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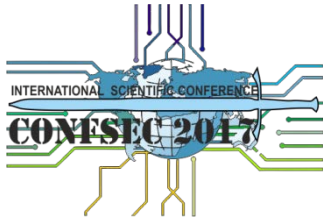
ISSN: (PRINT) 2535-0668

ISSN: (ONLINE) 2535-082X

YEAR III, ISSUE 2/2019



PUBLISHER SCIENTIFIC TECHNICAL UNION OF MECHANICAL ENGINEERING - INDUSTRY 4.0
BULGARIA



INTERNATIONAL SCIENTIFIC JOURNAL SECURITY & FUTURE

PUBLISHER:

**SCIENTIFIC TECHNICAL UNION OF MECHANICAL ENGINEERING
INDUSTRY-4.0**

108, Rakovski Str., 1000 Sofia, Bulgaria
tel. (+359 2) 987 72 90, tel./fax (+359 2) 986 22 40,
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ISSN (PRINT) 2535-0668
ISSN (Online) 2535-082X
YEAR III, ISSUE 2 / 2019

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SECURITY SYSTEM CREATING IN CONDITIONS OF UNCERTAINTY AND RISK- OUTLINE OF THE PROBLEM

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Abstract: *The article presents selected considerations in the field of the security environment with respect to uncertainty and risk factors along with the approximation of the strategy F.U.D. [fear, uncertainty and doubt].*

KEYWORDS: SECURITY SYSTEM, F.U.D. STRATEGY, RISK FACTORS.

1. Introduction

The organization of the security system in its geospatial form until recently contained the areas: land, air and sea and space, but the dynamics of technology development meant that its fifth dimension became permanent broadly understood and defined cyberspace, thus creating a security environment. Digital space, penetrating the remaining areas caused a specific problematic network, which sets the need for a new way of organizing and shaping the security environment. All areas of the environment in the process of shaping the security system have common elements: identification of risks and threats, potential analyses and probability of their occurrence, and the preparation of appropriate forces and measures and restitution plans. Time is an additional common factors for all areas.

The security environment is affected by certain conditions, which includes: chances, challenges, risks and threats of the implementation of interests and the achievement of goals in the field of security. Chances include all circumstances (phenomena and processes), which are conducive of the implementation of interests and the achievement of the intended goals. Challenges include the decision-making dilemmas and choices that a given subject faces, including the necessity of incurring specific costs. Risks are uncertainties connected with a particular action and its consequences – including the potential risk of adverse effects of the action taken. The principle is to increase the level of risk directly proportional to the level of activity (e.g. an increase in terrorist threats due to involvement in international operations). For this reason, the skilful estimation and reduction of particular risks is becoming ever more important. While threats are the direct or indirect destructive influences on the subject. Threats are a classic environmental factor. The strategic objective of each subject is (or should be) to ensure safe conditions for the implementation of interests by: reducing identified risks, eliminating threats (external and internal), proper estimation of challenges and skilful use of the occurring chances by making proper decisions [1].

2. Organization of the security system

The organization of each security system depends primarily on the strengths, means the abilities possessed, but the possibility of its shaping depends on the identified potential, which in turn determines the preparatory and executive activities in this area. The pursuit of tasks defined by each entity – in particular states – in the area of security is their organizing, maintaining and preparing in as comprehensive manner as possible. The indicated activities take place at specific levels and are processed and implemented in them. These areas, in turn, defined a specific way of managing the system – creating appropriate organizational and functional links.

In shaping the security system – apart from identifying the indicated factors in specific areas – risk identification and assessment play a key role. Risk understood as uncertainty

associated with a specific action and its consequences – including the potential danger of adverse effects of the action undertaken. The principle is to increase the level of risk directly proportional to the level of activity in specific areas. The risk as *a combination of the possibility of occurrence of any event and its consequences* is determined not only by the need of identification, but also the determination of thresholds of significance of impact on the functioning of the entity with the preparation and undertaking actions aimed at reducing the negative consequences of its materialization.

Examples of risk thresholds are given in Tab.1.

Type of risk	Effect
critical	significant damage to the functioning and possibilities of the entity's further operation
serious	serious deterioration or disruption of the entity's operation continuity
significant	significant impact on the functioning or partial disruption of operation continuity

Table 1. Types and effects of risk

Threats are another factor in the security environment. The strategic objective of each entity is (should be) to ensure safe conditions for the pursuit of interests by: reducing the identified threats, elimination of threats, proper assessment of challenges, and skilfully using emerging opportunities by making appropriate decisions. The possibility of eliminating threats also precedes the need to identify them and analyse the potential of materialization. In addition to typology of threats, it is important that the estimation of their occurrence is also made in combinations (e.g. external and internal). However, it is crucial to prepare the action in the event of the occurrence and materialization of the effects of the threat. This is involved with, among others, known standards for business continuity (e.g. ISO/IEC 27002 or NIST SP 800-34).

Regardless of the area/sector of operation – for each entity, ensuring the security of information assets of business continuity is of key importance. They have a basic meaning independent of the type of critical processes of a given entity. The business continuity management consist of:

- an analysis of business continuity requirements and risks in the scope of allowable break times in the implementation of critical processes and requirements regarding the availability of assets necessary to carry out these processes. In this area, the risk assessment allows to identify and estimate events that may cause a breach of the continuity of the organization,
- preparation and implementation of the organization's strategy within the scope of ensuring business continuity (defining the type of actions that will be taken to ensure business continuity and minimizing losses),
- development and implementation of plans allowing to restore the continuity of processes and replacement plans for critical assets,

- development of activities related to ensuring the entity's readiness to respond to a crisis situation (reviews, tests, plans updates).

Principles related to ensuring business continuity analogy concern the comprehensive development of the security system.

Returning to the aforementioned time factor, it should be emphasized that it is of key importance especially in the case of the materialization of negative events – reactions to an event and restoring the state of full functionality from before the event. In this sense, the division can be assumed:

Events	Time of unavailability
critical	exceeding the permissible time of unavailability
serious	within the maximum period of unavailability

Table 2. Events affecting the time of unavailability of the entity. Developed based on NIST SP 800-34.

The time parameter will be determined to a different extent – mainly depending on the type of entity and defined critical processes for its operation.

3. Uncertainty

The starting point for the analysis of the conditions of uncertainty is the theory of U. Beck: *Today and in the future we will have to live not so much in a world of previously unknown threats, as in a world that must decide about its future in the conditions of uncertainty created by itself.* According to this theory, among others, the society will not be able to control the threats it poses – not because of neglect and failure of modernity, but because of its victories (e.g. increase in industrialization affecting the growth of greenhouse gas emissions) [2]. However, it is worth adding that uncertainty – as a non-measurable phenomenon in principle will also apply to threats that are not yet possible to determine [naming] (e.g. types of digital threats). F.J. Milliken distinguishes three types of uncertainty regarding the environment:

- *uncertainty of state* (misunderstanding of events and directions of development of the environment),
- *uncertainty of the effect* (no possibility to predict external influence on the organization), and
- *uncertainty of reaction.*

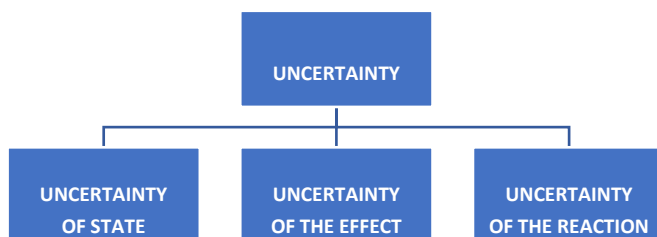


Fig. 1. Types of uncertainty

Uncertainty includes changes not only difficult to calculate and events that cannot be estimated, but above all – unpredictability. This fact causes significant complications in the possibility of shaping the security system at the stage of initial identification. In such a defined concept, it seems impossible to include an element of uncertainty in the analyses, however, one may attempt to adopt this category as a set preventing the adoption of preventive action plans, but enabling the undertaking of *ex post* actions (e.g. technical failures).

4. F.U.D. strategy

The F.U.D. [fear, uncertainty and doubts] is based on disinformation used, among others, in sales, marketing, politics, or broadly understood propaganda. The goal of the strategy is to influence perception by distributing negative ones and questionable or false information about the competition / opponent, etc.

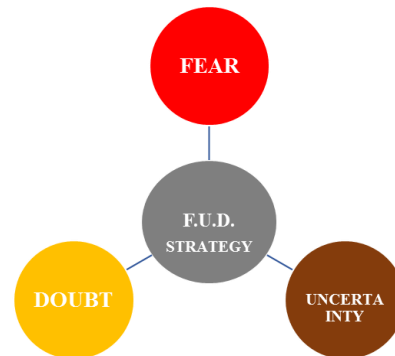


Fig.2. Elements of FUD strategy

FUD is an intended *tactic of rhetoric and error*, which was initially used in sales and marketing, especially in advanced technologies to discourage customers to consider competition products [beginning of the 1870s]. The idea was to convince buyers to use the *safe equipment* of a specific manufacturer, not competition equipment. The hidden coercion was based on reluctance to change, because change means risk, and risk can mean loss. An example can be a description of the system manufacturer: *Our software is 100% compatible with the existing software. [implication: some competitive systems are not.]* or: *Our equipment is 100% compatible with current systems, or: Our systems have already been used by over 1000 companies similar to yours. It has been proven. [implication: competition systems do not have such evidence].*[3] After 1991, this term was generalized, referring to all kinds of disinformation used as a competitive weapon, which is currently used in a wide range. Analogically to the previously indicated uncertainty factor, the FUD strategy aims to induce a subjective sense of fear, doubt and uncertainty.



Fig. 3. FUD strategy process

With regard to security, this factor can be of key importance in two ways: an example can be a reinforcement of a sense of threat in society, which results in restricting rights and freedoms [to the privacy contained in the *Patriot Act*, which formally ceased to apply in 2015 – work is under way over regulations defined in the so-called *Freedom Act*]. The tightening of safety regulations is not new and finds its justification, however, the risk factors and risks that would underlie the changes are often overinterpreted. In another respect, the implementation of the FUD strategy may cause social

unrest inspired by the services of foreign countries using, for example, social media.

In such context, the decisive aspect is also worth emphasizing. The decision-making process is based, above all, on information resources. The more reliable the information source – the more accurately the decision is made and the operation is more proper. The decision-making situation is influenced by both external conditions (general and task environment) and internal conditions (goals, structure, etc.) under which uncertain factors can cause the risk of making the wrong decision.

6. Results and discussion

Considering the unpredictability of uncertain factors – understood as unknown threats and risks, it can be assumed that the creation of a security system is objectively restricted in this respect. However, as mentioned, this category of uncertain events should be taken into account in management plans and – in particular, in ensuring the continuity of operation – using the *analogy of effects* as a tool. Then, taking appropriate actions would depend on the assessment of the impact of the given event. Regardless of objective reasons and barriers, identification of risks and threats should be subject to continuous updating as part of a dynamic and flexible adaptation of information resources and knowledge, as well as activities – to dynamically changing conditions of the environment and the security environment. Also in this case, the time factor is crucial – the faster identification, update and modification – the higher the level of the security system. The FUD strategy is today mainly associated with the sales and marketing sector, but its tools can be seen in all areas – especially in the area of information flows in cyberspace. Phenomena such as *fake news*, or *hate news* have permanently become part of online social media, becoming a tool of disinformation and propaganda.

These are phenomena that require not only analysis, but also the adoption of remedies, because – as results from the research – the impact on shaping public opinion by means of electronic media is definitely stronger than their classic counterparts. In addition, each user can become the creator of any information, anywhere in the digital space. In turn, the recipients of information check credibility and the truthfulness of only those that seem most unreliable or controversial for them. According to the results of the research carried out in 2018 [*Digital competences and the proliferation of threats*], in the area of checking the accuracy of information found on the Internet – almost ¼ of respondents confirmed that they check only what is controversial for them, and over 1/5 very rarely analyse the accuracy of information obtained from the network. 4.0% of respondents admitted that they never check whether the information obtained online is true. Taking into account the indicated tools of the FUD strategy and the results of research, it can be concluded that in the process of shaping the security system, not only factors and *uncertainty* criteria should be taken into account, but also factors related to the potential effects of the FUD strategy together with the possibility of neutralization of its effect in the information sphere.

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A NEW APPROACH TO THE HUMAN FACTOR'S ASSESSEMENT IN THE AUTOMATED CONTROL SYSTEM OF AVIATION SECURITY IN THE AIRPORT

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Abstract: This report concludes a series of articles by the authors devoted to the human factor and published in scientific journals «Industry-4.0» in 2017, 2018. The problem of the human factor is shown from a new point of view in the article, namely: the human factor is not only the limited possibilities of professional activity, due to human physiology, it is, above all, the limited possibilities of technology that does not take into account the characteristics of a person in the human-machine system. There are considered various aspects of this problem.

Keywords: Civil aviation, aviation security, human factor, integrated systems, harmonization of the human factor.

1. Introduction

The human factor (HF) in many industries refers to one of the most common concepts. This concept is especially widely used in civil aviation. It has become a regular occurrence to attribute the blame for most incidents to the human factor, while the understanding of what is related to this factor is often absolutely different. On the one hand, we can definitely consider that the human component is present almost everywhere. On the other hand, accusing the human factor of all the events essentially complicates the situation, since we cannot get a real accident picture, although this is not the purpose.

HF is a complex category with a fairly large number of components, not all investigated in case of an incident. HF is an inexhaustible field of research, even interdisciplinary. This is especially important in civil aviation, where, nevertheless, the main studies of the HF are concentrated in the field of flight safety, and even more often in the study of crew teams.

There has not been carried out any scientific research connected with the HF in the field of aviation security, although the importance of the HF is equally important. This work presents some approaches to the study of the HF in aviation security.

2. The human factor and the personnel threat

Aviation security as a scientific area deals with the issues of ensuring the protection of civil aviation from illegal interference in its activities. The objective functional of the system solving these problems is significantly different in its content from other systems as part of the aviation transport system. This fact determines the specifics of the means, methods and procedures used in aviation security. The human factor in the structure of the aviation security system occupies a particularly important place, since up to 80% of negative events are connected with it.

In modern safety systems, including flight safety systems, it is established that the causes of faulty actions of personnel are associated not only with the level of professionally important qualities of the individual, but also with the imperfection of the means of activity and its organization. I.e. the question of reducing the human factor's negative role is determined by the success in improving the parameters (characteristics) of a person and technology.

It is more complicated in aviation security systems because the procedures of personnel's professional activities are poorly formalized and algo-rhythmized, characterized by extreme manifestations, have a high degree of ambiguity, and the tasks are poorly structured and poorly formalized.

In terms of aviation security, it is proposed to consider the human (personal) factor as an inevitable evil, excluding a useful component, and all its negative manifestations are classified as security threats. In this case, the methodologies developed to protect the objects of the transport infrastructure can be used to study the human factor in order to reduce and/or eliminate its impact in aviation security, i.e. the well-known formula begins to work: detection-reflection-elimination.

The conceptual construct can be the basis for this approach. Indeed, the factor is the cause driving any process, determining

its nature or its individual features, where the cause is considered as the basis for any action. The threat involves the possible, the probable danger, the intention to cause harm. In this case, the concept of factor can be replaced by the concept of threat, and the actions of aircraft personnel in this part can be compared and equated to the actions of the offender, agreeing that these actions are not hostile, antagonistic, but are forced, random, often independent of the intentions of the personnel. In this way the concept of the personnel threat can be introduced.

The personnel threat (PT) in aviation security is a state of inadequate professional readiness of the operator and the situation's parameters in the safety system, determined by the limit level of the individual's psychophysiological parameters, allowing the appearance of a negative event. It should be noted that deliberate actions of personnel provoking negative events, even if it is an aviation security officer, automatically translate the situation into an act of unlawful interference (AUI).

3. Some approaches to the study of HF in aviation security

In modern aviation security systems, a person is considered as a source of threats, i.e. the security system should prevent and neutralize the anthropogenic impact. These can be terrorist threats, hooligan actions, negligence, theft, unauthorized photo and video shooting, violations of the regime and labor discipline, and much more. This is one category of threats. We consider personnel threats from the perspective of the man's imperfections and poor adaptation of the characteristics of the personnel to the protection parameters' technical means when working with personnel requirements can exceed the level of psychophysiological opportunity of the human-operator.

Aviation management security system is a process of rational behaviour of the system based on the measurement, assessment and analysis of the situation (contingency management) [10]. Contingency management is the process of measuring the parameters of the system, transferring it from one state to another in the interests of the target function, it is contemplated that there is no stage-by-stage approach in the solution of control problems, i.e. there may not be a solution algorithm. In this case, the heuristic approach becomes relevant.

Heuristics can be understood as methods of solving problems in conditions of uncertainty, which are opposed to formal methods of solution. Heuristic methods should be considered as having no prescriptive value, as in the case of using algorithmic methods. A heuristic algorithm is an algorithm for solving a problem, the correctness of which is not proved for all possible cases, but it is known that it gives a fairly good solution in most cases, i.e. it is not completely mathematically justified, but at the same time it is a practically useful algorithm.

Heuristic algorithms and procedures give the greatest effect in combination with the theory of decision-making [11, 12].

The decision-making procedure can be single-criteria and multi-criteria, depending on the complexity of the problem.

