in others, monthly. This is due to the specifics of the unit's internal policy, the availability of resources, the scope of tasks, and other factors. It is important to have systematic training, regardless of its frequency, so that personnel are prepared to act in the event of a threat to critical infrastructure.

The question "What circumstances, in your opinion, contributed to the shortcomings in the performance of tasks related to the protection of critical infrastructure?" was answered with the largest number of votes for "Lack of coordination of joint actions" (33 %). These results confirm that shortcomings in the performance of critical infrastructure protection tasks are largely caused by the lack of coordination and joint actions between different law enforcement agencies or units. Therefore, the mechanisms of cooperation and coordination between different institutions need to be improved to increase the effectiveness of measures to protect critical infrastructure.

To the question "How do you assess the level of training of personnel to respond to threats in the field of critical infrastructure protection?", the majority of respondents indicated "Medium" (70 %), which means that most members of the security and defense forces assess the level of training of personnel to respond to threats in the field of critical infrastructure protection as medium. Obviously, there are certain aspects that need to be further improved or strengthened.

Answering the question "How do you assess the level of personnel's capability to respond to threats in the field of critical infrastructure protection?", the majority of respondents (66 %) assessed the level of personnel's capability as average. This may indicate a basic level of training and the ability of personnel to respond to threats, but it is possible that certain aspects require further improvement of efficiency and competence.

The results of answering the question "Which areas of critical infrastructure do you consider the most dangerous?" are as follows: chemical – 51 %, energy – 37 %, i.e., employees of the security and defense sector perceive the energy and chemical sectors as particularly dangerous in the context of critical infrastructure protection. Obviously, this is due to the potential consequences of accidents or terrorist attacks in these sectors, which can have a serious impact on society and economic sectors.

When asked the question "What threats and risks to critical infrastructure do you consider to be the greatest?" the vast majority of respondents (44 %) indicated terrorist attacks. The respondents consider terrorist

attacks to be the most serious threat to critical infrastructure facilities, as they can lead to serious consequences for the security of the nation and the functioning of key sectors of the economy and society.

To the question "Do you have internal procedures (departmental) for assessing risks in the field of critical infrastructure protection?" the largest number of respondents answered "Yes " (64 %). The results of the survey confirm that the security and defense forces have internal procedures for assessing risks in the field of critical infrastructure protection. This is an important aspect of ensuring security and compliance with security standards, as it allows for the effective identification and management of potential threats.

To the question "How do you assess the state of technical support and communications equipment used in the performance of critical infrastructure protection tasks?", respondents answered as follows: sufficient – 53 %, in need of improvement – 33 %. The majority of security and defense professionals assess the technical support and communications equipment used in the performance of critical infrastructure protection tasks as sufficient and in need of improvement, meaning that there is room for further improvement of technical support for more efficient and safer work of professionals in this area.

To the question "How do you perceive the interaction with the bodies/units of the security and defense forces in the performance of joint tasks on the protection of critical infrastructure?", the answer "Limited interaction" received the largest number of votes (58 %). These results indicate that respondents perceive interaction with other bodies/units of the security and defense forces in the performance of joint tasks on the protection of critical infrastructure as limited, i.e., there are certain obstacles in the interaction between different security and defense structures that require attention and further resolution to ensure more effective coordination and joint actions in the field of critical infrastructure protection.

The majority of respondents answered the question "How do you perceive interaction with local authorities and local self-government bodies in the implementation of measures to protect critical infrastructure?" "Limited interaction" (64 %). The majority of respondents believe that cooperation with local authorities and local self-government bodies in the process of implementing measures to protect critical infrastructure facilities is limited. Obviously, there are certain problems or obstacles in cooperation between these structures. Possible reasons include insufficient information exchange, imperfect coordination processes, and insufficient participation of one of the partners in the development and implementation of protection strategies. Such conclusions are useful for further improving cooperation mechanisms and increasing the effectiveness of critical infrastructure protection. To the question "Are there standards or protocols for interaction with other bodies/units of the security and defense forces, local authorities and local self-government bodies involved in the protection of critical infrastructure?" the majority of respondents answered "Yes" (63 %). This indicates that in the field of critical infrastructure protection, there are established standards or protocols for interaction between security and defense forces and local authorities and local governments. Their existence helps ensure a systematic and coordinated response to potential threats to critical facilities, efficiency and effectiveness in preventing incidents and providing the necessary assistance in the event of a hazard. Such standards are an important component of the security system, helping to ensure coordination and interaction between various authorities and units responsible for the protection of critical infrastructure.

When asked the question "What complications in the field of cooperation with the bodies/units of the security and defense forces, local authorities and local self-government bodies have arisen in the implementation of measures to protect critical infrastructure?" the largest number of votes was given to the answer "Problems with information exchange" (46 %). Thus, one of the most common problems in cooperation with the security and defense forces, local authorities and local self-government bodies in the implementation of critical infrastructure protection measures is the exchange of information. This may be the result of insufficient coordination between different structures, as well as a lack of effective mechanisms for exchanging the necessary information between them. Overcoming these complications requires additional measures to improve communication and information systems between the relevant authorities and units.

