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Environmental, Sanitary and Health Requirements in the Design and Operation of Radiation-Hazardous Facilities

Stefko Burdzhiev
Department of Security and Safety
Varna Free University "Chernorizets Hrabar"
Varna, Bulgaria
stefko.burdzhiev@vfu.bg

Georgi Georgiev
Department of Security and Safety
Varna Free University "Chernorizets Hrabar"
Varna, Bulgaria
georgi.georgiev@vfu.bg

Abstract— The article examines environmental, sanitary and health requirements in the design, development and operation of radiation-hazardous facilities, as well as the protection of personnel, the population and the environment. It discusses the main sources of radiation hazard, the principles of justification, optimization and dose limitation, engineering barriers, zoning, radiation monitoring, individual dosimetric control, personal and collective protective equipment, decontamination and the role of emergency planning. Emphasis is placed on the preventive approach: safety must be embedded at the design stage and maintained during operation through technological discipline, continuous control, training and clear coordination between the licensee, the regulatory authorities and the forces of the Unified Rescue System. Practical recommendations are proposed to increase preparedness for radiation accidents and improve real-time data exchange.

Keywords—radiation pollution; radiation-hazardous facility; radiation safety; protection design; safety design.

I. Introduction

Modern industrial production concentrates large amounts of energy, hazardous substances and complex technological processes. This turns some industrial facilities into a constant source of technogenic risk, which in the event of an unfavourable combination of technical failure, human error, natural impact or malicious action can lead to an accident with consequences for people and the environment. Radiation hazardous facilities occupy a special place in this system, because the potential impacts are not limited to the facility site, but can affect settlements, agricultural areas, water resources and critical infrastructure [1, 2].

A radiation-hazardous facility (RHF) is an object or facility where, under conditions of normal operation, accident or destruction of the facility, exposure of personnel and the population, as well as/or radioactive contamination in the area of the facility or outside it above the natural gamma background, may occur. This group includes nuclear facilities and facilities with sources of ionizing radiation, repositories for radioactive sources and radioactive waste , laboratories, specialized medical institutions , industrial and scientific structures, as well as activities in which radioactive materials are generated, stored or transported [3, 4].

The main feature of radiation risk is that radiation safety cannot be guaranteed only by reacting after an incident. Prevention and management of radiation risk must be embedded in the entire life cycle of the facility from design to cessation of activity and scrapping: selection of the appropriate site, design fully compliant with the Act on the Safe Use of Nuclear Energy (ASUNE), construction, commissioning, normal operation, repair, emergency preparedness, decommissioning and waste management [3]. Therefore, radiation safety should be considered as an integrated system of regulatory, engineering, technical, organizational, medical, communication, etc. measures [5–7].

The goal of the report, is to examine the potential radiation risk, its relationship with natural and man-made disasters, as possible causes of radiation pollution, the prevention and management of radiation risks, the accumulation of deeper knowledge about the connectivity and interdependence of individual radiation hazardous sites (RHS) and their elements, showing possible connections and models of protection of their personnel, the population and the environment, based on national and international experience, that of the European Union (EU) and North Atlantic Treaty Organization (NATO) member states.

Based on the above, the hypothesis has been built for the establishment and definition of the protection of the

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personnel of the RHS, the population and the environment in the event of radiation contamination, as a systematic and organized activity, and the effectiveness of the protection - as a result of the actions of the many specialized interested organizations (institutions), united in a system of systems - the unified rescue system (URS); national security protection system (NSPS), etc., and this is already at the stage of their design.

The thesis being defended is that the prevention and management of the risk of radiation contamination is a systemic activity and its continuity (sustainability) is most effectively guaranteed by protection built as a system, a subsystem of the national security system of the state.

The object of study are the requirements for ensuring the security and continuity (sustainability) of the activities of radiation hazardous facilities and the continuity (sustainability) of the operation of the national system for monitoring and management of radiation risk.

The subject of the study is the environmental, sanitary and health requirements in the design and operation of a RHF, as well as some aspects of the interconnection and organization of activities, interaction and coordination of competent national authorities and organizations for monitoring and management of the risk of radiation pollution, in natural and man-made disasters, in order to ultimately guarantee their safety and sustainable operability.