If the control efficiency is characterized by some optimal test F:

$$F = F(X_1, X_2, \dots, X_l, A_1, A_2, \dots, A_p, Y_1, Y_2, \dots, Y_q, Z_1, Z_2, \dots, Z_r, t); \quad (1)$$

where X is the control, A, Y, Z - the factors influencing the decision, mathematically, the control objective is expressed in the desire for the maximum possible increase (or decrease) in the value of the criterion F : $F \rightarrow \max$ (or $\min$).

The person responsible for decision-making has a task: with the given values and characteristics of the selected factors $A_1, \dots, A_p, Y_1, \dots, Y_q, Z_1, \dots, Z_l$ find the optimal values of $X_1, \dots, X_l$, controls $X_1, X_2, \dots, X_l$ of the set of their admissible values that would convert to the maximum (minimum) of the optimality criterion F .

For a multicriteria problem, the strategy of the operating side X can be a scalar, a vector, a matrix, or an even more complex formation, for example, n -dimensional vector, i.e. $X = (x_1, x_2, \dots) = (x_j), j \in \overline{1, n}$.

The means of achieving the management goal is the appropriate choice of strategy X from the area of its permissible values, i.e. it is necessary to find the optimal strategy X , determined by two conditions: strategy X must be admissible and must be the best in the sense of the principle of the adopted compromise in the task.

There are popular studies [6, 14, 15, 16], which present the results of modeling separate processes of aviation security, which investigated different types of models: linguistic, mathematical, qualimetric, structural and logical, predictive, and some others.

The study [17] shows the principal possibility of mathematical modeling of the tasks in the field of aviation security, related to the human factor, in the format of mathematical physics' boundary value problems.

The boundary value problem for partial differential equations is the problem of obtaining the solution of a partial differential equation in a given domain under given additional limitations on the solution at boundary points, edge or boundary conditions. Partial differential equations are classified either depending on their mathematical nature or depending on the physical meaning of the problems they solve: second-order equations, equations with two variables, linear equations, for example, second-order equations with two independent variables

$$A \frac{\partial^2 u}{\partial x^2} + B \frac{\partial^2 u}{\partial x \partial y} + C \frac{\partial^2 u}{\partial y^2} + D \frac{\partial u}{\partial x} + E \frac{\partial u}{\partial y} + Fu = G \quad (3)$$

where A, B, C, D, E, F and G – constants or prescribed functions of independent variables x and y , nonlinear, describing a nonstationary process in three-dimensional space

$$\frac{\partial}{\partial x} \left[\sigma_1(x, y, z, t, u) \frac{\partial u}{\partial x} \right] + \frac{\partial}{\partial y} \left[\sigma_2(x, y, z, t, u) \frac{\partial u}{\partial y} \right] + \frac{\partial}{\partial z} \left[\sigma_3(x, y, z, t, u) \frac{\partial u}{\partial z} \right] = \quad (4)$$

$$= a(x, y, z, t, u) \frac{\partial^2 u}{\partial t^2} + b(x, y, z, t, u) \frac{\partial u}{\partial t} + c(x, y, z, t, u) u + d$$

The values of the function u are searched inside a certain area S , and boundary conditions are set on the boundary:

$$\left(\alpha u + \beta \frac{\partial u}{\partial n} \right) \Big|_{\Gamma} = f, \quad (5)$$

where α and β – prescribed functions of the boundary Γ , f – known function, possibly solution-dependent u , $\partial u / \partial n$ – the derivative of the sought function by the normal to the boundary Γ .

There are also elliptic equations, Laplace equation, Poisson equation, parabolic and hyperbolic equations, biharmonic equation and others. The analytical solution of such equations is almost impossible due to the insurmountable complexity of the computational process, that is why numerical methods are used. Brain-computer models are of particular interest, they reduce the degree of uncertainty in the formation of the model due to the procedure of training neurocomputer network [18,19].

The simulation prediction is a certain distribution of the intensity of personnel threats on the topology of the transport infrastructure object, which allows identifying extreme points of impact of threats and including them in the list of priority when monitoring the situation in the TF (transport facility).

The situation in the TF related to the security is assessed through the dynamics of incidents, which represent threat manifestation. It is through the incident that the negative impact of personnel is manifested to the maximum extent, so the task is to make a decision on the management of these personnel, i.e. to exclude this negative impact. The control system should provide the possibility of automated adjustment of the work's algorithm with the inclusion of tools for reconstruction of the structure of the aviation security management system.

4. Conclusion

The problems in the field of aviation security related to the human factor are multifaceted and quite complex. Classical approaches to solving these problems have almost reached their limits. There are needed new approaches, one of which you can find in this report.

The idea of the new approach is a fundamental revision of the human factor's physical meaning, realizing that the HF in rigorous definition is not a factor, but a much more complex and multifaceted category relating to complex systems and having an objective functional that is not amenable to the strict mathematical investigation.

The authors introduce a new concept: the personnel threat, by which we understand the state of inadequacy of the operator's professional readiness and the parameters of the situation in the security system, determined by the limit level of the individual's psychophysiological parameters, allowing a negative event appearance. Monitoring of this threat and its study involves the use of known methods, mathematical or heuristic, with their specific adaptation and limitations, subsequent measurement and analysis in a quantitative format, which simplifies the procedure for making decisions on personnel management.

The suggested approach increases the level of aviation security of the transport infrastructure's object by reducing the level of negative impact from the aviation personnel.

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CORPORATE GOVERNANCE AND SOCIAL RESPONSIBILITY IN "FIGHT" AGAINST ECOLOGICAL CRIMINALITY

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Abstract: The technical-technological revolution has changed its core business activities and has created a new socio-economic and economic structure called: knowledge society, information society, digital society, digital economy and electronic economy. Enterprises are part of society they function in; therefore, they must, besides the implementation of economic objectives, pay attention to the impact they have on society and environment i.e., they should act responsibly. The growing conflict between economy, ecology and ethics (model "3E") must solve the corporate-social responsibility and global consensus around vital issues for the survival of mankind. Because of this, we are further improving our internal regulations by strengthening corporate governance, compliance, and risk management, in order to further increase corporate vitality and transparency. Corporate governance is based on a way of sharing rights and responsibilities in a group of corporate actors, especially shareholders and managers in all areas of human activity. Environmental quality management in this co-authoring work is defined as the management of all activities in society that have or may have an impact on health and quality of life.

KEYWORDS: CORPORATE GOVERNANCE, SOCIAL RESPONSIBILITY, STAKEHOLDERS, ECO-CRIME, ECO-SECURITY, SUSTAINABLE DEVELOPMENT

1. Introduction

The man is surrounded by nature and part of it, it contains all that is needed, and the destructive forces lead to more and more eco-hazard and (un) sustainable development. In a constant "struggle", man has reached yet another powerful natural force, to nuclear energy and numerous chemical compounds-mixtures and biological agents. This is another series of scientific and technological inventions that can help a person, but also to endanger and destroy him. Nuclear danger - the phenomenon of the modern era, certainly with its action unpredictability, represents, and it will be in the future, a great threat to humanity, especially in the conditions of ever more present eco-terrorism.

Always, and especially in modern conditions of existence, between eco-security and globalization there is a significant interaction. Any state in question, the region as well as the continent, can be affected by significant eco-problems. The green garden effect does not leave immune to Europe, Asia or America, or any other part of the globe. Also, nuclear radiation, the euthanic use of NHB weapons, NHB terrorism, or any other type of weapons of mass destruction

In the coming period, in the Western Balkans and the environment, the participation of leading domestic and foreign experts in the field of public, private, corporate and urban security is expected in order to exchange and consolidate their experiences. The main topic of this year's and next security / security days is security and economy, An actual challenge for the administration of companies and the security sector.

Cooperation in the field of eco-safety in the promotion of environmental protection, in general, must have a significant place in the general integration flows and globally. The very nature of environmental security points to the need for cooperation, and this is the only way to avoid the prevention of possible accidents in the field of eco-security.

Therefore, in the field of eco-security, local threats can have global conditions. Likewise, the resolution of global environmental problems requires the engagement of all, or global engagement. However, in such situations, it is necessary to note that investment in environmental protection is drastically different from country to country, according to their economic power and access to a block, first and foremost. In this sense, it is difficult to build any global standard, which all countries could fulfill, and again, on the other hand, this standard is inevitable and is no longer a matter of protecting the environment but the survival of the human species on the earth in general. Therefore, the necessity of treatment is necessary and urgent. Part of the problem is to solve the problem through international conventions and organizations.

2. Emergency situations and eco-crisis

In ecology, the word "extraordinary situation" is today one of the most commonly used words by mass media, and in everyday life it is often heard or read. Environmental emergencies have become more frequent, more diverse, regardless of whether they have been created by the action of nature or man, each day they cause more and more consequences for people, material goods and the environment. Bearing in mind all the features of the 21st century, terrorist emergencies pose a serious threat to national and regional security.

Extraordinary situations are one of the constants of human history and its conceptual definition is determined primarily by the various types of dangers that endanger the safety and which, caused by the nature of the action or the activity of a human factor, can lead to its creation in a certain territory, which is difficult to suppress within the framework Eco-safety and sustainable development.

In this co-authoring work we will pay special attention to applying clear rules of work and establishing the principles of corporate governance within and social responsibility, from the aspect of eco-security and sustainable development, which should include: transparent management and administrative control systems, consistent and rational management of corporate finances, social responsibility of the corporation.



Figure 1. Safran policy is based on six strategic priorities which were defined

At Safran, we see corporate social responsibility as a source of growth and performance improvement. Our core commitments of innovating to protect the environment, striving for excellence in the protection of people and goods, valuing our employees, suppliers

and partners, and affirming our values of integrity, are pursued with all internal and external stakeholders.

Safran's corporate social responsibility policy encompasses all of the Group's stakeholders: customers, shareholders, suppliers, employees, unions, community associations, government authorities and institutions, financial analysts and ratings agencies, consumers and the media. This policy is anchored in the ethical values that form the basis of our corporate culture and are shared across the Group: responsible corporate citizenship, people development and recognition, meeting commitments, and the power of teamwork.

Thirty relevant issues were listed and validated by the Group's CSR steering committee. These issues have been grouped according to five major themes: governance, products and services, sSocial and management, society and environment.

The analysis of this map highlights a convergence of perceptions among all respondents. Indeed, in most cases, internal stakeholders rated the importance of each issue in the same way as external stakeholders. This illustrates that the importance of these issues is taken into account upstream by the company.

It emerges from this analysis that the priority issues are:

- anti-corruption and business ethics;
- responsible relationships with suppliers;
- quality of products and services;
- continuity of business and procurement ;
- customer relations;
- intellectual property and access to technology;
- safety of products and services;

These results will be used by Safran to continuously improve its performance while taking into account the ongoing dialogue with its stakeholders;

▪ The concept of materiality refers to the importance of issues such as sustainable development, i.e., their positive or negative influence on a company's business (its ability to create, preserve and redistribute value) and on that of its stakeholders. The end result of the analysis is often presented in the form of a matrix, a materiality matrix, which cross-references the expectations of internal and external stakeholders in graphic form;

▪ Safran is driven by the values and ethics shared by all of our employees. We conduct our business in compliance with the highest standards of honesty, integrity and professional behavior. Through this approach, we strive to be worthy of the trust placed in us by our customers, employees, shareholders, suppliers and all other stakeholders.

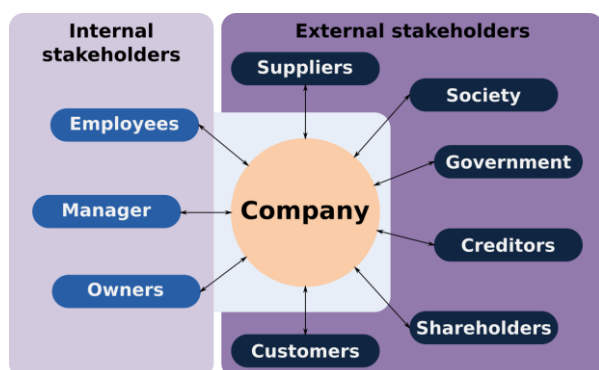


Figure 2. Security challenges and stakeholder interest in corporations

Employees are expected to deal with customers, suppliers and business partners in the Group's interest and in compliance with laws and regulations. All personnel must take particular care to uphold laws on competition, export and re-export controls, labor and employment, safety, health and environmental protection.

Business courtesies, such as gifts and hospitality, given to or received from customers, suppliers and other partners are solely used to build brand image and maintain good business relationships. However, these courtesies must not exceed a nominal value and may not influence, or give the appearance of influencing, any business decision. Safran should always be guided by common

sense, discretion and prudence in these situations. Business courtesies are prohibited by law under certain circumstances and in certain countries. Safran's employees must comply with the applicable laws and regulations in each country where we do business.

Reflecting our full commitment to fair competition, Safran strictly complies with all competition laws in the countries where we do business. These laws generally prohibit agreements or practices that could restrain or undermine trade or competition. In particular, they ban price fixing, bid rigging, splitting markets, territories or clients between competitors, or boycotting or discriminating against certain customers or suppliers without legal justification. The discussion or disclosure of commercially sensitive information relating to competitors, customers or suppliers may also violate applicable laws.

Each employee must uphold the principles of fairness and integrity in dealings with customers. Since Safran's business largely concerns air transport safety, there can be absolutely no compromise. Any situation that seems questionable to an employee must be immediately reported to management or a Quality manager.

Safran selects suppliers on the basis of objective criteria and demands high performance to ensure that we can fully meet our expectations and those of our customers. Under no circumstances will Safran use suppliers that employ children or use forced labor. In 2010, Safran signed a charter governing relations between major contractors and small and medium-size enterprises (SME), under the auspices of the French Ministry of the Economy, Industry and Employment.

Under no circumstances may employees damage Safran's reputation or compromise the integrity of its assets or information systems. Paid work of any kind that employees may perform outside the scope of their employment with Safran must not cause conflicts of interest with their duties within the Group. From the same standpoint, considerable caution is required when purchasing shares, directly or via an intermediary, in companies doing business with Safran. These restrictions do not apply to listed companies, except if confidential information is used, which may be construed as insider trading.

Ensuring our people's health and safety is a primary goal at Safran. We are an equal opportunity employer; hiring and promotion are solely based on professional qualities and results. We fully respect the dignity and private life of each employee. Furthermore, one of our core values is to create the conditions needed for all employees to be fulfilled in their chosen profession. All Safran companies comply with the personal data protection rules known as the "Binding Corporate Rules" (BCR), applicable to the processing and transfer of data outside of the European Union.

The certification audit, carried out in compliance with current international standards (ISAE 3000, International Standards on Assurance Engagements), entailed an evaluation of Safran's corporate culture and commitment to implementing the anti-corruption program (based on a clear policy and broadly circulated ethical guidelines, the deployment of Compliance Officers, an effective risk management policy, control and measurement activities to apply the program and wide circulation of relevant information both within the company and externally).

Known for our excellent products and services, Safran drives economic, social and cultural progress, and shares the fruits of these improvements. For example, we are committed to developing a culture based on prevention, to more efficiently manage all health, safety and environmental risks. We actively contribute to social inclusion and equal opportunity through a corporate policy that promotes the integration of underserved communities, and by promoting diversity throughout our organization.

Safran has defined Group-wide requirements in terms of trade compliance. We deploy a network of Trade Compliance Officers, backed by comprehensive training, to ensure the strict application of these requirements. We are involved in a number of international initiatives, placing us in the front lines of the fight against corruption. Safran has defined strict trade compliance requirements, applicable to all of our companies. Each company applies these

requirements in terms of operating procedures tailored to its organization, products and markets.

3. Fundamentals of globalization security

The concept of security is one of the fundamental preconditions for the existence of a social community. It is the basic function of each state, since without a proper level of security we can not talk about democratic governance, or the stability of the society as a whole.

If we look at the etymological significance, in our field of speech, two terms are used: security and safety. Security itself comes from the Latin word *securitas*-atis, which means security, absence of danger and certainty, self-confidence, fearlessness, protection (*securus*-safe, carefree, reliable, fearless, confident, steady, firm, loyal, true). Thus, in English, two expressions are used: security and safety.

Defining the term "security", prof. Javorović emphasizes the following: Safety is a state in which there is no disturbance of the normal "state of things due to various threats and danger; security as a state of full balance between man and nature and their interaction, which does not lead to degradation of nature and Quality of the human community", that is, "security as a state of balance between constructive and destructive forces, in which there is no disturbance and degradation of the ecological system, the civilization of the human community, man and his values and values, or they do not exceed the scope of development".

In general, there is no single understanding of the concept of security. From different definitions and visions, it is possible to differentiate internal and external security. When it comes to the difference between the concepts of national and state security, most authors do not distinguish between these two terms. Whether the determinant is national or state security depends on the very object of security, or the subject to be protected. As a security object, a state can appear, and hence the state security or nation, in which case the security assumes nationality. When it comes to state security as a security object, it can be a state as an institution, a majority nation, or all members of society, regardless of religion, nation, ideology or any other affiliation.

In this regard, the issue of some other types of security that would be determined by the security object is posed logically. Thus, international and global security, as well as the security of some other collectivities, arise. The paradigm that monitors security is reflected in who is the subject behind certain types of security.