The majority of respondents (22 %) answered the question "What shortcomings have you noted in management decisions on the protection of critical infrastructure?" "Inefficient organization of work of local government authorities". This data shows that experts from various law enforcement agencies see a number of shortcomings in management decisions on the protection of critical infrastructure. For example, inefficient organization of local authorities can complicate the implementation of strategies and measures to protect critical infrastructure. The shortcomings can be overcome by improving management processes, including coordination and cooperation between different levels of government, as well as by introducing more flexible and adaptive strategies in crisis management.

To the question "What problems (challenges) in the field of protection of QIPs would you like to mention that are not covered in the questionnaire?" 37 % of respondents (the largest number) answered: "The need to improve communication systems". This answer indicates an important problem that was not considered in the questionnaire. Improving communication systems will ensure more efficient transmission and processing of information, which is critical for managing and responding to potential threats. This problem needs to be addressed at the level of strategic planning and resource allocation to ensure the stability and security of critical facilities.

Answering the question "What changes, in your opinion, should be introduced to protect critical infrastructure facilities?", the majority of respondents said: "To improve the organization of interaction between the entities involved in ensuring the security of critical infrastructure" (26 %); "To improve the legal framework for the protection of critical infrastructure" (18 %). Thus, respondents see the need for changes in various aspects of critical infrastructure protection: improvement of the legal framework, organization of interaction between security actors. These changes will contribute to the effectiveness of measures to ensure the security of critical facilities.

The question "What measures are necessary to improve the protection of critical infrastructure?" was answered with the highest number of votes: "Developing a model of response of the components of the security and defense sector of Ukraine to threats to critical infrastructure facilities in a special period" (36 %); "Developing a model of response of the components of the security and defense sector of Ukraine to threats to critical infrastructure facilities in peacetime" (29 %). Experts of the security and defense sector are aware of the need to develop and implement specialized models of response to threats to critical infrastructure. Such models will facilitate better coordination and planning of actions in the event of potential hazards, which can increase the overall level of security and ensure more effective protection of critical infrastructure facilities in various situations, both in peacetime and in times of emergency. These answers confirm the relevance of the study.

To the question "To define the role of the National Guard of Ukraine in the performance of tasks related to the protection of critical infrastructure facilities", respondents answered: "Main" (37%), "Leading" (36 %). Half of the respondents consider the National Guard of Ukraine to be the leading force in this role. The other half considers its role to be the main one. This view is explained by the specifics of the work and functional responsibilities of each of these structures, and also depends on their experience and effectiveness in performing security tasks.

The question "To define the place of the National Guard of Ukraine in the fulfillment of defense tasks" was answered by the majority of respondents: "In the chain of main executors" (48 %); "In the chain of management" (32 %). This recognizes the important role of the National Guard of Ukraine in ensuring the security of the country and protecting critical infrastructure, although its place in the chain of command may vary depending on the perspective and experience of each of these structures.

Answering the question "In your opinion, which law enforcement agency (military formation) should be entrusted with the responsibilities of the authorized body in the field of critical infrastructure protection?", the vast majority of respondents indicated: "The National Guard of Ukraine" (43 %). Thus, they consider the National Guard of Ukraine to be the most suitable military formation to perform the duties of the authorized body in the field of critical infrastructure protection. This may reflect the specifics of the National Guard's activities, its specialization and ability to respond quickly to security situations. The National Guard of Ukraine has a significant resource potential, including human and material resources, as well as high efficiency in dealing with emergency situations. In response to the question "What possible measures or initiatives do you propose to improve the security of critical infrastructure facilities?" the respondents provided their suggestions. The following areas were named as the main ones:

– strengthening the legal framework (improving and clarifying legislation governing the protection of critical infrastructure, including the development of new regulations that consider current threats and challenges);

– staff development (organizing regular trainings, seminars and exercises for employees responsible for the security of critical infrastructure facilities to improve their knowledge, skills and abilities in risk management and threat response);

– increasing investments (ensuring sufficient funding for the development and implementation of modern technologies and security systems at critical infrastructure facilities);

– strengthening interagency cooperation (promoting more effective coordination and information exchange between various agencies and structures responsible for the security of critical infrastructure);

– development of innovative technologies (accelerating the introduction of the latest technologies, such as

video surveillance systems, drones, sensor systems, artificial intelligence, to improve efficiency and response to threats);

– public education (conducting information campaigns and training events for the public on the security of critical infrastructure facilities and measures taken to reduce risks).

Conclusions

Based on the above, the following can be noted.

1. Global trends towards increased threats to the functioning of critical infrastructure, as well as the catastrophic consequences of damage to critical infrastructure in the regions of Ukraine as a result of russia's large-scale armed aggression, raise the issue of protecting systems, facilities and resources that are critical for the functioning and sustainable development of society, increasing socio-economic stability and, in general, for ensuring national security. Until now, the study of the methodological foundations for studying the problems of protecting critical infrastructure has not been given due attention, which has led to the relevance of the study.