II. MATERIALS AND METHODS

A. Radiation safety and protection in the design of radiation hazardous sites (RHS)

In practical terms, before the design begins, the site for the construction of the RHF is selected and assessed, and this should include not only engineering-geological and seismic factors, but also meteorological characteristics of the area, including wind rose, hydrological characteristics, distance to settlements, transport connectivity and accessibility, possibilities for evacuation of personnel, population, material and cultural values, and the presence of other risky industries. These factors directly affect the radiation risk, because they determine the potential possibilities, directions and paths for the transfer of radioactive contamination, and the response time in the event of an accident [8–11].

Design is the most important stage because it is where the so-called "passive" protections are established, which do not depend at all or are minimally dependent on human intervention.

The three pillars of the international protection system are applied in the design:

- Justification (expediency): Any activity with sources of ionizing radiation must bring more benefits than harms.
- Optimization (As Low as Reasonably Achievable (ALARA) principle): Exposure levels should be "as low as reasonably achievable".
- Dose limitation: The project (designer) must ensure that even with certain deviations from normal work, no one will receive a dose above the maximum permissible dose for the relevant group (target category – personnel, population) [3]-[6].

The principle of justification requires that any activity involving sources of ionizing radiation should bring greater public, medical, scientific or economic benefit than the possible harm. The ALARA principle requires that exposures be kept as low as reasonably achievable, taking into account technical capabilities, costs and social impact. Dose limitations set an upper limit that the project must not allow to be exceeded for personnel and the public.

In principle, the design is based on the concept of defense in depth. These are a series of sequentially constructed physical barriers in the path of propagation of radioactive particles and ionizing radiation:

- Primary containment: Encapsulation of the radioactive substance;
- Biological protection: Use of materials that are a physical barrier and stop the spread of various radionuclide particles, electromagnetic and ionizing radiation.

Defense in depth practically combines several independent barriers: constructive containment of the radioactive substance, biological protection, controlled ventilation and filtration, emergency interlocks, physical protection, access control, redundancy of critical systems and technical means for radiation monitoring. Moreover, the failure of one protective barrier does not automatically lead to a risk of dangerous radiation exposure or uncontrolled spread of radioactivity, both in the area of the RHF and beyond its territory. [3, 5].

The designer, through the project, must divide the territory of the radiation hazardous site into:

- Controlled area: A place where special access and work regimes are required due to the risk of radiation;
- Surveillance zone: An area around the controlled zone where the radiation background is monitored, but the regime is lighter;

Outside the borders of the RHF, the following are also formed:

- Sanitary protection zone;
- Surveillance area.

Project zoning is directly related to sanitary and environmental protection. Controlled and supervised areas are defined inside the site, and outside it – a sanitary protection zone and a monitoring zone, when the nature of the site requires it. Zoning should provide a clear separation between workplaces with different radiation risk, personnel routes, radiation control points, sanitary locks, places for storing personal protective equipment and points for decontamination (decontamination) [4, 12].

Already at the design level, the objects and parameters of radiation monitoring, the network of measurement points, the types of measuring instruments, the frequency of control, methodological support and the procedure for documentation are determined. At higher-risk objects, automated radiation monitoring systems must provide information in real time to a central point and, in certain scenarios, activate protective functions, for example, blocking a technological process, closing hermetic barriers or changing the ventilation mode [4, 7].

At the design stage of a radiation hazardous facility, the following is regulated:

- radiation monitoring sites;
- types of radiation monitoring;
- controlled parameters;
- permissible levels of controlled parameters;
- network of radiation monitoring points;
- frequency of radiation monitoring;
- technical means and methodological support for radiation monitoring;
- the composition of the necessary premises and the staff of workers performing radiation monitoring.

In order to obtain information about the state of the radiation situation in a radiation hazardous facility and in the environment, both during its normal operation and in the event of a radiation accident, the radiation monitoring system created at the facility as a whole must be in a mode that provides measurements of the parameters of the radiation situation in the following areas:

- dosimetric monitoring of personnel exposure;
- radiometric monitoring of skin contamination of personnel, property and transport within the restricted areas;
- monitoring the radiation situation in places where personnel work with radiation sources, including radioactive contamination;
- technological control;
- radiation monitoring of the environment.

The design should also include emergency management solutions: reliable notification, safe routes, shelters, backup power supply, communications, the ability to remotely control hazardous operations, and working conditions for emergency teams. In this sense, the design of a radiation hazardous facility is not just a construction and technical activity, but a complex system for preliminary risk management [8, 9, 13].