If an individual stands behind individual security, behind the national, state, or nation, the question arises which entity is behind global security. In the era of total change of the global image of the world, the integration processes and the contemporary security challenges of the risks and threats of the national strategy, they are increasingly giving way to international, bloc and global tactics, while states largely limit their sovereignty and transfer it to some other non state entities.

The perception of issues and problems of ecological security points out direct connection with environmental protection, as essentially inseparable phenomena. It is a process of protecting vital interests of individuals, society, nature, the state, the region and the world from real and potential threats caused by anthropogenic or natural impacts on the environment. Literature sources show that the most common risks in the work and environment that can affect ecological safety are as follows:

- high-risk industrial processes and handling of toxic and radioactive materials,
- radioactive contamination and toxic pollution,
- uncontrolled disposal of radioactive and military waste,
- unsatisfactory collection and disposal of solid waste,
- inadequate management and pollution of water resources,
- inadequate management and degradation of soil and soil,
- natural disasters and accidents (floods, earthquakes, droughts, fires). ..

In addition to the impact of these anthropogenic factors and natural disasters, there is a real potential risk of new security risks

that can turn into crises and threats to environmental security (various military and non-war risks and threats such as wars, terrorism, proliferation, political risks, refugees, etc.).

In academic speech, the crisis signifies a phase of disorder in the seemingly normal development of a system, and this complex phenomenon is often used as a concept that includes all types of negative events and, more broadly, applies to situations that are unwanted, unexpected, unpredictable, and almost Inconceivable, and cause unbelief and uncertainty

Although the term is often used up, globalization has no clear and precise definition. True, there are definitions that are more or less general, abstract or concrete, influential or less influential, but some unique answer to the question of what globalization does not have. According to the definition of the International Globalization Forum, globalization is the process of denationalization of the market, policy and legal system at the highest political and economic level.

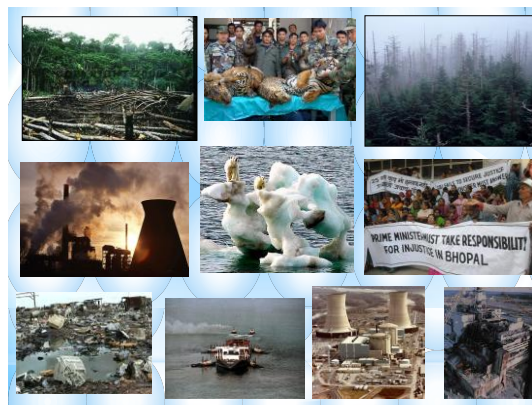


Figure 3. Globalisation and crime in contemporary society

Globalization is generally understood as the "consequence of modernity", "western modernization project" as a "global human condition". The strong effects of governance and the spread of globalization processes to everyday life, and especially in developed countries. Globalization is at the same time the creation of new transnational systems of power and the transformation of the institutions of the society in which we live.

At the same time, international relations for the first time really became global. Communications are current, and the world economy functions simultaneously on all continents. The whole range of problems that have arisen (uncontrolled expansion of nuclear weapons, NHB terrorism, environmental threats, demographic explosions and economic interdependence can be solved only at the world and regional level.

4. Global organization and "fight" against eco-crime

Environmental crime typically refers to any breach of a national or international environmental law or convention that exists to ensure the conservation and sustainability of the world's environment. Five areas are considered to be of major importance: illegal trade in wildlife, illegal logging and its associated timber trade; illegal, unreported and unregulated (IUU) fishing, illegal trade in controlled chemicals (including ozone-depleting substances) and illegal disposal of hazardous waste. New types of environmental crime are also emerging, for example in carbon trade and water management.

Environmental crime is one of the most damaging, high profile and economically significant fields of global criminal activity – second only to drug trafficking, and is pushing our planet to the point of eco-system collapse.

From the global aspect of eco-security, the so-called "Hazards". These are special hazardous industrial areas, the existence of which is a potential risk of an ecological accident occurring.

The geographical and geo-strategic position of the country is of great importance for eco-security, especially in terms of global

security. Thus, for example, when the famous accident of the nuclear power plant in Chernobyl occurred in 1986, the countries of the former SFRY were found to be hit by precisely because of its geographical location and sensitivity to radiological contamination

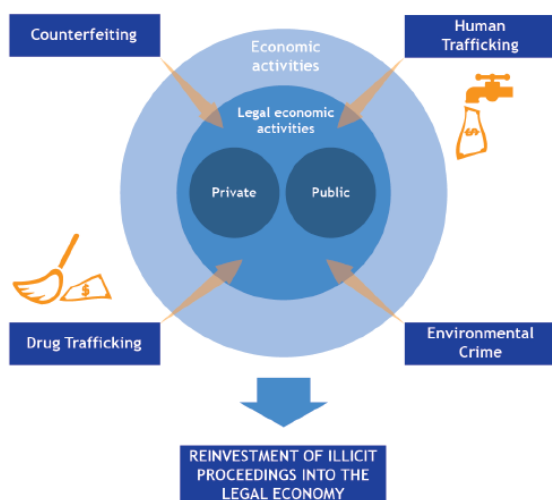


Figure 4. Theoretical Model of the Modus Operandi

So today, there is a new form of crime that has a particular danger, which is eco-crime. Its danger is much higher than in other forms of crime, in that it takes on global and regional circumstances both in terms of rapid expansion and mass, as well as in the breadth and severity of the consequences it can cause. Namely, the consequences caused by eco-crime are irreversible in most cases. Today, the two most important international organizations dealing with environmental protection and eco-security, which operate globally and have legal and political capacity under the auspices of the UN, are UNEP and UNDP.

General co-operation between states in the field of eco-security is more developed than economic or political co-operation. In this regard, the mass media and non-governmental propaganda promotes environmental protection and eco-security, with the aim of raising awareness among all countries around the world about the importance of eco-issues and "fighting" against eco-crime. In order to make it more efficient Cooperation in the field of eco-security, it is necessary to take the following measures and activities:

- to legally regulate potentially hazardous industrial systems through hazard maps, and in this respect to establish a data exchange and notification system;
- Legally prescribe the standards and measures taken in certain situations of threats to eco-security, which would be unified for all countries according to the possibilities;
- legally regulate the protection of watercourses, cross-border pollution / air, soil and water contamination, ecological aspects of international traffic;
- legally and politically determine an umbrella organization that will deal globally on the most direct, explicit and unique way to issues of eco-security.

5. Ecological safety in the post-modern environment

Ecotoxicology and Environmental Safety focuses on integrated mechanistic research related to short and long-term pathways and interactions of substances and chemical mixtures in environmental systems and subsystems on their bioavailability, and assimilation in organisms, as well as biological responses of these organisms, and damage mechanisms (endocrine disruption, genotoxicity); and on their subsequent fate in the environment, food chain, including humans.

Novel technologies, techniques, and methods such as biomarkers, biosensors and bioanalytical systems, bioremediation methods, QSARs and QSPRs, advanced high performance computational methods, models, and their applications in obtaining

and processing interdisciplinary ecotoxicological information are also addressed in this co-author's work.

We welcome the applied outcome of complex ecotoxicological research such as developing the science-based Environmental Quality Criteria, standard toxicity tests, techniques, and methods for ecotoxicological evaluation of the environment, as well as developing ecotoxicologically proven methods and technologies for prevention, interception, and remediation of human-induced damage to ecosystems.

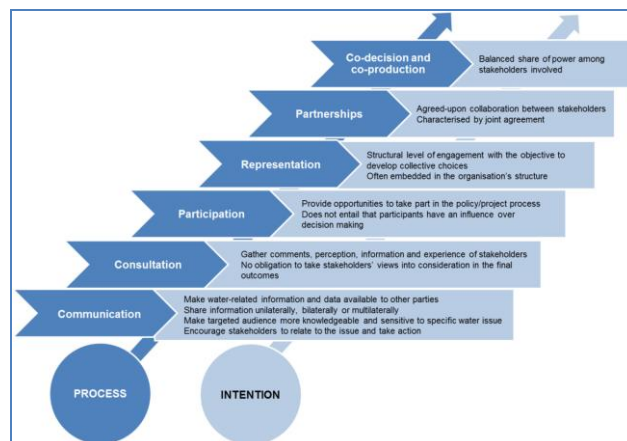


Figure 5. Environmental crime also often involves a cross-border dimension

In the current post-modern environment, if people can so adversely affect the planet Earth, then we are able to correct something. This will require new forces, new ways of thinking, smarter methods of production, wise consumption, and new systems of financing and risk management. In this section the issues of NHB accidents / events are being actualized, the possible solutions of NHB protection are proposed, including the fundamental changes in global, food, energy and financial systems that are necessary to meet the needs of current and future generations-sustainable development.

Behavioral leaders of institutions in the region based on management styles, which mainly depend on: characteristics, profiles and activities of managers. Organizational culture is a set of organizational behaviors that can be seen in the organization's environment while the organizational climate is shaped by the management through a personal policy within an organization.

In some Western Balkan countries, the Association of Corporate Security Managers was formed, mainly within the chambers of commerce, the initiative of professionals, experts from all areas of corporate security, with the aim of promoting, developing and popularizing the profession as well as strengthening professional and corporate standards. These specialized Associations bring together a large number of corporate security managers from private companies and public companies from home and abroad. So far, a significant number of scientific-professional meetings, education, presentations and meetings of security managers have been held. Traditionally, each year they organize and are very busy with the International Conference of Corporate Security Managers, and awarded annual awards for top managers, companies, institutions and larger companies, with the best results in the field of corporate governance and social responsibility in the security system.

In the case of critical infrastructure, it is best to see how public and private interest intertwine. The EU has the largest number of critical infrastructure in private ownership, but its protection is of public importance, because the consequences for protection will not be tolerated only by the private owner, but by a large number of citizens.

6. Conclusion

Ecological safety has no limits and is a global problems, task and obligation. In the current geopolitical constellation of relations, the UN organization appears as the main (not the only) organization with capacities to take care of the eco-security of the region and the world.

Developing awareness of environmental issues and sustainable development, especially in areas where different ethnic groups of people live (multicultural areas) and coming into contacts that, historically viewed, are marked by conflicts, intolerance and conflicts, is linked to. The problems of upbringing and education for the protection of the environment and sustainable development in a pluralistic and multicultural society.

Today, in the post-modern environment there is a certain disagreement from the aspect of participation in environmental degradation, which is determined by industrial, economic, technological, military, scientific and any other development of a certain state, as well as its size, population and natural resources. In this regard, it is necessary to find adequate solutions / answers on a global scale, with mandatory material and professional assistance from the leading countries in the world, along with the respect of small and medium-sized countries, and urgently plan priority tasks in the field of eco-safety, bearing in mind the vulnerability of the survival of the human species, Which grows every day and warns of the harsh reality of today.

In everyday activities, it is necessary to point out the importance of knowing the principles and measures of security protection of critical infrastructure (primarily public devices and their parts exposed to theft) and knowledge and proper use of legal protection mechanisms in order to preserve the integrity and credibility of public enterprises and companies, but also The interests of national and public security. Consideration should be given to security and criminal aspects, the problems of stealing parts of public utilities for heat, gas, energy, water, sewage and other resources, important for the supply of citizens and the functioning of the economy in the environment and rural areas.

Problems of illumination and proof of the theft that endanger critical infrastructure should be presented and analyzed through reviews of relevant criminal law, detection and resolution problems - difficulties in implementing regulations, as well as proving the theft of public equipment and parts in criminal proceedings.

Making decisions with the conditions of modern dangers is complex, because in the environment a chaos is created, which prevents the normal functioning of the system. In order to prevent this, it is necessary to define in the peace the optimal methodology, which in this co-author's work is given as the O4-discovery (obscure) method, decides, orders, disables (informs).

The greatest efficiency is only possible in the context of military-security decision-making - integration of expert systems and decision support systems, which is now one of the major tasks of researchers in the defense and security system in the Western Balkans and the environment.

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DETERMINING THE BIOMOTOR ABILITIES EFFICIENCY OF THE MILITARY ACADEMY CADETS ACCORDING TO THE NATO STANDARDS FOR PHYSICAL PREPAREDNESS

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Abstract: The world trend of armies that are suitably prepared from a physical point of view requires a proper and well prepared sport infrastructure and conditions for regular performance of physical activities. The NATO member states place great importance on the good physical preparedness, and for that reason they use unified system of standards that follow the physical fitness of the army members. As a result of the practical applicability of the NATO standards, the Army of the Republic of Macedonia uses this system to evaluate and assess the physical fitness and preparedness of the uniformed staff, the professional soldiers and the cadets. The study analyzes only the biomotor efficiency of the cadets of the Military Academy and their success in achieving the previously determined NATO requirements for physical preparedness. The results of the study show that, generally, the cadets have achieved high level of biomotor quality on the evaluation scale, and meet most of the previously determined criteria, however, there are also cadets who failed to pass the army physical fitness and preparedness test.

Keywords: MILITARY ACADEMY, CADETS, NATO STANDARDS FOR PHYSICAL PREPAREDNESS, DESCRIPTIVE STATISTICAL PROCEDURES

1. Introduction

In order to achieve high level of combat readiness and preparedness, every army applies a national physical activity program [2]. When we analyze and conduct this type of program we should take into consideration that this program correlates to the contemporary security trends, events and threats on national and international level. Nowadays, the main characteristic of the global and national security is the significant increase of security threats, which are resulting from terrorism, organized crime, illegal migration, drug trafficking and ethnic conflicts.

Establishing a capable, well equipped and highly professional army that will protect and preserve the safety and stability of the country from the different types of security threats is an extremely important challenge, and we should approach to it systematically and invest in it with all available means and resources (equipment, infrastructure, training, organization).

This commitment can be achieved with finding and developing suitable program that would meet the demands imposed on the seniors, professional soldiers and cadets in order to improve the general and professional working ability, which is a precondition for successful examination of the physical preparedness which is important for adequate and successful performance of the professional duties [4].

2. Statistical data and methodology used

The study is conducted with a help of a sample of respondents, a total number of 122 cadets of the Military Academy in Skopje between the ages of 19 and 23. From the total number of cadets, 32 are from the first academic year (22 males and 10 females), 27 cadets from the second academic year (20 males and 7 females), 34 cadets from the third academic year (23 males and 11 females) and 29 cadets from the fourth academic year (22 males and 7 females). A battery of three biomotor tests have been applied to the respondents [11]:

- Push-ups on a flat surface for 2 minutes (PUSH-UPS)
- Abdominal exercises in lying position with lifting the upper part of the body for 2 minutes (ABS)
- Running 3200 meters (R3200)

The results that the cadets have shown on these tests are expressed with points, according to the rulebook for maintaining and examining the physical preparedness of the army [8].

In order to achieve the standards that have been set, they should have a minimum of 60 points or 60% on each test. The final grade is actually calculated from the points average from the three sport disciplines and it is expressed in several categories:

- grade 1 – 'insufficient' to 60 points;

- grade 2 – 'sufficient' from 61 to 65 points;
- grade 3 – 'good' from 66 to 75 points;
- grade 4 – 'very good' from 76 to 85 points; and
- grade 5 – 'excellent' from 86 to 100 points.

The physical preparedness check test is compulsory conducted once a year, and if not passed within the given period, there is also an additional examination date.

The data from the applied variables in the study have been elaborated with the help of descriptive statistical procedures. During the data elaboration process, the average values (mean) of the biomotor tests, minimum and maximum (min., max.) for each group of respondents were calculated and classification of the results in groups was performed – frequency analysis (f%). Furthermore, with the application of the T-test of independent samples, the difference between the average values between the groups was calculated.

3. Results and discussion

The preview of the results in Table 1 show that the general physical fitness and preparedness of the cadets is relatively high because the average values of all biomotor tests are between 76 and 85 points, in other words, a grade 4. By comparing the average results of the cadets from the first, second, third and fourth academic year, we can notice that there are no significant differences between them, with the exception that there is small tendency of achieving more points during the four-year studies in the Military Academy.

Table 1. Average results (points) from the test of biomotor abilities taken by the cadets

Variable	PUSH UP		ABS		T3200m	
	points	min/max	points	min/max	points	min/max
I g.	79,29	56/100	77,59	56/100	82,37	55/100
II g.	82,66	55/100	77,96	41/100	82,66	52/100
III g.	80,67	55/100	85,44	66/100	83,55	55/100
IV g.	85,65	58/100	84,62	41/100	80,20	46/100

Table 2 shows the percentage frequency distribution of the biomotor tests results taken by the cadets, calculated with the help of frequency analysis. According to the results presented, it can be established that there is a huge difference between the number of cadets who have met the NATO criteria for physical preparedness compared to those who failed to meet the criteria.

The total span of biomotor requirements that have been met and biomotor requirements that have not been met on the PUSH UP and

ABS tests is N=115 (94%) in contrast to N=7 (6%), while on the R3200m test it is N=110 (90%) in contrast to N=12 (10%).

