Ensuring Radiation Safety in Ukraine: the Activities of the IAEA in the Conditions of the Russian-Ukrainian War

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Abstract

The relevance lies in the fact that Ukraine has a comprehensive system of state regulation in the field of nuclear and radiation safety, in particular, control over sources of ionizing radiation is carried out on the basis of relevant legislative acts and registration mechanisms created taking into account international standards. However, with the full-scale invasion of Russia into the sovereign territory of Ukraine, our state was faced with war crimes by the Russian army and actions to seize nuclear energy facilities and destroy industrial facilities, which led to the loss of control over sources of ionizing radiation.

The purpose of the article is to determine the possibilities of the IAEA to influence Russia to ensure radiation safety in Ukraine in the conditions of the Russian-Ukrainian war.

Results. In the combat zone and in the occupied territories of Ukraine, nuclear energy and industrial facilities that used ionizing radiation sources and nuclear materials remain in danger. In particular, in peaceful life, sources of ionizing radiation are widely used throughout the world in agriculture, industry, medicine and various fields of research. In the conditions of the war that Russia unleashed, there is a loss of control over such sources.

Conclusions. According to the rules, if further exploitation of ionizing radiation sources is not envisaged and a decision is made to transfer spent sources of ionizing radiation to the category of radioactive waste, then the possibility of long-term storage and disposal of spent sources of ionizing radiation as radioactive waste in accordance with regulatory requirements must be ensured. The situation that has developed with the loss of control over nuclear energy and industrial facilities, where sources of ionizing radiation and nuclear materials were used, can lead to unpredictable and catastrophic consequences for Ukraine, as well as in the case of criminal use for other territories and millions of people.

Keywords: State Nuclear Regulatory Inspectorate of Ukraine, IAEA, public administration, spent sources of ionizing radiation, radioactive waste, disposal, safety, disposal facility, disposal options

Забезпечення радіаційної безпеки в Україні: діяльність МАГАТЕ в умовах російсько-української війни

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Анотація

Актуальність полягає в тому, що Україна має комплексну систему державного регулювання в сфері ядерної та радіаційної безпеки, зокрема контроль за джерелами іонізуючого випромінювання відбувається на підставі відповідних законодавчих актів та реєстраційних механізмів, створених з урахуванням міжнародних стандартів. Але з повномасштабним вторгненням росії на суверенну територію України, наша держава стикнулась з воєнними злочинами російської армії та вчиненням дій щодо захоплення об'єктів атомної енергетики і руйнування промислових об'єктів, що призвело до втрати контролю за джерелами іонізуючого випромінювання.

Метою статті є визначення можливостей МАГАТЕ для впливу на росію для забезпечення радіаційної безпеки в Україні в умовах російсько-української війни.

Результати. У зоні бойових дій та на окупованих територіях України залишаються в небезпеці об'єкти ядерної енергетики та промисловості, на яких використовувались джерела іонізуючого випромінювання та ядерні матеріали. Зокрема, в мирному житті джерела іонізуючого випромінювання широко використовуються в усьому світі в сільському господарстві, промисловості, медицині та різних сферах досліджень. В умовах війни, що її розв'язала росія, стається втрата контролю над таким джерелами.

Висновки. По правилам, якщо подальша експлуатація джерел іонізуючого випромінювання не передбачається та приймається рішення щодо переведення відпрацьованих джерел іонізуючого випромінювання до категорії радіоактивних відходів, то має бути забезпечена можливість довгострокового зберігання та захоронення відпрацьованих джерел іонізуючого випромінювання як радіоактивних відходів відповідно до нормативних вимог. Ситуація, що склалася при втраті контролю над об'єктами ядерної енергетики та промисловості, на яких використовувались джерела іонізуючого випромінювання та ядерні матеріали, може призвести до непередбачуваних та катастрофічних наслідків для України, а також у разі злочинного використання й для інших територій, та мільйонів людей.

Ключові слова: Державна інспекція ядерного регулювання України, МАГАТЕ, публічне управління, відпрацьовані джерела іонізуючого випромінювання, радіоактивні відходи, захоронення, безпека, сховище для захоронення, варіанти захоронення

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Introduction.

In Ukraine, the issue of physical protection of nuclear facilities and nuclear material has been given due attention since the declaration of independence. In particular, the need for state regulation in this area was identified (On the Participation of Ukraine, 1993) and urgent measures were identified for the physical protection of nuclear material and nuclear facilities (On Physical Protection, 2000).