Ultimately, the design documentation should ensure traceability between the hazard analysis, the planned protective measures and the residual radiation risk. When a risk cannot be eliminated through engineering, technical and technological solutions, it should be managed through preventive and organizational measures, automated control and interlocks, personnel training, and strict adherence to emergency procedures. This avoids the formal design of individual systems without a common logic for integral safety [5, 6].

Today, modern design should rely on remote control (robotic arms, automated conveyors) to remove the person from areas with high background. Built-in automated radiation monitoring systems (ASRM) should provide a real-time signal to a central console and be able to automatically activate protective interlocks (e.g., stop ventilation or close hermetic doors) [13–15].

The analysis conducted suggests that the Preventive Approach is mandatory even at the design stage of the RHS, in order to create the most effective engineering protection, biological barriers, zoning of spaces and automated radiation monitoring systems. as the most modern means of radiation safety with minimal influence of the "human factor".

It is particularly important to understand that the design of a nuclear power plant is not only a technical, but also a strictly regulated process - each project must ensure compliance with a whole series of international, European and national regulatory documents before receiving a license from the Nuclear Regulatory Agency (NRA).

And last but not least, knowledge of the design zoning (controlled and supervised area) is essential for the rescue teams of the RHF and those of the Unified Rescue System (URS) in order to fully fulfill their obligations under the Internal and External Emergency Plans and to determine the safe limits of action in the event of a radiation accident.

B. Radiation safety and protection during the operation of radiation hazardous facilities

During operation, design decisions are transformed into a real system of technological discipline, instructions, control, maintenance and accountability. Operation of a RHF is a process in which technical designs are transformed into a living system of rules. Here, the main responsibility falls on the licensee (the organization managing the facility).

Each RHF operates on the basis of an approved comprehensive technological regulation. Any operation with ionizing radiation sources must be described in operating instructions, and deviations from the technological regime must be considered as a potential emergency factor [3, 4, 14].

Radiation monitoring of the working environment aims to assess the exposure of personnel, to detect deviations from the normal radiation environment and to prevent the spread of radioactive contamination. Usually, the radiation control process combines stationary automated systems, portable and mobile radiometers and x-ray meters, laboratory analyses, taking various samples of air, water, soil, food, surfaces and technological environments, and materials, as well as proper documentation of the results of measurements and sample analyses in registers and databases in information systems [4].

In practice, the radiation situation can be assessed as normal, unfavorable, dangerous or extremely dangerous according to the exceedance of control levels, possible doses and the need for emergency interventions and protective actions.

This classification should not remain formal. It should be linked to pre-planned solutions: restricting access, stopping activities, increased monitoring, activating an emergency organization, notifying competent authorities, and attracting forces and resources from the Unified Rescue System [1, 8, 16].

Radiation monitoring of the environment has two important functions: informational and analytical. The informational function is aimed at early detection of emissions and changes in the radiation background. The analytical function clarifies the radionuclide composition, spatial distribution, trend and possible dose loads. In the event of an accident, the rapid determination of the boundaries of contamination, the dynamics of distribution, meteorological conditions, evacuation routes and access of emergency teams are of paramount importance [7, 17].

The technical maintenance of each element of the radiation monitoring and control systems is a very essential part of radiation safety. Faulty sensors, uncalibrated dosimetric equipment, compromised consumables and filters, poorly sealed barriers or faulty ventilation can turn an otherwise normal technological situation into a risk. and emergency. Therefore, proper operation and maintenance, periodic inspections, calibration and independent control should be planned rhythmically according to technological requirements, documented and checked by competent control persons [4].

Decontamination is applied when radioactive contamination of personnel, various surfaces, equipment, vehicles, outdoor spaces and/ or terrains is established. The choice of method depends on the type of radionuclides, the type of surface, the degree of radiation contamination, the time since the beginning of the incident and the possibility of this contamination spreading. The practical approach includes localization of contamination, restriction of access, measurement of radiation contamination, appropriate treatment of surfaces in the decontamination process, control measurement and subsequent management (treatment) of the collected waste as potentially radioactive. The aim is to reduce the dose load and prevent secondary contamination of the working and environmental environment [4, 17].

Radioactive waste management is an integral part of operational safety. It is necessary to minimize the waste generated and its separate collection, labeling, and marking, temporary storage, reporting, and transfer to a competent organization. This process should be planned during the design process, because the lack of sufficient capacity for safe storage or incorrect classification of waste can create a new source of radiation risk [3, 8].