Table 2. Results frequency of the biomotor tests taken by the cadets

Variable	PUSH UP				ABS				R 3200m			
	I g.	II g.	III g.	IV g.	I g.	II g.	III g.	IV g.	I g.	II g.	III g.	IV g.
Points	N=32	N=27	N=34	N=29	N=32	N=27	N=34	N=29	N=32	N=27	N=34	N=29
86-100	11	13	13	18	9	9	17	19	16	13	16	12
	34%	48%	38%	62%	28%	33%	50%	66%	50%	48%	47%	41%
76-85	7	5	5	2	9	7	11	1	7	5	8	4
	22%	19%	15%	7%	28%	26%	33%	3%	22%	19%	24%	14%
66-75	6	3	11	4	10	7	6	4	10	3	4	8
	19%	11%	33%	14%	31%	26%	18%	14%	31%	11%	12%	28%
61-65	5	4	3	4	0	2	0	2	0	2	3	2
	16%	15%	9%	14%	0%	7%	0%	7%	0%	7%	9%	7%
< 60	3	2	2	1	3	2	0	3	2	4	3	3
	9%	7%	6%	3%	9%	7%	0%	10%	6%	15%	9%	10%

Table 3 presents the results of the applied T-test and the significance of the average value differences among the cadets. The results analysis shows that there are certain differences between the cadets in the biomotor area that has been analyzed, but significant statistical differences are noticed only on the ABS test ($T=-2,97$ and $T=-2,63$). This data clearly shows that there is no significant improvement of the basic biomotor abilities during the studies and the changes are not in accordance with the previously established educational goals stipulated in the curricular plans and programs of the Military Academy [12].

Table 3. T-test composed of the biomotor abilities tests taken by the cadets

T-test	PUSH UP				ABS				R 3200m			
Groups	I g.	II g.	III g.	IV g.	I g.	II g.	III g.	IV g.	I g.	II g.	III g.	IV g.
I g.												
II g.	-0,87				-0,10				-0,07			
III g.	-0,39	0,54			-2,97	-2,63			-0,32	-0,20		
IV g.	-1,68	-0,75	-1,39		-1,70	-1,48	0,47		0,59	0,56	0,82	

Physical activity and sport activities within the frames of the Military Academy are integral part of the curriculum and syllabus, a part of the combat training, and they contribute to physical development, development of the psychophysical functions and the moral of the cadets. In order to meet and fulfill the educational criteria, the whole training process that includes exercises, at the Military Academy (morning workout, classes in special physical exercise and sport, stamina workout and applied exercises, sport competitions, skiing, swimming etc.) are adjusted to the needs of the army, otherwise speaking, aim to qualify the cadets to participate and perform specific combat activities in conditions of war and peace [4].

Basically, due to the nature of the army profession, it is necessary to constantly maintain the physical and combat preparedness on high levels, because it is the only way to successfully and continuously perform the job duties [10].

The previous experiences only confirm the opinion that only physically and psychologically prepared army members can fully perform the most complex combat tasks and to adapt to different environmental working conditions [3] [9] [1] [6].

Every army that aims to be modern and advanced, alongside the military technique and equipment, must pay particular attention to the human potential and resources as important strategic means (factors) of defense. A confirmation of that is the contemporary peaceful practice of the modern armies of the world which invest massively in maintaining the high levels of the motoric and functional abilities and capacities of their national armed forces [7].

4. Conclusion

The physical exercise and sport training content of the Military Academy is a planned, systematic and permanent educational and pedagogical process that aims to develop the biomotor abilities of the cadets and to impact the process of acquiring knowledges and skills that are closely related to the performance of the army duties.

In order to provide recurrent information about the effects caused by the different types of physical exercise, the statistic analysis results of the study manifested that the physical preparedness of the cadets is to a large extent acceptable and meets the specific security requirements of the army profession, even though, during the studies, no significant quality improvement of the basic biomotor abilities of the cadets has been noticed.

To overcome these omissions, it is necessary that the experts in charge of conducting the sport activities of the Military Academy revise the previous physical exercise program and to suggest more measures and activities in order to make improvements.

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DEFENSE PREPARATIONS AS THE STATE SAFETY CONDITION – SELECTED LEGAL DOCUMENTS

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Abstract: Defense preparations are an antidote to emerging political and military threats. They cover, in accordance with applicable legal regulations, the military, economic and administrative area, as well as entrepreneurs and individual citizens of the state. They are mostly based on defensive tasks, that is, special benefits and personal and material benefits in accordance with the law on the general obligation to defend the Republic of Poland.

The article presents selected legal documents regarding this issue in the Republic of Poland.

Keywords SECURITY OF THE STATE, DEFENSE OF THE STATE, DEFENSE PREPARATIONS, DEFENSE TASKS, DEFENSE BENEFITS

Introduction

The current situation in the world, the possibility of various types of threats¹ that in the future may lead to conflicts, wars will force states and nations to care for the broadly understood security². [Security is the foundation of the functioning of every state, its provision is an important factor for the existence and survival of the nation]³, it is one of the most important functions of the state. Therefore, in times of danger, states prepare themselves in the event of their occurrence.

Defense preparations in Poland cover a wide range of planning activities defining tasks, preparing forces and means for their implementation by all elements of the defense system of the state⁴, which is part of the national security system of the Republic of Poland. As M. Kuliczowski rightly points out [... defense preparations are an interdisciplinary undertaking covering all areas of state functioning, and the scope of these preparations has significantly expanded into important non-military areas, especially political, economic, ecological, cultural, etc.]⁵.

The important activities of the organs of executive and public administrative authorities in these preparations are aimed at securing the state against armed attack and creating opportunities for survival for the population in crisis and war situations by providing authorities, administrations and people with a

communication system, medical care, food and security. One should therefore be aware that a well-prepared state must engage all possible and necessary forces and means to prepare for the event of a crisis or war.

Selected legal documents regulating the defense preparations of the state

For the purpose of efficient and regulated preparation of defense in Poland there is a number of legal documents regarding these issues. The basic and at the same time starting is the Act of November 21, 1967 on the general obligation to defend the Republic of Poland, where art. 2 specifies that the defense of our country, the preparation of people and state property in the event of war is the task [... of all organs and government administration and other state bodies and institutions, local self-government bodies, entrepreneurs and other organizational units, social organizations, as well as every citizen in the scope defined in the Act]⁶. Another more detailed executive document to the above-mentioned Act is the Regulation of the Council of Ministers of June 15, 2004 on the conditions and mode of planning and financing tasks performed as part of state defense preparations by government administration bodies and local self-government bodies, where conditions and the mode of planning tasks that are performed as part of defense preparations, their financing and the principles of imposing defense tasks⁷. The division of defense tasks can be made on the basis of stages of their implementation, starting from tasks of a preparatory nature, through tasks to react to the existing situation and ending with reconstruction tasks related to restoring the original state or using the second division defining the purpose of activities⁸, or using the second division defining the purpose of activities, where defensive tasks can be divided into preparatory and executive⁹. In addition, this document specifies in detail what defensive planning is¹⁰ that includes the performance, arrangement, updating of operational plans¹¹ and defense programs¹².

¹ [Threat – a situation in which the probability of creating a dangerous state for the environment arises. Assuming areas in which a threat may arise as the foundation, military and non-military threats can be distinguished.

Among non-military threats the following can be listed, in turn: political threats, economic (business) threats, psychosocial threats, ecological threats, internal threats, and others]. Ed. J. Pawłowski. *Dictionary of terms in the field of national security*, AON, Warszawa 2009, p. 162.

² Security is: [a state of non-threat, peace, confidence]- J. Stańczyk, *Contemporary understanding of security*, ISP PAN, Warszawa 1996, p. 15.

³ S. Wojnarowska-Szpucha. *Migration of the population with the threat of social security in Poland*, [in]: *Challenges and threats to the security and defense of the Republic of Poland in the 21st century in the social and technological-environmental dimensions*, (ed) Z. Trejnis, L. Kościelecki, ASPRA-JR Publishing House, Warszawa 2018, p. 57.

⁴ [The defense system of the state is a coordinated set of steering elements and executive elements, as well as the functions and processes implemented by them, and the relations between them. SOP is created by all forces and resources intended for the implementation of defense tasks, organized, maintained and prepared appropriately for these tasks]. *Defense strategy of the Republic of Poland 2009*, Ministry of Defense, Warszawa 2009, chapter 3, point 57.

⁵ Ed. M. Kuliczowski, M. Wojcieszko, *Public administration in the process of state defense preparations - selected problems*, War Studies Academy, Warszawa 2018, p. 73.

⁶ The Act of November 21, 1967 on the general obligation to defend the Republic of Poland, Journal of Laws of 1967 no. 44, item 220.

⁷ Defense tasks, as part of tasks in the field of national security, include undertakings implemented by executive bodies and other state bodies and institutions, entrepreneurs and citizens associated with preparing the state for efficient operation and survival in conditions of external threat to the state, crisis and war, implementation of specific operational undertakings in these conditions, as well as removing the effects after resolving the threat, aiming at restoring the state of normal functioning of the state – *Defense Strategy of the Republic of Poland 2009*, Ministry of Defense, Warszawa 2009, chapter 3, point 67.

⁸ See W. Kitler, *Concept, essence and scope of defense tasks* [in:] *Local self-government in the national defense of the Republic of Poland*, (scientific dir.), W. Kitler, AON, Warszawa 2015, p. 21.

⁹ Ibidem, p. 21.

¹⁰ Defense planning is: [defining the ways of performing defense tasks by government administration bodies and local self-

A significant part of defensive tasks as part of defense preparations is attributable to entrepreneurs doing business in the territory of the Republic of Poland, including entrepreneurs of special economic and defense importance¹³.

The tasks of entrepreneurs for the defense of the state are activities in the scope of:

- 1) economic mobilization;
- 2). militarization;
- 3) operational planning;
- 4). defense training;

5) resulting from the obligations of the host state¹⁴. All these undertakings involve entrepreneurs of special economic and defense importance who conduct their activities in an area larger than one province or perform tasks in the field of: [...operation of airports and seaports, distribution, broadcasting of radio and television programs, production, transport and storage of petroleum products, production, renovation or modernization of armaments and military equipment, execution of special trade, transport, postal services, telecommunications services, manufacturing, distribution and transmission of natural gas, liquid fuels and electricity]¹⁵. The Act on organizing tasks for state defense carried out by entrepreneurs in its records also refers to the economic mobilization program¹⁶, defining the tasks of government administration bodies and entrepreneurs in securing the functioning of the economy, Armed Forces and other entities that will conduct security and defense activities of the state, also providing the population with vital needs.

An equally important document is the Regulation of the Council of Ministers of September 21, 2004 on the defense readings of the state in which three states of defense readiness have been defined, the rules for implementing these states and tasks and their implementation related to the change of defense readiness of the state. According to the above-mentioned regulation, the following conditions apply: the state of permanent defense readiness of the state, the state of functioning of the state in time of peace, when there are no serious threats, during this time all planning, training

government bodies and the use of necessary forces and resources for this purpose, including operational planning and defense programming] – Regulation of the Council of Ministers of June 15, 2004 on conditions and the mode of planning and financing tasks performed within the framework of state defense preparations by government administration bodies and local self-government bodies, Journal of Laws of 2004, no. 152, item 1599, § 2, par. 6.

¹¹ Operational plans are performed as part of operational planning which includes [...determining activities related to the preparation and operation of government bodies of local self-government bodies in conditions of external threat to state security and during war, included in sets of operational tasks, as well as determination and measures necessary for their performance] – Ibidem, § 2, point 7.

¹² Defense programs are carried out as part of defense programming, which includes [...defining defense tasks carried out in peacetime, for a ten-year planning period, starting in an odd year, included in material and financial measures, to maintain and develop the defense potential of the state and the preparation of the Armed Forces, government administration bodies and local self-government bodies to operate in conditions of an external threat to state security and during war, as well as designing budget funds allocated for this purpose] – Ibidem, §.2, point 8.

¹³ The list of entrepreneurs of special economic and defence significance and government administration bodies to which they are subject is in: Regulation of the Council of Ministers of November 6, 2017 amending the ordinance on the list of entrepreneurs of special economic and defense importance, Journal of Laws of 2017, item 2143.

¹⁴ See the Act of August 21, 2001 on organizing tasks for state defense carried out by entrepreneurs, Journal of Laws of 2001 no. 122, item 1320, art. 2.

¹⁵ Ibidem, art. 3.

¹⁶ Currently, in the inter-ministerial arrangements there is a draft of the new Act on organizing tasks for state defense implemented by entrepreneurs and the economic mobilization program.

and control activities are carried out to prepare the state for possible crises, wars. The state of defensive readiness of the crisis time is introduced at the moment of the threat of the state, which requires the activation of procedures, actions aimed at preventing, eliminating threats and removing their consequences. The last state of defensive readiness of the war occurs in case of armed aggression against our country or when it results from our international obligations¹⁷, in this state mobilization, the introduced martial law¹⁸ and development of the entire defensive system of the state.

The legal act that refers to the issues concerning the preparation of the national security management system is the Regulation of the Council of Ministers of April 27, 2004 on the preparation of the national security management system, which regulates the preparation of the state for defense, defining who creates the state management system (public authority bodies, managers of organizational units performing tasks related to the management of national security, as well as command bodies of the Armed Forces of the Republic of Poland)¹⁹. The system of managing the national security of the Republic of Poland should be prepared on the basis of the guidelines of the above-mentioned regulation, so as to ensure continuity of decision-making and actions for these bodies in conditions of threat to national security.

The Regulation of the Council of Minister of January 13, 2004 on general principles of performing tasks under the universal defense duty is a document defining the principles of defense tasks performed by public administration bodies²⁰, entrepreneurs, organizational units performing tasks important for safety and social organizations. These tasks include: creating conditions for planning and implementation of defense tasks and their coordination, cooperation of all entities in the implementation of these tasks and providing information on their planning and implementation.

In order to ensure the efficiency of communication systems used to defend the country in 2004, a Regulation of the Council of Ministers was issued in this matter. The regulation specifies how these systems are to be prepared, who is responsible for this task and what characteristics should be fulfilled by such systems (they should be: reliable, resistant to interference, create conditions for safe transmission of information, be able to maintain communication when changing the place of control, preferentially

¹⁷ North Atlantic Treaty, Art. 5 [The parties agree that an armed attack on one or more of them in Europe or North America will be considered an assault against them all, and therefore they agree that if such an armed assault occurs, then each of them, as part of executing the right to individual or collective self-defence, recognized under article 51 of the United National Charter, will assist the Party or Parties under attack, taking, immediately, independently and in agreement with other Parties, actions it considers necessary, including the use of armed forces, to restore and maintain the security of the North Atlantic area].

¹⁸ In Poland, martial law is introduced by the President of the Republic of Poland at the request of the Council of Ministers, cf. the Act of August 29, 2002 on Martial Law and on competences of the Supreme Commander of the Armed Forces and the principles of its subordination to the constitutional organs of the Republic of Poland, Journal of Laws of 2002, no. 156 item 1301.

¹⁹ See the Regulation of the Council of Ministers of April 27, 2004 on the preparation of the national security management system, Journal of Laws of 2004 no. 98, item 978, § 2.

²⁰ Public administration – is a set of activities, actions and organizational and executive undertakings carried out for the public interest by various entities, bodies and institutions on the basis of law and in legal forms or a system composed of people, organized for a steady and systematic orientation towards the future implementation of the common good as a public mission consisting mainly (but not exclusively) on the current performance of acts, equipped for this purpose with the state authority and material and technical resources.

Source: <http://www.sejm.gov.pl/Sejm8.nsf/BASLeksykon.xsp?id=3B2030E D865DCD89C1257A780044A4CE&litera=A> (access 25.04.2019).

support special users)²¹. To meet these requirements, defensive communication systems are created using: [departmental telecommunications networks, telecommunications networks of telecommunication entrepreneurs, dedicated telecommunications networks, postal operators' infrastructure, military field post, special mail subordinate to the minister component for internal affairs and courier services subordinated to the minister of foreign affairs]²².

The health service is also obliged to prepare in the event of threats to national security through the implementation of the following tasks: [...increasing the number of beds in the hospital base and changing its profile, creating substitute hospital places, performing outpatient health services, determining the manner of securing staffing needs and employment rates in medical entities, using organizational units of public blood services, determining the method of sanitary and epidemiological protection, determining the method proceedings in the event of a radiation emergency, defining the manner of providing services for the needs of units subordinated to or supervised by the Minister of National Defense and the minister competent for internal affairs and for the needs of the Head of the Internal Security Agency, determining the manner and scope of record keeping and medical reporting in the conditions of mass inflow of the injured, wounded and sick people, defining the manner of providing services for medical entities carrying out defensive tasks]²³ as well as their coordination and cooperation in the implementation of these tasks with other bodies. Many of these tasks are coordinated, organized by the voivode²⁴, who is responsible for, at least, determining the location and number of substitute hospital places, approving plans created before the bodies of territorial self-government units regarding the implementation of tasks for defense purposes, possible increase in the number of hospital beds²⁵, drawing up a balance of medical staff in the province and presenting it annually to the minister responsible for health matters, as well as drawing up a plan for the possible transfer of medical personnel in the province.

As part of defense preparations in the Republic of Poland, defense training is organized, in which all entities involved in ensuring state security are involved²⁶. The binding legal act on

training is the Regulation of the Council of Ministers of October 8, 2015 on defense training, defining which subjects are obliged to undergo defensive training, what scope of subjects should be included in the training program and the competence of the authorities regarding planning and implementation of training²⁷.

State defense preparations are also readiness to protect facilities of particular importance to state security and defense implemented on the basis of the Regulation of the Council of Ministers of June 24, 2003 on the objects particularly important for security and defense of the state and their special protection, which distinguishes two categories of objects (the first one is subject to the Minister of National Defense and the other to the Minister of Home Affairs), tasks within their protection and competences of the authorities in these matters. [Preparation of special protection of facilities includes conceptual, planning, organizational, logistic, technical, training and control works]²⁸.