2. An expert survey was conducted to study current problematic issues in the field of critical infrastructure protection in Ukraine, which identified a number of key aspects of critical infrastructure protection by the security and defense forces of Ukraine. In general, the results of the expert survey indicate that the security of critical infrastructure facilities is an urgent problem that requires a comprehensive approach and joint efforts of various structures and government entities, including continuous improvement of legislation and the legal framework for the protection of critical infrastructure facilities.

3. The respondents' answers indicate the need to improve the qualifications of personnel, effective management and coordination between the components of the security and defense sector, raise the issue of developing innovative technologies to improve the level of security of critical infrastructure facilities, and justify the importance of investing in modern technologies and security systems to ensure the appropriate protection of critical infrastructure facilities. The respondents also raised the issue of educating citizens and involving them in the process of ensuring the security of critical infrastructure.

4. The results of the expert survey proved the need to develop models for responding to threats to critical infrastructure in different conditions: both in a special period and in peacetime. This approach requires systematic and flexible planning and response to potential threats regardless of the context. The respondents assume that the development of appropriate models will make it possible to increase the effectiveness of critical infrastructure security measures and promote preparedness for various crisis scenarios.

5. The respondents defined the role of the National Guard of Ukraine in the protection of critical infrastructure as leading and main, and the answers to the questions about the place of the National Guard of Ukraine in the protection of critical infrastructure were: "In the chain of main executors"; "In the chain of command". The National Guard of Ukraine is also identified as the most suitable formation among the components of the security and defense sector, which should be entrusted with the duties of the authorized body in the field of critical infrastructure protection.

Thus, the areas of research are aimed at further development of the scientific and methodological apparatus for optimizing the activities of the National Guard of Ukraine to protect critical infrastructure facilities.

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The article was submitted to the editorial office on 18.04.2024

УДК 351.862.4

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МЕТОДОЛОГІЧНІ ЗАСАДИ ВИВЧЕННЯ ПРОБЛЕМ ЗАХИСТУ ОБ'ЄКТІВ КРИТИЧНОЇ ІНФРАСТРУКТУРИ

Світові тенденції до посилення загроз функціонуванню критичної інфраструктури, а також катастрофічні наслідки пошкодження об'єктів критичної інфраструктури в регіонах України через широкомасштабну збройну агресію російської федерації актуалізували питання захисту систем, об'єктів і ресурсів, критично важливих для функціонування і сталого розвитку суспільства, підвищення соціально-економічної стабільності й загалом для забезпечення національної безпеки. Дотепер питанню дослідження методологічних засад вивчення проблем захисту об'єктів критичної інфраструктури не приділялося належної уваги, що й зумовило актуальність дослідження.

Для вивчення сучасних проблемних питань у сфері захисту об'єктів критичної інфраструктури в Україні було проведено експертне опитування, за результатами якого виявлено низку ключових аспектів, що стосуються захисту об'єктів критичної інфраструктури силами безпеки й оборони України. У цілому результати експертного опитування вказують на те, що безпека об'єктів

критичної інфраструктури є актуальною проблемою, вимагає комплексного підходу та спільних зусиль різних структур і суб'єктів влади для її вирішення, а отже, постійного вдосконалення законодавства та правової бази у сфері захисту об'єктів критичної інфраструктури.

Відповіді респондентів свідчать про необхідність підвищення кваліфікації персоналу, ефективного управління та координації дій між складовими сектору безпеки й оборони, активізують питання розвитку інноваційних технологій для підвищення рівня безпеки захисту об'єктів критичної інфраструктури, а також обґрунтовують важливість інвестицій у сучасні технології та системи безпеки, аби забезпечити відповідну захищеність об'єктів критичної інфраструктури. Респондентами також підняте питання щодо просвітньої роботи із громадськістю і залучення її до процесу забезпечення безпеки об'єктів критичної інфраструктури.

За результатами експертного опитування доведено необхідність розроблення моделей реагування на загрози об'єктам критичної інфраструктури в різних умовах: в особливий період, у мирний час. Такий підхід наголошує на важливості системного та гнучкого планування й реагування на потенційні загрози незалежно від контексту. Респондентами робиться припущення, що розроблення відповідних моделей дасть змогу підвищити ефективність заходів забезпечення безпеки об'єктів критичної інфраструктури і сприятиме готовності до різних сценаріїв кризових ситуацій.

Респонденти визначили роль Національної гвардії України у виконанні завдань із захисту об'єктів критичної інфраструктури як провідну й основну, а щодо місця Національної гвардії України у виконанні завдання із захисту найбільшу кількість голосів було віддано відповіді «В ланці основних виконавців» та «В ланці управління». Національна гвардія України визначена також найбільш придатним формуванням серед складових сектору безпеки й оборони, на яке доцільно покласти обов'язки уповноваженого органу у сфері захисту об'єктів критичної інфраструктури.

Тому наукові дослідження спрямовуватимуться на подальше розроблення науково-методологічного апарату оптимізації діяльності формувань Національної гвардії України із захисту об'єктів критичної інфраструктури.

Ключові слова: *критична інфраструктура, сектор безпеки й оборони, кризові ситуації, державна безпека, система захисту, експертний аналіз, Національна гвардія України.*

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