An essential element is the control of changes. Any change in a technological process, RHFm, ventilation scheme, measurement system, source used or storage method must be previously assessed in terms of the impact on the working and environmental conditions and on the radiation safety of the R&D facility. Without such control, even a small technical change can disrupt the design algorithms and logic. of radiation safety and protection [3, 5].

Documentation has a very important evidentiary and management value. The registers (logs) for dose loads, the results of radiation monitoring, the results of checks on the technical serviceability and suitability of equipment, for the performed repair activities, training, briefings, for the conducted emergency drills and the transferred waste, allow traceability and timely detection of negative trends. In the event of an accident, it is these data that will show what the real risk was and whether all procedures were accurately implemented [4, 7].

The theoretical knowledge and practical experience acquired over the years give me reason to conclude that the decontamination of RHFs of buildings and facilities, including nuclear power plants, was a particular challenge. In most cases, covered with bitumen, which easily adsorbs radioactive substances, the RHFs are resistant to decontamination using traditional methods (using decontamination solutions). The most effective method for decontamination of RHFs is the mechanical removal of bitumen coatings, which is associated with low productivity, especially in conditions of high external gamma radiation. In practice, various specialized decontamination solutions and methods for dry or wet cleaning were used, with the collected liquids being treated as liquid radioactive waste.

In addition, it is imperative to emphasize that:

- Safety during operation is based on strict compliance with labor and technological discipline, technological regulations (Art. 18 of the ASUNE) - any deviation from the instructions is a potential source of emergency risk.
- Radiation monitoring of the working environment and radiation risk management are continuous processes that ensure that the facility does not pollute the environment above permissible limits during its normal operation.
- Regular decontamination and technical maintenance of protection systems are a prerequisite against material fatigue and the unintended release of radioactivity into the working environment and the environment.

III. RESULTS AND DISCUSSION

A. Radiation safety and protection of personnel at radiation hazardous sites

Personnel are the most directly exposed group in the operation of radiation hazardous facilities. Their protection is based on a combination of individual dosimetric monitoring and control, clear rules and instructions, consistent medical supervision, continuous training, and the use of modern, functioning personal and collective protective equipment [4, 18].

Individual dosimetric control covers external and, when necessary, internal exposure. Personnel working in a controlled area must be provided with personal dosimeters, be kept on file and receive information about their own dose exposure. In emergency activities, additional dosimetric provision is appropriate because the conditions are dynamic and the risk of uneven exposure and dose overload is significantly higher [4, 12, 19].

Personal protective equipment is selected according to the specific hazard: external exposure, risk of radioactive contamination of the skin, inhalation risk, work with liquid or powdery contaminants, repair operations, confined space or elevated temperature. Personal protective equipment (PPE) does not replace engineered barriers, but is the last important protection against internal exposure of radionuclides and the spread of contamination [4].

Collective means of protection – shelters, filter-ventilation systems, protected control points, sanitary locks and checkpoints – provide protection for groups of people and maintain the manageability of the site in adverse conditions. They must be technically sound, checked, equipped with communications and taken into account the real number of people who can use them [18].

Medical supervision and training are critical to preventing various occupational injuries. Personnel without the necessary training, qualifications, instruction, or medical fitness should not be allowed to work. to activities with sources of ionizing radiation. Training should be practical and include working with dosimetric equipment, proper donning and doffing of personal protective equipment (PPE), passing through a sanitary lock, actions in case of alarm and reporting deviations [3, 4].

Personnel protection is also a management issue. It is necessary for the managers of the RHF and those of the teams to maintain a higher level of safety culture, in which the reporting of small deviations - near-incidents and related technical problems is not formally sanctioned, but is used to improve the protection system. It should be clear that in radiation safety and protection, concealing a small, seemingly minor problem can become the cause of a serious subsequent emergency event [5].

Repair and unscheduled activities are particularly risky because they are often performed in a changed radiation environment, open technological systems, limited space, increased physical exertion and the need for sometimes very quick decisions. Therefore, such activities require a preliminary and strict work program, a detailed dose estimate, a certain allowable downtime, the presence of a prepared equivalent backup team, means for backup communication and readiness for sudden cessation of work in case of a change in dosimetric readings [4, 20].

Psychological resilience also matters. In conditions of a radiation hazard alert, personnel must perform procedures calmly without panic or improvisation. This is achieved through continuous and repetitive training, clear management, practical training and trust between individual team members that measurements and instructions are reliable. A good safety culture reduces the likelihood of unauthorized departure, incorrect removal of PPE or transfer of contamination [5, 17].