In order to increase the defense capabilities of the Republic of Poland, ensure the efficient functioning of the departments of state administration and national economy and organizational units performing extremely important tasks from the point of view of security and defense as part of defense preparations, existing and specially created units will be subject to militarization²⁹. The units will be militarized that carry out tasks within the framework of: [production of goods, services and implementation work and expertise necessary to secure defense needs of the state, military transport and logistic support of the Armed Forces and allied reinforcement forces under the responsibility of the host state, operation of communication systems, transport, power industry, gas industry and the fuel sector, as well as performing functions resulting from supremacy in the Polish airspace, construction, development and reconstruction of the state's defense infrastructure, as well as the collection and maintenance of mobilization reserves for the technical protection of facilities of special importance for security and state defense]³⁰, that is all entities which, by their actions, strengthen the security of the state and contribute to its defense.

All undertakings, defensive tasks, in order to be able to be quickly and well implemented, require human and material resources. In order to provide these resources in the Republic of Poland, there are legal regulations that give the state the possibility to use the resources of the national economy, to secure them in peace through the imposition of personal and material benefits. The basic document in this regard is the Act of November 21, 1967, mentioned at the beginning of this article, a general obligation to defend the Republic of Poland and an executive document issued by the Council of Ministers of August 11, 2004 on personal and material benefits for defense in the event of an announcement of mobilization and during the war. The personal benefit is the performance of a certain type of activity, work for the defense, whereas the material benefit consists in putting into use the real

²¹ See the Regulation of the Council of Ministers of August 3, 2004 on the preparation and use of communication systems for defense purposes of the state, Journal of Laws of 2004 no. 180, item 1855.

²² Ibidem, § 6.

²³ Regulation of the Council of Ministers of June 27, 2012 on the conditions and manner of preparation and use of medical entities for the defense needs of the state and the competence of the authorities in these matters, Journal of Laws 2012, item 741, § 1.

²⁴ The voivode is: [...a representative of the Council of Ministers in the voivodeship, head of the government's combined administration in the voivodeship, a supervisory body over the activities of territorial self-government units and their associations in terms of legality, a government administration body in the voivodeship, whose properties belong to all matters regarding government administration in the voivodeship not reserved in separate acts to the properties of other bodies of this administration, a representative of the State Treasury, in the scope and on the terms specified in separate acts]. The Act of January 23, 2009 on the voivode and government administration in the voivodeship. Journal of Laws of 2009 no. 31, item 206, art. 3.

²⁵ [The planned number of hospital base beds in a voivodeship should be less than 75 hospital beds per 10,000 inhabitants, while 50% of which should be the treatment beds, including beds provided for uniformed services]. The Regulation of the Council of Ministers of June 27, 2012 on the conditions and manner of preparation and use of medical entities for the defense needs of the state and the competence of the authorities in these matters, Journal of Laws 2012, item 741, § 4.

²⁶ The training is attended by representatives of government administration at all levels as well as local government administration and entrepreneurs. However, according to the Act on general obligation, citizens of municipalities participate in self-

defence training. Own study based on: RRM of October 8, 2015 on defense training, Journal of Laws 2015, item 1829, the Act of November 21, 1967 on the general obligation to defend the Republic of Poland.

²⁷ Ibidem, § 1, 6, 9.

²⁸ Regulation of the Council of Ministers of June 24, 2003 regarding objects of special importance for the security and defense of the state and their special protection, Journal of Laws 2003 no. 116, item 1090, § 5, par. 2.

²⁹ Militarization – transferring the rules and methods of military organization to bodies and organizational units of the public administration and national economy, applying some elements of military discipline in them and giving them military character by appointing people to serve in militarized units ...]. Ed. J. Pawłowski, *Dictionary of terms in the field of national security*, AON, Warszawa 2009, p. 66.

³⁰ Regulation of the Council of Ministers of November 24, 2009 on the militarization of organizational units performing tasks related to national defense or security, Journal of Laws 2009 no. 210, item 1612, § 3.

estate or movable property³¹. The regulation specifies how benefits can be collected, who is authorized to impose them, on what basis the reimbursement of expenses for services rendered and issues related to the payment of possible damages are made.

Summary

Due to the volume of the article, only the legal documents selected by the authors regarding the defense preparations of the state were presented. However, one should be aware that the issue of defense preparations is very broad, affects many spheres of the state, institutions, entrepreneurs and citizens, and therefore there are many other legal and strategic documents regulating these issues.

In order to prepare the state in the event of danger and war, use all available forces at your disposal, prepare them properly, plan in peace time, so that the state is ready to counteract various crisis and war threats of varying magnitude and scope.

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<http://www.sejm.gov.pl/Sejm8.nsf/BASLeksykon.xsp?id=3B2030ED865DCD89C1257A780044A4CE&litera=A>

³¹ See Ed. J. Pawłowski, *Dictionary of terms in the field of national security*, AON, Warszawa 2009, p. 146-147.

USE OF THE OPPORTUNITIES OF COMPUTER GRAPHICS IN THE EDUCATION AND TRAINING OF CADETS IN NATIONAL MILITARY UNIVERSITY “VASIL LEVSKI”

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Abstract: This article presents the peculiarities of computer graphics introduction of innovative methods, and the susceptibility of students to the application to the teaching method. Teaching enjoys to high status, depending in part on the amount of study required to prepare for employment. The organizational complex is stable in some sides and changing in others.

Keywords: EDUCATION, COMPUTER GRAPHICS, IMAGE

1. Introduction.

The dependence on human participation and human behavior with regard to the surrounding world and the continuous visualization of reality, continuous training of students in the methods of Computer graphics and the adoption of information security methodology should be carried out and the question of the development of the students of the National School Vasil Levski of Medicine answered Computer graphic training is necessary, even for elementary school students, not only for secondary school students and students. Nowadays, it becomes a serious social problem that anyone can manipulate graphical information for a different purpose. It is increasingly important to ensure the security of data, its protection against intrusion and the ability of users to recognize such graphic data. A large number of imaging applications are available on the market, many of which are free and offer tools and effects sufficient to have an amateur impact on a graphic product.

This report makes a study of the preparedness and satisfaction of the subject "Computer Graphics" of the students at the Faculty of Artillery, Air Defense and Communication and Information Systems at the National Academy of Sciences "Vasil Levski" Shumen.

The first goal of this report is to be created and tested a questionnaire, which should rate the students' awareness of the opportunities offered for self-improvement and development of skills in the field of computer graphics. The second goal is to obtain awareness-raising factors for computer graphics, defined by the level of awareness of the huge influence of it that has in our daily lives. [2], [3] and [4], peculiarities and innovations in the traditional and e-learning of cadets are considered.

Education and computer graphics

Computer graphics training is constantly evolving. Research on the content of educational information on graphic capabilities has been summed up in various sources. In many studies, there is a variety of content quality in different graphical software environments through researches on existing projects and computer learning education measurements which are based on three dimensions that relate to ethics when working with graphical information and the practice of protecting the intellectual property in the form of graphical, final product.

Cognitive Behavioral Theory

Cognitive Behavioral Theory, which includes student theory and behavior, according to [1], stands out as an easy-to-remember model that explains the relationship between thinking and emotion. It is called model A-B-C: A = Activating Event, B = Beliefs, Thoughts, C = Emotional and Behavioral Effects (see Figure 1). This study suggests that computer graphics education as an activation event will improve awareness of the potential for career development and development.

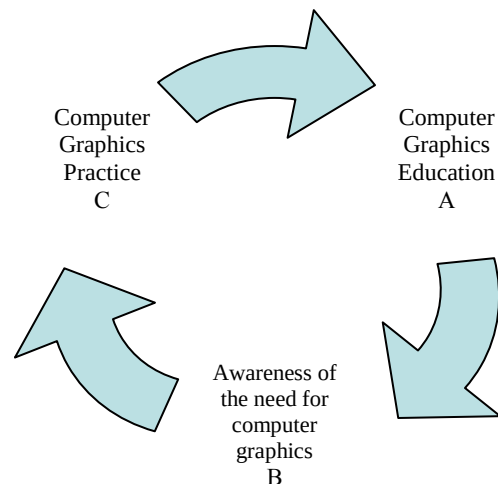


fig. 1. A-B-C model

1. Study among learners.

An analysis is carried out using the questionnaire, which consists of fourteen elective answer questions and the results are presented in diagrams representing the satisfaction rate of the computer graphics training.

The poll has been completed by 20 students, all of whom are students at the "A, VBA and CIS" faculty at NVU "Vassil Levski". After the analyzes are made, it can be seen in figure 2 that satisfaction with the possibility of preparation for the subject "Computer Graphics". It is seen that over 75% of learners are pleased to be able to access the learning materials from anywhere.

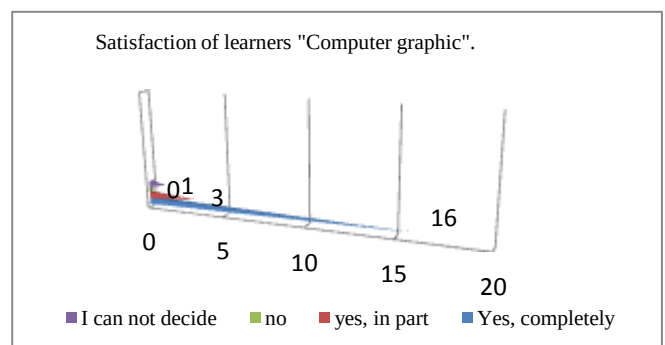


fig.2. Satisfaction of learners

The questionnaires examine the way the information is presented and the number of exercises. The analysis of the results presented in Fig. 3 shows that:

- About 80% of learners are very pleased with the organization and the number of exercises-18;
- 2 responded with "good".



fig. 3. Evaluate the number of exercises

Students' attitude towards their type of training is also interesting, with a selection of the most popular types: traditional, electronic or distance learning. As can be seen in Figure 4, modern generation prefers e-learning.

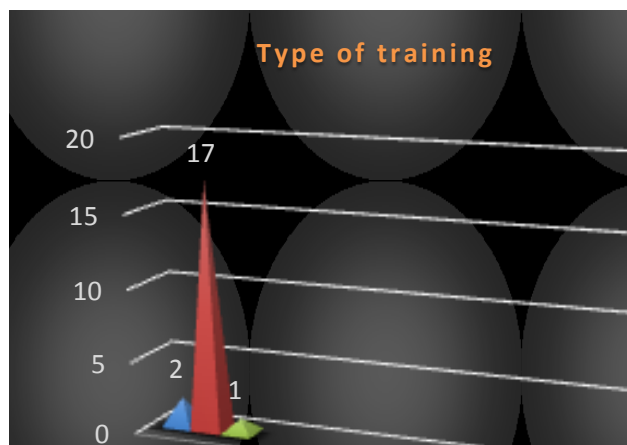


fig.4 Types of training and learner preferences

The poll allows us to see if students would like to introduce e-learning. This would help to develop different electronic systems for the needs of faculty education. This type of training will allow flexible updating of the learning content and learners easily reach it, given that they are continuously online. Figure 5 shows that not all of them prefer e-learning, it is clear that about 20% would like to have another source of information as it is noticed that they can not define exactly what.

The poll was realized among 20 students, eight men and 12 women. The gender breakdown is presented in Figure 6b, and Figure 6a shows the age range of the subjects studied. These demographic data are of a confidential nature and allow us to conclude that a division under this sign should not be made.

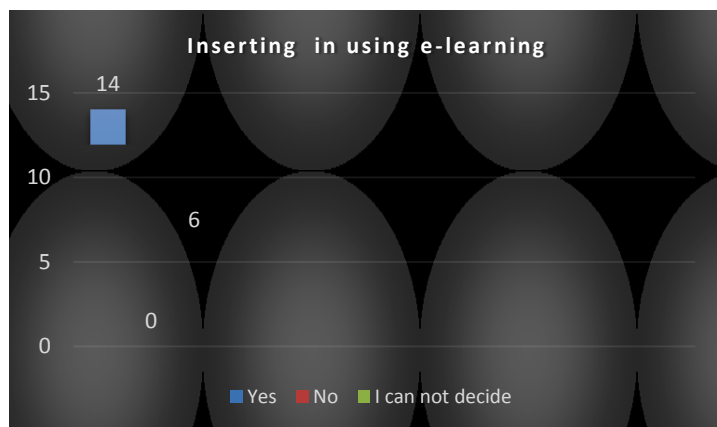


fig.5. Attitudes to using e-learning

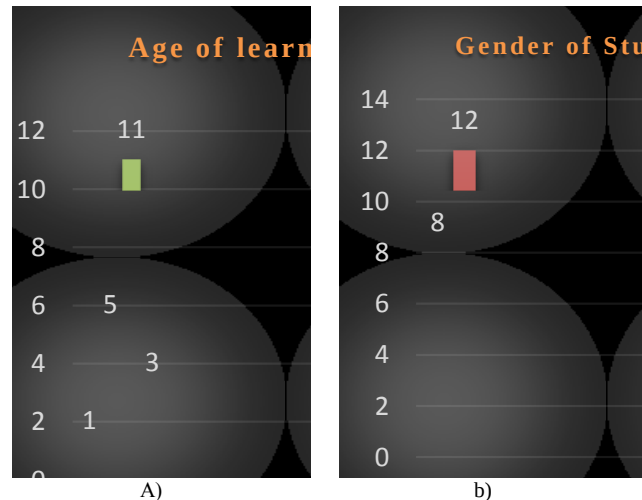


fig.6 Demographic data

4. Conclusion

This study is aimed at the computer graphics training of students and cadets in the NVU "Vasil Levski ". The purpose of this report is to research whether computer graphics and information awareness affect the interests of learners. The results show that learners have an excellent motivation, interest and desire to use different learning sources. It is a fact that 75% of them would like to receive e-learning through different platforms, which does not mean that traditional teaching does not have a place in learning. The results of the analysis confirm that their satisfaction is over 75% and it is indicative that the same satisfaction is also with the practical part of the training. There are some limitations in the study. In future studies, the research sample should be designed on a wider range of students to track the development of interests and technology over time.

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APPROACHES THAT DECONTAMINATION OF CHEMICAL WARFARE AGENTS AND TOXICAL INDUSTRIAL CHEMICALS

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Abstract: Adequate and timely protection of the people and the infrastructure necessary increase efficiency in liquidation of the consequences of chemical, radiological and biological agents. CBRN decontamination teams are using decontamination technique to minimize exposure to hazardous agents and limit the spread of contamination. The disposables decontamination means and methods are very divers, and an evaluation of the most appropriate aspects often encountered in the real cases could determine the adequate organization approach to be used.

Keywords: chemical, radiological and biological agents, decontamination

1. Introduction

The threat of exposure of the civilian population to nuclear, biological, and chemical agents, which has traditionally been considered a military issue, has increased due to the potential causes from direct military attacks, stolen weapons of mass destruction (WMDs), acts of terrorism, and industrial accidents and disasters. Based on mass casualty effects, the release of such CBRN agents might create thousands of casualties, thereby overwhelming local health and medical resources. The specificity of the likely CBRN situation that may be created after terrorist actions and new approaches to unclear identification, protection of endangered entities and eradication of the latter. Consideration should be given to reconsidering the political, military and civilian approach. For that reason, CBRN protection should be seen as a comprehensive political, military and civil approach based on the main pillars of prevention, protection and rehabilitation. [11, 12, 13, 14].

The proliferation of WMD and the associated threat of terrorism are among the most serious challenges for the international community in post-Cold War security. An important challenge for NATO is to find its place in international efforts against the proliferation of these substances and materials.

2. Protective zones after chemical incident

Response areas as defined in [2] and schematically shown in Figure 1 below are important for determining the response roles / places and PPE requirements for release events. Note that the dimensions and location of these zones may change over the course of an event.

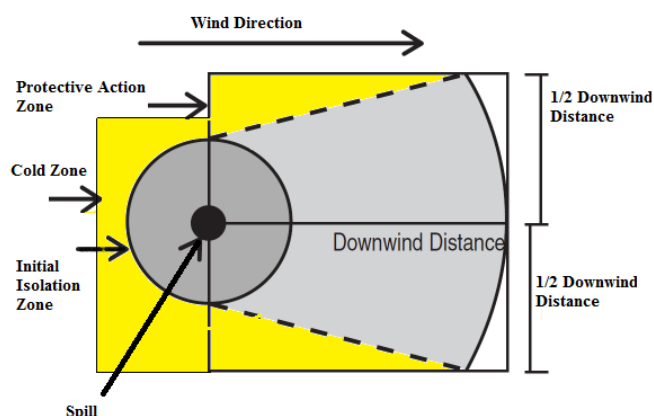


Fig. 1 Protective distance after chemical incident. [1, 2]

The initial isolation zone (hot zone) is the innermost of three main areas of chemical spill. It is the area in the immediate vicinity of a release, the release occurs at the center of this zone and it contaminant concentration is considered sufficient to cause death or injury to unprotected personnel or responders wearing inappropriate protective clothes and gas masks. All people entering the hot zone must wear prescribed levels of protection MOPP 4, and they must

follow the procedures established to enter, work in the area, and exit the zone in a short time. [1, 2].

The warm zone is located upwind and outside the hot (initial isolation) zone and protective action zone, between the hot zone and the cold zone. The inner perimeter marks the outside edge of this zone and is considered the initial control zone. This is the area that provides a transition between contaminated areas and the uncontaminated areas. The warm zone provides a buffer to further reduce the probability of the cold zone becoming contaminated or being affected by other existing hazards. Decontamination of personnel and equipment takes place in a portion (decontamination corridor) of the warm zone (fig. 2). The main decontamination facility/corridor is located at the exit point of the warm zone. Responders in the warm zone must have property protective clothes and gas masks appropriate to the tasks they will undertake.

The protective action zone is located downwind from the chemical release. Individuals in this area may be evacuated, sheltered in place, or supplied with protective equipment. This zone could be several square kilometers in size, regardless of whether the release takes place indoors or outdoors. The protective action zone can evolve over time.

The cold zone (or clean zone) is the outermost part of the release or incident site, and is a designated non-contaminated or clean area. The outer perimeter marks the outside edge of this zone, surrounding the incident scene. Support equipment and vehicles and main military formations such as command staff are located in the cold zone and traffic is restricted to authorized response personnel. MOPP 4 level is not required in this zone because exposure levels are below levels causing effects. Potentially contaminated personnel, clothing, equipment, and samples are not permitted in this zone, but are left in the warm zone until they are decontaminated or made safe for transport. The boundary between the cold and warm zone is defined based on the extent of contamination spread; there may be contamination within the warm zone but none in the cold zone.

Decontamination focuses on remediation of various locations and equipment with which chemical agents have come into contact and avoid spread and contamination.

The goal of decontamination is to reduce the overall hazard to acceptable levels as rapidly and expeditiously as possible. Minimizing contamination and the spread of contamination is primarily achieved by avoiding direct contact with liquid, solid, vapour or aerosolized contaminant. Gross decontamination involves the removal of as much contaminant as early as it is safe to do. The spread of contaminant is controlled by ensuring that the decontamination corridor is capable of containing the amount of expected contaminant, the flow of the run-off (if present) is directed towards the hot zone, and the movement along the decontamination line is closely regulated. There are many different ways of reducing contamination and the end goal is to achieve a safe level of contaminant.

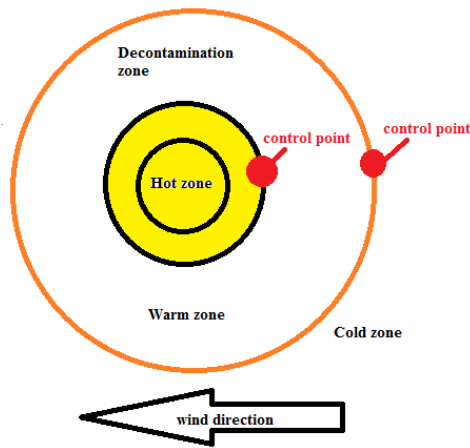


Fig. 2: Decontamination area in chemical incident (adapted from Fig. 1).

Decontamination can be defined, as a method essentially involving the conversion of toxic chemicals into harmless products by degradation. Decontamination is based on one or more of the following principles:

- to destroy chemical agents by chemically modifying these (destruction);
- to physically remove chemical agents by absorption, washing or evaporation;
- to physically screen-off the chemical agents so that these cause no damage.

Decontamination measures for PPE may include/involve absorbents, adsorbents, vacuuming, evaporation, chemical degradation, dilution, wash-down or simply clothing removal. These measures will vary according to the contaminant, the phase of the activity and the item that is contaminated. During decontamination, PPE remains in place until deemed safe to be removed.

2. Decontamination approaches and effectiveness.

Decontamination approaches of chemical warfare agents and TIC (toxic industrial chemicals) is a complex process and can be considered in different ways. From methodological point of view, there are three basic methods of decontamination: mechanical decontamination, physical decontamination and chemical decontamination.

There are several basic approaches to hazard decontamination that can themselves be achieved by a variety of means

- Placing a barrier around the contaminant to render it unable to cause harm;
- Removing the contaminant without deactivating it, sometimes by dilution into some other medium such as water or air (a physical process), or by absorbing/adsorbing onto something else, meaning that it is either relocated and further treated by other means, or diluted sufficiently for safety; or, lastly and preferably,
- Breaking down the contaminant, by various means, most commonly chemical (e.g., bleach).

In the case of creating a barrier, the responder should not normally be in direct contact with the original contaminant, and therefore any PPE selection is based on attenuating whatever lesser hazard there is remote from the initial contaminant (such as off-gassing).

In the case of removal, the responder could contact the agent during the removal process, for example by being splashed by

contaminated water. Hence, PPE must act as a barrier against both the contaminant and any removal medium or process.

Lastly, in the case of breaking down the contaminant, chemical means in particular can be quite dangerous on both humans and their PPE, so PPE must be chosen to resist both the agent's action as well as that of the chemical decontaminant used.

Appropriate process is of course extremely important in minimizing the possibility of excessive spread and transfer of contamination during decontamination. Once decontamination of the contaminated item (whether it be the environment, equipment, or an individual) is complete, the remaining consideration is how to safely doff PPE that may still have some contamination on it. Therefore PPE must always be chosen with safe doffing in mind.

Wet and dry decontamination approaches are both employed, with various advantages and disadvantages. Wet decontamination usually implies the use of sufficient quantities of (generally) water-based decontamination solutions that dilute and remove contaminants. If it possible the personnel can use a surfactants and hot water to remove a lot of chemical agents until full decontamination. Dry decontamination implies the use of totally dry or minimally damp approaches such as spraying with fine aerosols or vapors, wiping or vacuuming. An approach like misting with bleach or application of reactive skin decontamination solutions is closer to dry decontamination because a large excess of decontamination solution is not used. As a result of their potential for penetration of the equipment, dry and wet approaches impose different requirements on PPE. [6, 7, 8, 9]

In Fig. 3 shows the methodology that can be applied when selecting the decontamination method.

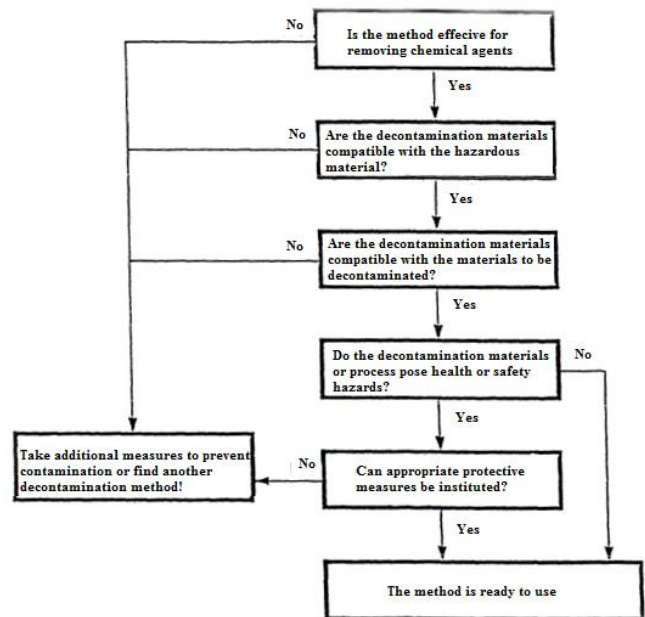


Fig. 3: Methodology to choose an decontamination method.

For chemical agents, evaporation is assumed to begin after the conclusion of the dissemination and deposition processes and continues as victims travel to and arrive at the medical facility. Evaporation prior to decontamination will limit hazards created by extremely volatile, quickly evaporating materials such as phosgene. Fedele et al. [3] derived characteristic time constants for the evaporation of CWAs. The time constant, τ , is the time for approximately 63% of the existing amount of material to leave the surface. This constant is defined in Equation (1):

$$(1) \quad \tau = \frac{m_0}{C_{vol} V_{ev}},$$

Where are: C_{vol} - is the volatility of the liquid, $d.m^{-3}$; m_0 is the initial mass per unit area, $g.m^{-2}$. V_{ev} is an empirically determined evaporation transfer rate, $m.min^{-1}$.

The effectiveness of a decontamination procedure can be expressed as the decontamination factor (DF). It is the ratio of contamination concentration on material before decontamination to the residual contamination concentration on the material after decontamination as given in Equation (2):

$$(2) \quad DF = \frac{C}{R},$$

Where are: C - is concentration of the contaminant before decontamination, $g.m^{-3}$; R is residual concentration after decontamination, $g.m^{-3}$.

A decontamination process that removes material will result in a DF greater than 1. The percentage of contamination removed from the surface can be given by Percent contamination removed (Equation (3)):

$$(3) \quad \%removed = \left(1 - \frac{1}{DF}\right),$$

Such analysis is useful in the laboratory, but in practice the efficacy of decontamination on-site is rarely validated in any meaningful way, even in rehearsal. The common question of "how clean is clean?" [4,5] for site remediation holds equally for personnel decontamination activities—how does the responder know when the PPE is clean enough or the air in the decontamination line is clean enough to remove PPE? How does the responder know whether further skin decontamination is needed, and when it has been adequate?

In theory, knowledge of the agent and appropriate exposure limits combined with near real-time surface and air sampling by appropriate detectors would be required to answer these questions at the time of the incident. [10, 12]

In fact, there are little published data that directly support the question of how much contamination can be removed from a person after chemical exposure by removing the person's clothing despite the frequent claims of values such as 80-90% [4]. This information is relevant to PPE decontamination as well. The results are likely to vary depending on the surface being decontaminated (PPE being worn), the specific hazard agent and its physical state (i.e., solid, liquid, vapor or gas).

4. Conclusion

The choice of a suitable area for decontamination should take into account the main features: water sources, terrain, meteorological influences, but also an accurate assessment according to the zones that are determined after a factual reconnaissance. The effectiveness of field decontamination is difficult to determine in a mathematical way, it is necessary to carry out CBRN intelligence.

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ENERGY SECTOR OF THE BAIKAL NATURAL TERRITORY IN TERMS OF IMPACT ASSESSMENT ON THE ECOSYSTEM OF LAKE BAIKAL

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Abstract: The study deal with the functioning of energy objects in the Baikal natural territory and they impact on the ecosystem of Lake Baikal. It is shown that pollutants have a major impact on the atmosphere from where can spread over long distances and leached from the air to the water and soil surfaces. The role of energy sector of the Baikal natural territory in the impact on the lake ecosystem has been determined.

KEYWORDS: ECOLOGICAL ZONE, HEAT POWER PLANTS, SMALL BOILERS, BERNING THE COAL, AIR POLLUTION

1. Introduction

This study examines the functioning of energy objects and their influence on the elements of the environment: the atmosphere, water bodies, and soils. At the same time, the impact assessment of energy objects located in the Baikal natural territory is investigated.

The concept of the Baikal Natural Territory (BNT) is defined by federal law of Russia No. 94 of May 1, 1999 "On the Protection of the Lake Baikal" (as amended on July 14, 2008) and is worded as follows: "The Baikal Natural Territory is the territory that includes Lake Baikal, the water protection zone adjacent to Lake Baikal, its catchment area within the territory of the Russian Federation, specially protected natural areas adjacent to Lake Baikal, and the territory adjacent to Lake Baikal till 200 kilometers to the west and north-west from it"[1].

The borders of the Baikal natural territory partially cover three subjects of Russia: the Republic of Buryatia, the Irkutsk Oblast and the Zabaykalsky Krai. In general, the area of the Baikal natural territory is 386.2 thousand km², of which 57% is the territory of the Republic of Buryatia (97% of the republic's population lives in this area), 29% is in the Irkutsk oblast (where the population is 54%) and 14% - Zabaykalsky Krai (the population of this part of the region is 15.5%). Within the framework of the Law and in accordance with the Order of the Government of the Russian Federation No. 1641-p dated November 27, 2006 "On the Borders of the Baikal Natural Territory", ecological zoning is regulated [1-2] and three ecological zones are distinguished (Figure 1) [3]:

- the ecological zone of atmospheric influence is an area till 200 km wide to the West and North-West of lake Baikal, on which economic objects are located, which have a negative impact on the unique ecological system of the lake;
- central ecological zone - an area that includes Lake Baikal with islands, a water protection zone, and specially protected natural areas adjacent to the lake;
- buffer zone - the territory outside the central ecological zone, which includes the catchment square of Lake Baikal within the territory of the Russian Federation.

Zoning of the territory provides, above all, the regulation of anthropogenic impact on the lake Baikal ecosystem.

The character and scale of the impact of energy sector is connected with the flow of pollutants into the elements of the environment, their quantity and quality. In this study, enterprises generating electric and thermal energy are considered as energy objects. In general terms, pollutants from the burning of organic fuels enter the atmosphere from energy objects, and as rule heated clean water is discharged into water bodies. Impact on soils is connected with destruction of landscapes and the formation of a significant amount of waste (ash and slag), including the excretion of significant areas for their storage.

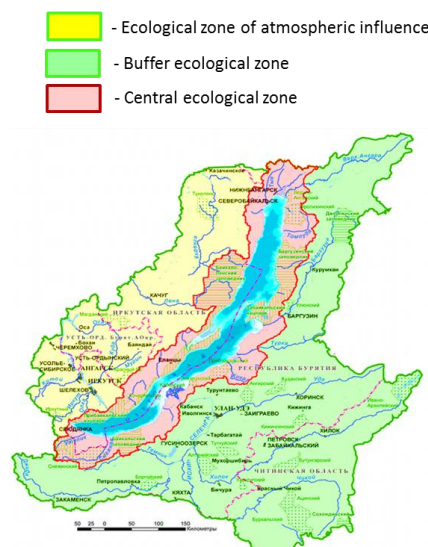


Fig. 1. Ecological zones of the Baikal natural territory

So, the greatest impact of energy sector to the natural environment arrive from the atmosphere, which gets a significant amount of harmful substances that can spread over long distances and areas, washed out of the air and deposited on the water surface and soil.

The impact assessment of the energy objects on the environment is carried out by using: statistical data, state reports on the ecological situation in the regions of the Russian Federation, annual reports on the activities of enterprises, and methods for determining emissions from boilers of different capacities approved by the Government of the Russian Federation.

2. Results and discussion

2.1. The ecological zone of atmospheric influence

The ecological zone of atmospheric influence is almost completely located on the territory of the Irkutsk Oblast (99% of the area), only in the northern part a small territory of the Severobaikalsky District of the Republic of Buryatia falls within the zone (or 1%) [4].

In this zone, enterprises of the Irkutsk-Cheremkhovo industrial region predominantly are predominantly located and in fact - in the five largest cities of the Irkutsk region - Irkutsk, Angarsk, Ussolye-Sibirskoe, Cheremkhovo and Shelekhov. In these cities, 7 large-scale thermal power plants of PJSC Irkutskenergo operate year-round, from which about 200-250 thousand tons of pollutants enter the atmosphere in different years [5].

The contribution of all power plants of the atmospheric influence zone to the total emission of the five cities under consideration is estimated at 65-70%.

From the standpoint of energy sector, the negative impact on the Baikal natural territory, as well as the water area of the lake Baikal is associated not only with significant amounts of heat power plant emissions, but also with conditions of entry of impurities into the atmosphere. It does mean that an emission height from heat power plants is of more than 150 m, when pollutants enter outside the surface layer, and are involved in long-distance transport.

For the Baikal natural territory and the water area of Lake Baikal, three heat power plants of the cities of Angarsk and Irkutsk, which are located closest to the lake, can have the greatest negative impact to Baikal. The character of the impact of these three heat power plants is determined by the facts that:

- they are enough large, working on coal, that contributes to the formation of a significant amount of emissions - more than 50 thousand tons per year from each station;
- sulfur oxides prevail in emissions - up to 70% of the total volume of emissions;
- the height of the emission exceeds 150 m, respectively, pollutants come outside the surface layer of the atmosphere, entering into long-range transport processes.

The features of long-distance transport of pollution are determined by fact that winds of the west and north-west directions can bring to the southern part of the central ecological zone of the BPT and water area of the lake of harmful impurities from these three stations which located on the distance of 80 to 100 km from the lake Baikal. At the same time, the maximum load of heat power plants occurs in the winter period, and climatic and geographical features BPT are determined by the high frequency of anticyclones in the cold period of the year with low precipitation and stagnation situations, which significantly reduces the ability of the atmosphere to self-purification (2-3 times lower than the average Russia).

According to the long-term monitoring of the atmosphere and atmospheric precipitation, which is conducted year-round by the staff of the Limnological Institute of the SB RAS in the settlement of Listvyanka, gaseous emissions of large heat power plants enter into a long-distance transport and manifested as plumes in the coastal areas of the southern part of the lake Baikal. In recent years, concentrations of oxides of sulfur and nitrogen, which reach dozens and hundreds of $\mu\text{g}/\text{m}^3$ recorded at a permanent monitoring station of the atmosphere (in Listvyanka) and can cover large areas of southern Baikal, including the eastern shore [6, 7].

In the ecological zone of atmospheric influence, the assessment of wastewater discharges by energy enterprises was not carried out because the wastewater into the lake Baikal cannot receive. The situation is similar with production and consumption wastes, whose impact on the lake's ecosystem Baikal and adjacent territories in the context of assessing the contribution of energy sector from the ecological zone of atmospheric influence is not appropriate.