An in-depth study of the activities in several RHFs showed that the personal discipline and compliance with radiation safety requirements of the personnel concerned, including the use (non-use) of PPE, as well as individual dosimeters, are not at a good enough level. For this reason, it is imperative to note that:

- Personnel protection is a combination of state and departmental dosimetric control and personal responsibility and discipline in wearing individual dosimeters.
- The correct selection of personal protective equipment (PPE), its technical condition and reliable operation are the last and practically the only barrier to internal exposure and radiation in a dusty or contaminated radioactive environment.
- Medical fitness and systematic training of personnel are not just a formality, but a legal instrument for decisively reducing occupational diseases and making mistakes in critical situations.

B. Radiation safety and protection of the population and the environment

One of the main measures to ensure radiation ¬safety of the population is the regulation of radiation exposure from various sources of ionizing radiation.

Control levels (doses, levels, activities, flux densities, etc.) are established in each specific radiation hazardous facility. Their values take into account the level of radiation safety achieved in the facility and provide conditions under which radiation exposure must be below permissible limits.

Furthermore, in order to prevent exceeding the permissible dose of anthropogenic radiation for the population (1 mSv/year) and to reduce radiation from anthropogenic sources ¬in accordance with the principle of optimization, as noted above, radiation norms (quotas) are established.

Protection of the population begins before the accident through planning, monitoring, awareness and readiness for rapid notification. In normal operation, the main tools are emission and immission control, dose limits, monitoring in the sanitary protection zone and the observation zone, as well as periodic assessment of the environmental impact. In an accident, early warning, assessment of the situation, sheltering, access restrictions, evacuation, sanitation and control of water and food become the leading ones [4, 6, 8, 20, 21].

A radiation accident requires interaction and coordination between the licensee of the RHF, the Nuclear Regulatory Agency, health authorities, local authorities, the Directorate General of the National Safety and Health Protection, the police, medical structures, voluntary groups and other elements of the Unified Rescue System. Disaster Protection Plans. Part III, must contain realistic scenarios as close as possible to realistic scenarios, including the most adverse weather conditions, failure of connections and communications, difficult access to the RHF, the need for partial or complete evacuation and predicted prolonged radiation contamination [1, 3, 8, 9, 16].

Early warning and notification of the population is an essential preventive and psychological measure. The lack of clear information in many cases leads to panic, arbitrary evacuation, improper use of various preparations and distrust of institutions. Pre-prepared messages, access to Information about the radiation background, accurate and timely explanation of the measures and a single communication center reduce the risk of chaotic behavior. It is especially important to explain that iodine prophylaxis is applied only in cases of risk of radioactive iodine -131 and on the instructions of the competent medical authorities [7, 12, 19, 22].

Environmental protection requires an assessment of the impact on environmental factors - air, water, soil, vegetation, animals and the food chain. In the case of radiation pollution, sampling, laboratory analysis and control of pollution are organized, restriction of consumption of certain food products, control of water sources, management of contaminated foods and materials and monitoring of long-term effects. The relationship between radiation monitoring, sanitary control and the authorities responsible for food and agriculture is important [4, 7, 17].

In the context of defense and security, radiation-hazardous sites should also be considered as elements of critical infrastructure. Their protection includes not only technological safety, but also physical security, cybersecurity of monitoring and early warning and notification systems, resilient communications, redundant data exchange channels, and readiness for action in the event of combined threats. This is especially important for sites whose compromised resilience may have cross-border, socio- political, psychological, or long-term environmental effects [1, 7].

Annual exercises between site personnel, local authorities, voluntary groups and the Unified Rescue System forces are an important practical test of the effectiveness of the Disaster Protection Plan, Part III – Radiation Protection. The exercises should be comprehensive and test not only the formal announcement, but also the response time, the management method, the exchange of data, the radiation protection of emergency teams, the organization of evacuation, special and sanitary treatment, laboratory control and the restoration of readiness for subsequent actions - the return to normal operation [1, 7, 17].

Disaster protection plans should be developed to anticipate different phases of the accident. In the early phase, the priority is on warning, hiding, restricting access and protecting emergency teams. In the intermediate phase, detailed radiation reconnaissance and mapping of contamination is carried out, medical surveillance, food and water control and waste management are organized. In the late phase, the main tasks are recovery, social support, long-term monitoring and informing the population about the residual risk [7, 17].