2.2. The central ecological zone

The central ecological zone adjoins directly to the Lake Baikal and has a special environment protection and socio-economic status. One third of the territory of the central ecological zone is occupied by specially protected areas: reserves (11.9 thousand km^2), national parks (12.9 thousand km^2) and wildlife preserves (0.8 thousand km^2).

The special status of the use of this territory is regulated by the federal law "On the Protection of Lake Baikal" and, in accordance with the Decree of the Government of the Russian Federation No. 643 of August 30, 2001 "On Approving the List of Activities Prohibited in the Central Ecological Zone of the Baikal Natural Territory" with changes of Government Resolution No. 186 of March 2, 2015. These resolutions prohibit certain types of economic activity, including the construction of coal-fired boiler houses, except for their major overhaul and reconstruction.

The power objects in this area include the Baikalsk heat power plant and numerous boiler houses of various capacities, of which 66 are coal, 15 are electric boiler houses, 9 are use wood, 3 are gas and

1 oil. In the structure of installed capacity of heat sources, coal-fired boilers occupy more than 90% [8].

It should be noted that electric boiler houses, as the most environmentally friendly, function only in the coastal areas of the Irkutsk oblast, which is explained by the acceptable level of electricity tariffs in the region. Among the energy technologies used, layer combustion of solid fuels has the greatest weight. The majority of boilers houses use boiler units with a capacity of up to 1 Gcal/h, in which flue gas cleaning is usually not performed or is not performed satisfactorily.

Due to the lack of statistical information, officially approved methods for calculating emissions of pollutants into the atmosphere by heat power plants and boiler houses of different capacities were used to assess the impact of energy objects on the atmosphere of the central ecological zone [9-11].

The total estimated emission from the boiler houses of the central ecological zone amounted to 24.5 thousand tons per year, and the share of small capacity boiler houses where flue gas cleaning is not performed accounts for 60% of the total emissions at a fuel consumption of 26% from the total burning fuel. More than 74% of the fuel is burned in 9 large boiler houses, but only 40% of total emissions into the atmosphere enter from them.

As a consequence of the predominant use of coal, in the composition of emissions (up to 80%) particulate matters are prevail, or so-called "black carbon". The distribution of emissions from boiler houses in the central ecological zone has two clearly expressed manifestations in the southern and northern parts of Lake Baikal: 12.4 thousand tons in the south, 1.75 thousand tons in the middle part of Baikal and 10.3 thousand tons - in the north.

It should be noted that at present there are no data, both official statistics and initial information for calculating emissions from heat sources of year-round tourist bases, as well as a number of small boiler houses that heat one building. In addition, for the central ecological zone, it is important to take into account emissions not only of energy objects, but also of private houses of settlements heated by coal and firewood.

According to official statistics, wastewater discharges into surface water bodies (rivers, streams) and directly into the waters of Lake Baikal in the central ecological zone is carried out only on the form of sewage discharges on special treatment facilities in large settlements: Slyudyanka, Baikalsk, Severobaikalsk. It is rather difficult to identify the contribution of wastewater discharges from large boiler houses operating in these cities. As for small capacity boiler houses, they have no direct wastewater discharge, only loss of coolant during the transfer of thermal energy to the consumer. And in terms of impact assessing the on the waters of Lake Baikal influences of small boilers can be neglected.

The impact assessment of industrial waste from the energy sector is not only related to the lands that have been excretion for storage and that have been removed from economic circulation (forest, steppe, agricultural), but also due to pollutants entering the environment elements from storage sites. The impact of waste occurs through the soil and the air: dusting, burning dumps, filtering of ash dumps. Ash and slag waste obtained by thermal transformation from the combustion of coal may have an increased concentration of various radioactive elements (uranium, radium, thorium, etc.). This is due to the fact that coal, as a natural sorbent, is capable of accumulating natural radioactive elements, and when burned, their content in ash and slag can increase 3-10 or more times [12]. The problem of radioecological safety of coal, fly ash (not captured in treatment equipment), as well as ash and slag waste and products from them are requires take special solution at the state level. It is necessary to conduct continuous monitoring of the content of radioactive elements of burn coal at all energy objects. In the new conditions of digitalization of the Russian economy, including the energy sector, the organization of such monitoring is just beginning. Comprehensive monitoring of the impact of energy sector will allow analyzing the situation not only in quantitative terms, but also in qualitative terms. In this study, the impact assessment of ash and slag waste from energy sector is still considered from the standpoint of their quantitative formation.

The calculation of the amount of ash and slag wastes was based on the recommendations [13, 14]. Ash and slag waste includes residues of unburned fuel in the furnace devices of boiler houses. For large boiler houses, the volume of captured solid (ash) particles in special catching devices, which are moved to the ash dumps or waste storage, is also taken into account.

The total amount of ash and slag waste from energy objects in the central ecological zone is estimated at 79-80 thousand tons annually. Territorially, the largest amount of ash and slag waste falls on the Slyudyansky district: city Baikalsk - 25.1 thousand tons/year and the city of Slyudyanka - 19.2 thousand tons/year, which are located in the southern part of Lake Baikal. In the northern part - the largest amount of energy sector waste is generated in the city of Severobaikalsk (22 thousand tons/year). From the calculations it is clear that it is in these settlements that large energy enterprises are located.

One of the problems of the heat generation of large cities and settlements of the central ecological zone that needs to be solved in the coming years is the filled of ash dumps. Thus, in the city of Severobaikalsk, expansion or construction of a new ash dump is required, since the existing one is almost full.

2.3. The buffer ecological zone

The buffer ecological zone covers 75% of the area of the Republic of Buryatia and 25% of the Zabaykalsky krai.

In total, from all stationary sources of the zone in 2017, 85.2 thousand tons of pollutants entered the atmosphere, of which 75.2 thousand tons - in the Republic of Buryatia and 10 thousand tons - from stationary sources in the Zabaykalsky krai [5]. Assessing the contribution of energy enterprises to this emission and the possibility, under certain meteorological conditions, to influence the lake's ecosystem, it should be noted that only large energy objects of the Republic of Buryatia have a "high" emission sources. In the Zabaykalsky krai, these are mainly small capacity boiler houses in rural areas.

The Ulan-Ude thermal power station -1, the Timlyuy thermal power plant and the Gusinozyerskaya state district power station are referred to such energy sources in the Republic of Buryatia. Emission from these energy objects is estimated at 60-63 thousand tons/year (or 60% of the total emissions from stationary sources of the buffer ecological zone). Sulfur oxides are also predominant in the emissions of these stations [5].

In general, the buffer ecological zone is dedicated from the standpoint of the protection of water bodies, since the main inflow of water and the catchment area of the lake Baikal is located and formed in this area.

Sewage of large energy enterprises, as a rule, is characterized as regulatory clean warmed waters, however, when entering them into water bodies, they are capable of disrupting the hydrobiological and chemical composition of natural waters. Directly to Lake Baikal, wastewater from large energy enterprises of the buffer ecological zone does not flow. Accordingly, from the impact assessments of the on the lake's water area these wastewater are excluded. And also ash and slag waste and their storage due to remoteness from Baikal are excluded too.

3. Conclusion

As a result of a study for impact assess the of the energy sector of the Baikal natural territory on the lake's ecosystem Baikal was revealed that the main impact is related to the emission of pollutants into the atmosphere during the production of electrical and thermal energy. The total emissions coming from the energy objects of the Baikal natural territory is estimated at 280-300 thousand tons per year. That is comparable, and often higher than the annual emissions of some European countries. In general, the contribution of energy objects to the total emissions of the Baikal Natural Territory is estimated at 67.5%, (Table 1).

Table 1. Emissions to the atmosphere of the Baikal natural territory in 2017 by ecological zones and the assessment contribution of energy sector

Index	Ecological zone			total
	atmospheric influence	central	buffer	
Emission, total, thousand tons/year	301,8	24,5	85,2	441,5
among them: energy objects	210,3	24,5	64,1	298,9
Contribution, %	69,9	100	75,2	67,7

A specific feature of the energy sector of the Baikal natural territory is the use of coal as a fuel. At the same time, its combustion at large heat power plants located into ecological zones of atmospheric influence and buffer one is associated with the formation of a significant amount of gaseous emissions — sulfur and nitrogen oxides. Under certain meteorological conditions, such emissions can enter the southern and middle parts of Lake Baikal and later fall out in the form of acid precipitation. In turn, acidification in the elements of the environment leads to a change in the initial quality, as a rule, to deterioration.

In the central ecological zone, the sources of emissions are large and small boilers houses with a predominant emission of particulate matters. In quantitative terms, this emission is estimated at 24.5 thousand tons per year, but due to natural and geographical features, all these pollutants remain in the lake's ecosystem Baikal: will fall to the surface of the earth and the lake or be washed out with precipitation. Pollutants can have a synergistic effect (enhance the effect of various impurities), contribute to the formation of fogs, and in conditions of stagnation of the atmosphere forms smog situations, especially in winter time.

Along with the emission of pollutants into the atmosphere when coal is burned, ash and slag waste is generated, which must be stored and disposed of. At present time, it is important to organize the accounting of produce such wastes and their storage. In addition to, should be to establish a system of automatic continuous monitoring of emissions from existing enterprises around Baikal, including energy sector.

Recently, much attention has been paid to the creation of a unified integrated digital monitoring system of the Lake Baikal ecosystem. Such system will allow state monitoring of data of both a climatic and anthropogenic terms. In fact, this is a new level of organization of interaction with various services in the field of the protection of Lake Baikal, as well as the transition to the "Industry 4.0" platform.

Acknowledgments

The research is supported by the RFBR (Project № 18-57-81001).

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STUDY OF THE EFFECTIVENESS OF CORUNDUM AND BORON CARBIDE CERAMICS IN HYBRID PROTECTION SYSTEMS

ИЗСЛЕДВАНЕ ЕФЕКТИВНОСТТА НА КОРУНДОВА И БОРКАРБИДНА КЕРАМИКИ В ХИБРИДНИ ЗАЩИТНИ СИСТЕМИ

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Резюме: Извършен е високотемпературен синтез на корундова и боркарбидна керамика. Определени са физикохимичните им показатели. Пригодността им, като компонент от системи за индивидуална защита е оценена чрез балистични тестове
Ключови думи: КОРУНД, БОРЕН КАРБИД, БАЛИСТИЧНА ЗАЩИТА

Abstract: High-temperature synthesis of corundum and boron carbide ceramics was performed and the physical and chemical indicators of the obtained products were determined. Their suitability as a components of individual protection systems is assessed by ballistic tests.
Keywords: CORUNDUM, BORON CARBIDE, BALLISTIC PROTECTION

1. Introduction

The contemporary security issues, both globally and regional-ly, are linked to several factors:

- the persistent presence of local conflicts of varying intensity;
- increase of the number of highly motivated and highly aggressive terrorist groups that which go from anonymous acts to advertised direct attacks on civilians population and objects related to national security;
- a violent rise in organized crime, especially in the post-Soviet space.

These factors are interrelated and usually at least one of them is present in most critical situations. Against the security forces are now used not only pistols, but modern long-barreled guns with high striking capabilities against which the traditional defenses are not effective.

This calls for particular attention to be paid to the security of the army, the police and the other force structures in order to ensure safe functioning of critical infrastructure objects. The current task is to create reliable ballistic protection systems from affordable locally produced materials. The development and selection of new materials enables the realization of innovative solutions in this area.

2. Current state of the problem

The basic requirements for textile materials used in the development of protective structures are: low density to reduce the weight; high strength to increase resistance to destruction; high modulus of elasticity to reduce deformation [1, 2]. The most commonly used are fabrics of para-aramid high-modulus fibers: Kevlar (USA), Technora (Japan), Twaron (Netherlands), SVM (Russia), Armos (Russia).

Composite ballistic protection materials are multi-component materials consisting of a continuous matrix and discrete reinforcing material. The choice of matrix and of the reinforcing material determines the necessary combination of physico-mechanical, operational and technological properties. A special place in the group of composite materials for ballistic protection occupies those based on ultra-high molecular polyethylene. Unlike the aramids, they are not processed by weaving operations but are formed in the shape of sheets. High-modulus polyethylene fibers are commercially produced under the trade names of Dyneema (The Netherlands), Specta (USA), Techmilon (Japan), Espelen (Russia)

Textile and composite armors are effective against low-speed bullets but cannot provide protection from armor-piercing high-speed ammunition. That is why hybrid protective structures

which include a frontal ceramic layer and a support lyre made of textile or of composite material are developed [3].

Ceramic armors are developed strictly for projectile resistance with a high hardness and compressive strength combined with an advantage of lightweight. The need for lighter protection materials for use by the military has given merit to the use of ceramic armor materials. Ceramics offer an advantage over steel in weight reduction, and over all metals in impact energy absorption. Detailed studies of ceramic armors and the basic properties of ceramics are given in [4-8].

The main physico-mechanical characteristics of ceramics for ballistic protection are shown in Table 1 [9].

Table1: Physico-mechanical characteristics of different types of ceramics

Material	Density [kg/m ³]	Hardness [GPa]	Modulus of elasticity [GPa]	Bending strength [MPa]	Crack resistance coefficient [MPa.m ^{-1/2}]
Corundum AD85	3420	9.4	221	296	3-4
Corundum 1.AD998	3920	14.1	370	375	4-5
SiC	3200	24.5	460	570	5
B ₄ C	2500	25.5	460	410	4

The most commonly used are high-purity corundum, silicon carbide and boron carbide, listed according to their increasing ballistic efficiency and price. Boron carbide is one of the hardest ceramic materials and is very suitable for use as a face layer in hybrid protective structures. Typical for it is that when hit by high-speed ammunitions, it behaves as a glass-like material, but this does not affect its excellent protective properties. The main reasons limiting its wide use are the high cost and the difficult manufacturing of products with complex geometry from it.

The hybrid protective structures consist in principle of a top layer with maximum hardness and high resistance against penetration which destroys partially or completely the armor-piercing ammunition and a back layer retaining the fragments of the demolished ceramics and the ammunition.

In Fig. 1 is shown schematically a hybrid protective structure and the mode of action of the armor-piercing ammunition [10].

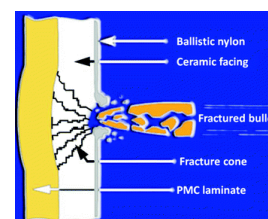


Fig 1 Diagram of a hybrid protection structure.

Russian sources give the following features of hybrid protection structures providing protection against a Dragunov sniper rifle firing 7.62mm B-32 armor-piercing bullet:

- Corundum/polyethylene backing - surface density of $42 \div 46 \text{ kg/m}^2$, thickness of 19mm.

- Boron carbide/polyethylene support - surface density of $34 \div 36 \text{ kg/m}^2$, thickness of 20 mm.

The Institute of Metal Science, equipment, and technologies "Acad. A. Balevski" with Center for Hydro- and Aerodynamics at the Bulgarian Academy of Sciences has been working in the field of research and development of security systems for individual protection, in particular hybrid structures, including ballistic corundum and boron carbide ceramics, for many years. As a result of this research were obtained the materials, which were tested to assess their effectiveness against armor piercing ammunition, and were obtained the results, presented in the paper.

3. Experimental studies

2.1. Materials

2.1.1. Ballistic ceramics

Corundum ceramic was obtained by cold isostatic pressing at 127.5MPa, followed by isothermal roasting at 1580°C for 2h.

Boron carbide ceramic was obtained by isostatic hot pressing at 200MPa and isothermal hold at 2000 °C for 1h.

The average physicochemical properties of the ceramics used are given in Table 2.

Table 2: Characteristics of the ceramics

Material	Density [kg/m ³]	Rockwell hardness HRA	Modulus of elasticity [GPa]	Bending strength [MPa]	Crack resistance coefficient [MPa.m ^{1/2}]	Sound velocity [m/s]
Al ₂ O ₃	3890	85	385	301	4	10335
B ₄ C	2500	95	460	409	5	12000

For the testing of both materials are made plates with dimensions 50x50x8mm and 50x50x10mm.

2.1.2. High-modulus polyethylene Dyneema

Ultra-high molecular polyethylene Dyneema HB25 was used. The product is designed to produce solid ballistic protection elements. The surface density of the material is 127-134 g/m². Bundles of cut sheets are pressed using a 400-tonne press. The technological process, which includes pre-heating of the molds, heating of the Dyneema packages, maximum permissible temperature and change of pressure and temperature is according to the manufacturer's instructions. Finally the plates are cut to its final dimensions of 250x300x10mm using water cutting.

2.1.3. Auxiliary materials

Sikabond-T polyurethane adhesive Sika is used to glue the tiles and to pack the samples. Kevlar textiles are used for bandaging.

2.2. Test samples

The two types of ceramic tiles shown in Fig. 3 are glued to a back layer of Dyneema and are packed with Kevlar fabric. The general appearance and structure of the sample is shown in Figure 2.

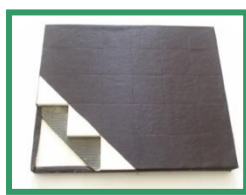
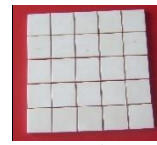
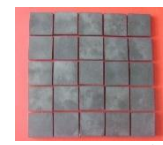


Fig.2 Diagram of a test sample.

The characteristics of the test samples are shown in Table3.



a. Plate made of corundum



b. Plate made of boron carbide

Fig. 3 Plates for ballistic ceramics with dimensions 50x50x8(10) mm.