To be effective, the warning system should use all available and possible channels: sirens, mobile messages, the BG-ALERT public warning system (BG-ALERT), official websites, departmental networks and channels, local media, social networks and communication through city halls and other institutions. Messages should be short, unambiguous and applicable: what happened, which areas are affected, what citizens should do, what not to do and where they will get further information [22–24].

Special attention should be paid to vulnerable groups – children, the elderly, people with disabilities, hospitals, social services, schools and settlements with limited transport accessibility and connectivity. Routes, transport, accommodation, medical support and responsible persons should be determined in advance for them. A general evacuation scheme is insufficient when it does not take into account these practical limitations [1, 7].

After an accident, the recovery phase is no less important than the initial response. It includes the controlled return of the population, cleanup and decontamination, management of contaminated materials, economic support, damage assessment, and ongoing health surveillance. If this phase is not planned in advance, public pressure can lead to hasty decisions and new risks [7, 17].

It is important to emphasize that:

- Protection of the population is effective only when there is a well-established and functioning system for early warning and notification of management bodies, forces and means of the URS and a high degree of public awareness and preparedness of the population for behavior and action in conditions of radiation contamination.
- Of utmost importance for the radiation safety of RHFs and for the protection of the health and life of their personnel and the population of adjacent settlements, municipalities and districts is the development and maintenance of Disaster Protection Plans, Part III, as well as their permanent practice by conducting annual joint training exercises between the RHF staff, the volunteer formations and the

local authorities to practice coordination and interaction between them in emergency and crisis situations.

IV. Conclusion

Radiation safety in the design, operation and protection of personnel and the population is an inseparable process that requires a connection between high technologies, strict compliance with the legal framework and constant human discipline. The analysis shows that the Republic of Bulgaria has a regulatory system harmonized with European requirements, but its effectiveness depends on the actual implementation of the rules, on the maintenance of technical means and on the readiness for a coordinated response on the ground. In addition, the conducted field study and the analysis of the available information require the following main conclusions to be made:

- The majority of possible radiation risks can and should be reduced at the design stage of the RHF facility, through defense-in-depth, design zoning, automated monitoring and minimizing dependence on subjective human intervention.
- The personal responsibility of the personnel, their training and acquired culture of radiation safety, knowledge of radiation protection standards is the main thing against unwanted radiation incidents. Technological discipline, individual dosimetric control, proper use of PPE and medical supervision should be considered as a comprehensive and unified system.
- The relationship with the rescue services is key. The management bodies, the forces and means of the Unified Rescue System, and the volunteer formations must maintain skillful coordination with the licensed operator, because in the event of an accident, they are the ones responsible, and ensure the protection of personnel, the population, and the environment in the first critical hours after the accident.

In view of the overall improvement of radiation safety in the design and operation of RHFs, it is advisable to do the following as soon as possible:

- To restore the integrity and modernize the network of radiation monitoring posts, including through the duty structures at the municipal and regional security councils, with the results of gamma background measurements being recorded, reported and summarized at the national level.
- To introduce integrated platforms for real-time data exchange between radiation hazardous sites, operational centers of the territorial units of the General Directorate of Fire Safety and Population Protection h, health authorities and local executive authorities.
- To expand the specialized training of the volunteer formations and emergency teams from the URS, with practical classes in decontamination, use of dosimetric equipment, personal protection and work in a controlled area.
- To restore and maintain a full-fledged system for repair, inspection and calibration of dosimetric equipment, as well as control over the serviceability and readiness for use of the available collective protective equipment.
- Maintain up-to-date disaster protection plans, Part III, at all levels, including worst-case scenarios, communications failure, complicated evacuation and prolonged contamination.
- To create easily accessible information resources for citizens regarding the gamma radiation background around large radiation-hazardous sites with a view to the correct behavior and action of the population in the event of a possible radiation accident.

References

[1] Disaster Protection Act. State Gazette, issue 102 of 19.12.2006, amended and supplemented.

[2] Vladimirov V.A., Izmalkov V.I., Izmalkov A.V. Risk assessment and man-made safety management. Moscow: Delovai Express, 2002.

[3] Law on the Safe Use of Nuclear Energy. State Gazette, No. 63 of 28.06.2002, amended and supplemented.

[4] Radiation Protection Ordinance, adopted by Council of Ministers Decree No. 20 of 14.02.2018. State Gazette, issue 16 of 20.02.2018, amended and supplemented.