Table 3: Test samples

Sample	Dimensions [mm]	Ceramics		Dyneema		Total mass [kg]	Areal density [kg/m ²]
		Mass [kg]	Thickness [mm]	Mass [kg]	Thickness [mm]		
Corundum	250x300 x19	2.234	8	0.545	8	3.250	40.3
Boron carbide	250x300 x19	1.500	8	0.545	8	2.516	33.50
	250x300 x21	1.875	10	0.675	10	2.900	38.67

2.3. Ballistic tests

The tests were conducted in the Ballistic testing laboratory of the Institute for perspective defense research at the Bulgarian Ministry of Defense according to the requirements of NIJ Standard-0101.04 with ammunition 7.62x54R B-32.

The test results for corundum are shown in Table 4.

Table 4: Results of the ballistic tests of corundum ceramics with thickness of 8mm

Shot No.	Perforation of the test sample				Results
	Ceramics	Padding of Dyneema	Back packing of Kevlar	Footprint depth [mm]	
1	yes	no	no	40	pass
2	yes	no	no	43	pass
3	yes	no	no	39	pass
4	yes	no	no	45	pass
5	yes	no	no	44	pass
6	yes	yes	yes	-	fail
7	yes	yes	yes	-	fail

The test results for boron carbide are shown in Table 5 and Table 6.

Table 5: Results of ballistic tests of boron carbide ceramic with thickness of 8 mm

Shot No	Perforation of the test sample				Results
	Ceramics	Padding of Dyneema	Back packing of Kevlar	Footprint depth [mm]	
1	yes	no	no	40	pass
2	yes	yes	no	40	pass
3	yes	no	no	43	pass
4	yes	yes	no	43	pass
5	yes	no	no	445	pass
6	yes	no	H no e	43	pass
7	yes	yes	yes	-	fail

Table 6: Results of ballistic tests of boron carbide ceramic with thickness of 10 mm

Shot No	Perforation of the test sample				Results
	Ceramics	Padding of Dyneema	Back packing of Kevlar	Footprint depth [mm]	
1	yes	no	no	40	pass
2	yes	yes	no	43	pass
3	yes	no	no	40	pass
4	yes	yes	no	41	pass
5	yes	no	no	40	pass
6	yes	no	no	43	pass
7	yes	no	no	44	pass

4. Results and discussions

Corundum ceramics: of the total 7 shots produced, there are two complete perforations of the sample after the fifth shot.

Boron carbide ceramics:

- for the 8mm thick test sample of the total 7 shots produced, there is one complete perforation of the sample after the sixth shot;
- for the 10 mm thick test sample of the total 7 shots produced, no perforation is observed.

Obviously, after each hit, changes in the structure and properties of the materials accumulate, leading to a deterioration of their protective qualities. The issue of sustainability against multiple hits is not fully understood. In addition to the number of shots, there is no clarity about time interval between the individual hits. Several years ago, studies have been conducted in the United States to specify this indicator and incorporate it in the NIJ Standard-0101.04 standard, but so far there are no concrete results. The average depth of the footprint in the plastic block is 42mm, which meets the requirements for the degree of blunt trauma.

The conducted preliminary tests have shown that protection against the ammunition used is provided by 17 mm armor steel with an areal density of 133.5 kg/m². The mass effectiveness of tested samples is:

- for the corundum sample with thickness of 8mm: 3.31;
- for the boron carbide with thickness of 8mm: 3.98
- for the boron carbide with thickness of 10mm: 3.45.

5. Conclusions

The results obtained show that boron carbide possesses better protective properties than corundum, both in multiple hit resistance and mass effectiveness. Both types of ceramics can be used in personal protective equipment, and the choice depends on the specific weight and price constraints

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LASER AND HIS IMPACT ON THE PEOPLE'S EYES

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Abstract: The purpose of this report is to provide useful and adequate information needed to minimise dangers associated with laser radiation in military and training activities of the Army. The assessment made in the report is based on the ability of laser beam to cause biological damage to the eye during laser system's malfunction or inability to protect the military staff from laser radiation. Laser radiation is absorbed into the outer layers of the body and therefore its biological effects are mostly limited to skin and eyes. If the laser beam strikes a person, the effects of laser radiation are characterized by a very rapid absorption of energy. The damage that is caused depends on the exposed organ and tissue and presents a particular eye hazard where the lens can focus the beam.

KEYWORDS: LASER, LASER SAFETY, MAXIMUM PERMISSIBLE EXPOSURE, LASER HAZARD CLASSIFICATION

1. Introduction

Today, several decades after the demonstration of the first laser in 1960 by T. Maiman, advances in a wide range of scientific disciplines have allowed laser technology to evolve and improve not only for civilian but also for military purposes.

During the Cold War, the US government relied on military strength through technological advances and, in the 1960s, multiplied its budget. Only for 1962, according to "Aviation Week and Space Technology", the Department of Defence promoted the laser spending about 1.5 million US dollars.

In 2000, the Joint Technology Bureau for High-Energy Lasers was created to bring all laser technologies together to develop a comprehensive laser weapon system that could be used by the Air Force. With continued advances in laser development in recent years, modern laser weapon systems have become a reality and an important part of the weaponry [1].

High-energy lasers typically powered by chemical fuel, electricity, or a stream of electrons cast in tensively focused energy rays on the object, [2] Lasers are used to solve different tasks by military such as: to define targets, transfer information, maintain target, determine distances for destroying targets and others.

To answer this question, you have to take into account the output characteristics of the laser. Those characteristics include wavelength, output energy and power, size of the irradiated area, and duration of exposure. If you are using a pulsed laser, you must also consider the pulse repetition rate and the pulse duration [1].

2.1. Advantages of laser weapons

Why are lasers so attractive for military purposes? The answer to this question lies in the advantages they have to the conventional weapons.

Laser technology is introduced in military affairs according to specific guidelines that have been developed in the following areas:(see Fig. 1)

- Laser location (ground, air, underwater);
- Laser communication ;
- Laser navigation systems;
- Laser weapons;
- Laser systems for missile defence and anti-satellite protection.

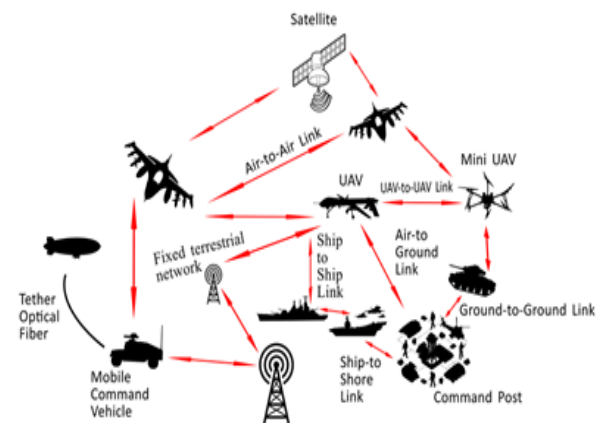


Fig. 1 Military laser applications: illustration of spatial and technology diversity

The advantages of using laser weapons in military operations, depending on the tasks to be solved (the objectives set) are:

- Very fast and can strike at targets with the speed of light (300,000 km/s);
- Targeting without waiting (both in height and in the side directions);
- Quick targeting opportunities, agile and in a short time span can intercept several targets or a one single target multiple times (compared, for example, with missiles or projectiles already launched to reach the goal);
- Absence of the possibility to shoot down a striking beam (as a projectile or a rocket) can not be distracted by a heat trap, is resistant to jamming systems (resistant to electromagnetic interference), etc.;
- Low price in comparison with some classical means of destruction (exceptionally cost effective when compared to conventional ammunition, with each laser shot costing as little as one US dollar);
- Ability to control the shot power that allows you to hit different targets at different distances;
- High localisation of destruction, which makes it possible to use such systems, for example, in urban conditions without incidental losses;
- Relative silence of the shot and invisibility for the eyes (for IR, UV ranges, especially pulsed lasers);
- Logistic support of the combat use of laser weapons (especially on the basis of solid-state lasers) is much simpler than for a number of classical systems of defeat.

According to their purpose, laser weapons can be classified as strategic and tactical.

We can divide on the basis of their energy/power levels the laser weapons into three groups high, medium or low energy weapons. (Fig. 2)

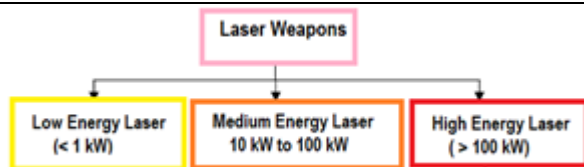


Fig. 2 Classification of laser weapons on the basis of energy/power levels

The low energy lasers usually give less than 1 kW of power and are used in weapon simulation systems for training or for jamming the sensors in communication systems, or can be used in anti-personal mode against the human eye. The use of these laser weapons for future military tactical operations radically change the situation on the battlefield. These lasers are more silent and less detectable by the enemy.

The medium energy lasers produce 10 kW to 100 kW of power and are used for the destruction of optical or optoelectronic devices on ground or space-based targets.

The High-energy lasers (HEL) generate more than 100 kW of power and are used for anti-aircraft or anti-missile systems.

2.2. TYPES OF MILITARY LASERS

1. Chemical laser

The first chemical laser, hydrogen fluoride (HF), was built in 1965, producing an output of 1 kW. Since then, the Department of Defence (DoD) has been interested in the research and development of more powerful chemical lasers for weapon applications. Subsequently, in 1968, the base demonstration laser of the Agency for Advanced Research Projects (DARPA) produced 100 kW, and in 1975 the naval-ARPA chemical laser (NACL) produced 250 kW.

2. Solid state lasers

Solid state lasers (SSLs) use a solid laser medium, such as glass or crystal, or gemstone (ruby, etc.). Rare-earth impurities such as Cr (chromium), Nd (neodymium), Er (erbium), Ho (holmium) or Ti (titanium) are placed in the crystal (active medium). Chromium is the material used in ruby crystals. Nd (neodymium) is used in the most commonly used lasers, namely the Nd: YAG lasers. For pumping the active medium (crystal), a flash lamp, an arc lamp, or another laser is used. This type of solid-state lasers operate at 1064.5 nm and can operate both in pulse mode and

CW mode. A great advantage of these lasers is the wide range of wavelength and pulse duration. The power level can reach megawatt when using Q-switching to achieve short pulse lengths. Different interactions with laser and other crystalline materials can double the electromagnetic frequency, which will reduce the wavelength by half, resulting in the laser beam in the visible range of 532 nm (green). The wavelength can be further divided into three or four, making this laser from the near infrared to ultraviolet wavelength. These lasers are usually used to indicate targets, measure distances, and so on. Other advantages of these lasers are that they can be made very small, user-friendly, cheap and battery-powered.

Modern fiber laser is a variety of solid SSL lasers. It is powered by electricity that excites diode lasers pumping the active medium (glass fibers). This makes such lasers extremely mobile and subject to support on the battlefield. In most cases, the active medium is a fiber treated with rare-earth ions such as Er³⁺, Nd³⁺, Ytterbium (Yb³⁺), Yttrium (Tm³⁺) or Praseodymium (Pr³⁺).

3.

4. Gas lasers

Gas lasers are also widespread in the industry. They use a pure gas or gaseous mixture for an active environment in the optic resonator. A typical gas laser contains a tube filled with the working gas and there is a pair of mirrors at the edges of

this tube. At one end of the tube the laser radiation leaves the resonator. Most gas lasers use electric current to cause pumping of the active medium (gas).

CO₂ lasers are also classified as gas lasers. These lasers were the earliest truly high-power lasers and have been among the most crucial lasers used in the research and development of high-energy laser (HEL) weapons. In the industry, the more powerful CO₂ lasers are used for welding, drilling, and cutting. There are many different types of CO₂ lasers that vary in pumping design.

CO₂ lasers work by burning hydrocarbon fuel (like kerosene or methane) in oxygen or nitrous oxide. The hot gas flows through a comb of nozzles, expands quickly, and achieves population inversion. The gas then flows through an optical resonator at supersonic speeds, resulting in stimulated emission and a laser beam. The wavelength produced by a CO₂ laser is also absorbed by glass. For example, the beam does not penetrate a windshield. Thus, shooting a CO₂ laser at a vehicle's windshield could deter while not reaching the driver at all.

4. Biological effects of optical radiation on the eye

If the opponent uses Class 3B and Class 4 lasers, a risk assessment must be performed to determine the protection measures required for safe operation.

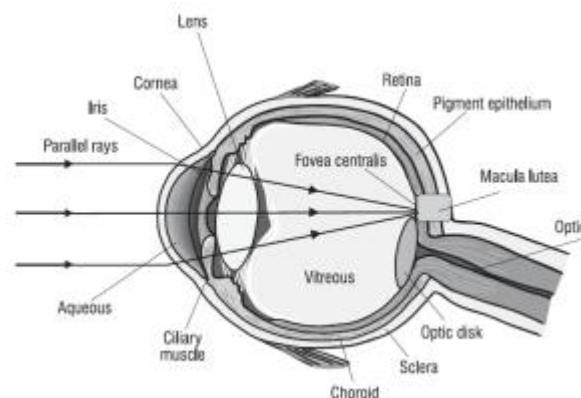


Figure 3. Schematic diagram of the eye [8]

Optical radiation is absorbed in the outer layers of the body and, therefore, its biological effects are mostly confined to the skin and eyes, but systemic effects may also occur. Different wavelengths cause different effects depending on the part of the skin or eye that absorbs the radiation, and the type of interaction involved: photochemical effects dominate in the ultraviolet region, while thermal effects prevail in the infrared region. Laser radiation can produce additional effects characterised by a very rapid absorption of energy by tissue, and is a particular hazard for eyes where the lens can focus the beam.

Light entering the eye passes through the cornea, aqueous humour, then through a variable aperture (pupil), as well as through the lens and vitreous humour to be focused on the retina (Fig. 3). The optic nerve carries signals from the photoreceptors of the retina to the brain.

5. Eye protection

In light of the foregoing considerations, it can be concluded that the eyes are exposed to a huge risk of injury from laser radiation if exposures exceed exposure limits.

In addition, it must be known that PPE (Personal Protective Equipment) safety goggles only guarantee protection for a particular laser source and a specified

distance for which they are specified. To adequately address the real dangers and recommendations of the Safety Advisor, he / she must know the intentions and technical parameters of the laser operative and tactical weapons available to the opponent. This is particularly important if there are multiple sources that require different types of protective eyewear, e.g. different wavelength lasers require their own unique eyewear.

The level of attenuation of optical radiation provided by protective eyewear in the hazard spectral region should be, at least, sufficient to decrease the exposure level below applicable MPEs [10].

3. Conclusions:

For the implementation of laser safety measures in the army, much of the trust lies in the education and training of staff: military personnel is trained to obey instructions and orders. When undertaking the risk assessment, as required by the Laser Safety Directive, consideration must be given to the military staff and to the fact that it may not always be possible to ensure that the exposure levels are below the exposure limit values.

Therefore, one approach used in this sector is Probabilistic Risk Assessment (PRA). This can be used to quantify the "probability" of risk. Various values may be adopted as a part of the PRA. However, an event with a probability of 10^{-8} is considered acceptable, even for an adverse event which, if it happened, could have catastrophic consequences. The use of PRA is complex and requires specialist expertise. However, a benefit for the military is that it may permit the use of artificial optical radiation in situations that might not be considered acceptable with a less rigorous assessment.

In order to use laser beams as weapons, a significant amount of laser output power is necessary. The output power depends heavily on the actual target. For the so-called soft targets, the minimum power to cause harm can be very low. Blinding lasers, for example, are designed to blind the human eye temporarily or permanently [11]. As the eye is very sensitive, these weapons require only a small amount of output power. Blindness can be caused in several ways: apart from burning the retina, a laser pulse can also break blood vessels inside the eye or cause a process of slow decline of the retina. At a distance of some meters, even an output power of a few milliwatts can damage the eye because the ocular focuses the beam onto the retina. This dramatically increases the intensity of the beam. Blinding lasers were used in the Falklands conflict and in the Iran/Iraq war of 1980s [12]. However, in 1995, these weapons were officially banned under International Humanitarian Law. If the aim is to destroy hard targets rather than to blind the enemy, however, the laser requires an output power which is many orders of magnitude higher than that of blinding lasers. As mentioned above in this article, many countries and research institutes develop and test lasers with continuous output power over 20 kW or impulse power over 1 kJ [13]. As stated above, the use of blinding laser weapons is illegal under International Humanitarian Law. In particular, these weapons violate the Fourth Protocol (1995) to the Convention on Prohibitions or Restriction on the Use of Certain Conventional Weapons Which May be Deemed to be Excessively Injurious or to Have Indiscriminate Effects. This protocol outlaws the use and transfer of laser weapons which are intended to cause blindness. Additionally, the signatories are obliged to take the necessary steps to prevent blindness caused by other laser weapon engagements [14]. However, the protocol is not applicable if collateral blinding occurs as a result of military laser applications that are otherwise considered legitimate. As a consequence, the protocol might be applicable to High Energy Lasers (HEL) weapons only, if they are especially designed for blinding purposes. Nevertheless, the protocol seems to have had some positive effects so far. The protocol the first step towards a comprehensive ban of

all laser weapons. This would be the first step towards preventive arms control, a concept which was developed to ban the introduction of new destabilising weapon systems [15].

Whether and to what extent a complete ban is realistically achievable is obviously another question.

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