[5] International Atomic Energy Agency. Fundamental Safety Principles. IAEA Safety Standards Series No. SF-1. Vienna: IAEA, 2006.

[6] Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionizing radiation. Official Journal of the European Union, L 13, 17.01.2014.

[7] Buchinska-Simeonova, N., Radinov, A., Nikolova, D. Are doctors in Bulgaria ready to professionally assist victims of radioactive contamination in a te terrorist act? Bulgarian Journal of Public Health, 2020, vol. 12, no. 2, pp. 54-65.

[8] Ordinance on emergency planning and emergency preparedness in the event of a nuclear and radiation accident. State Gazette, issue 94 of 29.11.2011, amended and supplemented.

[9] International Atomic Energy Agency. Preparedness and Response for a Nuclear or Radiological Emergency. IAEA Safety Standards Series No. GSR Part 7. Vienna: IAEA, 2015.

[10] Dolchinkov N., M. Pavlov, Influence of meteorological elements in accidents in enterprises with radioactive elements or dangerous chemical substances in Bulgaria, 14th International Scienfic and Practical conference Environment. Technology. Resources. Vide. Tehnologija. Resursi, 2023, ISSN 1691-5402, 1, pp. 49–54

[11] Dolchinkov N., M. Pavlov, Study of the Influence of Winds in the Potential Contamination with Hazardous Substances as A Result of Man-Made Accidents, Environment. Technology. Resources. Rezekne, Latvia, Proceedings of the 15th International Scientific and Practical Conference. Volume I, Print ISSN 1691-5402,

Online ISSN 2256-070X, https://doi.org/10.17770/etr2024vol1.7988, pp 130-135

[12] National Center for Radiobiology and Radiation Protection (NCRRP). Radioecological monitoring of working and living environment in the area of the ROO. Scientific monograph, Sofia, 2020.

[13] Stoilov, G. A systematic approach to the management of preventive measures and early technological disclosure in radiation hazardous sites. Collection of reports from the International Forum "Radiation Safety in the Modern World", vol. 3, 2022, pp. 112-125.

[14] Hristov, I., Petrov, N. Automated information systems for external radiation control and technological discipline in NPPs. Journal "First Atomic", issue 3, 2013, pp. 8-14.

[15] Dolchinkov N., N. Nichev, Gamma-background radiation control systems as a factor of Bulgaria's national security, Environment. Technology. Resources. Rezekne, Latvia, Proceedings of the 15th International Scientific and Practical Conference. Volume IV, Print ISSN 1691-5402, Online ISSN 2256-070X, https://doi.org/10.17770/etr2024vol4.8225, pp 83-88

[16] Pavlov, M. Organizational and technical aspects of the interaction between the Unified Rescue System and critical infrastructure operators in radiation threats. Scientific journal Security and Defense, issue 2, 2023, pp. 45-58.

[17] Regulation on the procedure for the construction, maintenance and use of collective protective equipment. Adopted by Council of Ministers No. 60 of 17.03.2009. State Gazette, issue 23 of 27.03.2009, amended and supplemented.

[18] Regulation on safety in radioactive waste management. State Gazette, issue 76 of 30.08.2013, amended and supplemented.

[19] International Commission on Radiological Protection. The 2007 Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Annals of the ICRP, 37(2–4), 2007.

[20] Executive Agency for Environment (EAE). National System for Radiological Monitoring of the Environment in the Republic of Bulgaria: Radiation Characteristics of the Environment. Annual Report, Sofia, 2023.

[21] Tsibryanski, R. Radioecological monitoring as a basic criterion and assessment for the safety of the population in the adjacent areas. Bulgarian Nuclear Society (BulAtom), 2017, pp. 15-28.

[22] Regulation on the terms and conditions for the functioning of the National Early Warning and Disclosure System. State Gazette, issue 21 of 17.03.2020, amended and supplemented.

[23] Regulation No. 8121z-413 of March 29, 2024 on the procedure for the establishment, maintenance, development and use of the BG-ALERT system for the dissemination of warning messages to the population. State Gazette, issue 32 of 09.04.2024.

[24] Dolchinkov N., State of the population disclosure systems in the changing radiation situation in Bulgaria, 12th International Scienfic and Practical conference Environment. Technology. Resources. ISSN 1691-5402, Vol 1, 20-22.06.2019, Rezekne, Latvia, pp. 54-58