Starting from the 90s of the last century, Ukraine has always been an active initiator of innovations (On the Participation of Ukraine in the Convention, 1993) on issues of ensuring nuclear and radiation safety, in terms of physical protection of nuclear material and nuclear facilities, with the aim of implementing the principles of this protection into national legislation and creating a state system of physical protection of nuclear facilities and objects, radioactive waste and sources of ionizing radiation (On the Physical Protection of Nuclear Facilities, 2000). Such activities continued, based on the IAEA measures (Nuclear Verification and Security, 2001) to improve the security of nuclear and radioactive materials, through the signing and subsequent ratification by Ukraine of amendments to the Convention on the Physical Protection of Nuclear Material (On Ratification of the Amendment to the Convention, 2008). Unfortunately, Ukraine's active position on the above issues could not protect against future armed aggression by Russia, as could the signed Budapest Memorandum on Security Assurances (Memorandum on Security Assurances, 1994).

Today's reality shows that "nuclear power plants can become objects of armed aggression and illegal seizure. This happened to Ukraine twice: in 2014, when Crimea, where the Sevastopol research reactor is located, was annexed, and in 2022, when Russia illegally seized the largest nuclear power plant in Europe, the Zaporizhia Nuclear Power Plant. Such actions have created unprecedented risks to nuclear safety and continue to create such risks every day" (Ministry of Energy: Ukraine called, 2024).

The IAEA's rhetoric regarding the situation resulting from Russia's invasion of Ukraine is restrained and consists of stating that "the world has experienced significant changes, including a global pandemic and the war in Ukraine, where for the first time a major nuclear energy program has found itself in the crossfire" (Grossi, 2024). At the same time, IAEA Director General R. Grossi notes that "groups with malicious intent must not be given the chance to use nuclear and radioactive materials to cause panic or harm" (Grossi, 2024).

The purpose of the article is to determine the IAEA's opportunities to influence Russia to ensure radiation safety in Ukraine in the context of the Russian-Ukrainian war.

Analysis of previous studies and publications. It is important to note that in recent years, researchers have paid significant attention to the situation around nuclear facilities located in the territory occupied by Russia, in particular: regarding nuclear energy and public opinion in Ukraine (Anpilova, 2020); about the risks in the current situation for nuclear energy in Ukraine (Massemin, 2022); about the alarming situation with nuclear reactors in Ukraine (Zerbib, 2022). But the least attention is paid to the safety of disposing of spent sources of ionizing radiation, which can accumulate in the combat zone. In previous years, this topic was given attention in the works of the author teams O. Tokarevsky, K. Fuzik, S. Kondratiev, Z. Alekseeva (2020), I. Kuzmyak and V. Kravtsov (2012). Attention was also paid to a review of the existing specialized software of regulatory bodies of countries around the world for accounting for the use of ionizing radiation sources (Mazur, 2021).

The war that Russia unleashed against Ukraine does not allow for proper state control over nuclear facilities, nuclear materials, radioactive waste and other sources of ionizing radiation that ended up in the occupied territory. Therefore, expectations are primarily based on the capabilities of the IAEA to address these important issues of nuclear and radiation safety.

Research results.

Ukraine has a comprehensive system of state regulation in the field of nuclear and radiation safety, in particular, control over sources of ionizing radiation is carried out on the basis of relevant legislative acts and registration mechanisms created taking into account international standards.

The central executive body that ensures the formation and implementation of state policy in the field of safety of nuclear energy use is the State Nuclear Regulatory Inspectorate of Ukraine. The activities of the inspectorate are directed and coordinated by the Cabinet of Ministers of Ukraine (On Approval of the Regulations, 2014).

The main tasks of the State Nuclear Regulatory Inspectorate of Ukraine are (On Approval of the Regulations, 2014):

- ensuring the formation and implementation of state policy in the field of safety of nuclear energy use;
- implementing state regulation of the safety of nuclear energy use;
- exercising the powers of the competent authority for the physical protection of nuclear material and nuclear facilities in accordance with the Convention on the Physical Protection of Nuclear Material and Nuclear Facilities; on the safe transportation of radioactive materials in accordance with the rules of nuclear and radiation safety during the transportation of radioactive materials; on emergency notification and information in accordance with the Convention on Early Warning of Nuclear Accidents. (On Approval of the Regulations, 2014).

The State Nuclear Regulatory Inspectorate of Ukraine, in accordance with its tasks, develops and implements measures to form a safety culture in the field of nuclear energy use and a culture of security of nuclear installations, nuclear materials, radioactive waste, and other sources of ionizing radiation (On Approval of the Regulations, 2014).

Our article focuses on ionizing radiation sources, therefore, in relation to them, the inspection: approves norms and rules for the physical protection of ionizing radiation sources; conducts safety assessments, state expertise on nuclear and radiation safety, and state expertise on the physical protection of ionizing radiation sources; carries out, in accordance with the procedure established by law, licensing activities for the use of ionizing radiation sources and the production of ionizing radiation sources; registers ionizing radiation sources; carries out state supervision over compliance with legislation on the conditions for issuing permits, norms and rules on nuclear and radiation safety, requirements for the physical protection of ionizing radiation sources,

as well as requirements for accounting and control of ionizing radiation sources; applies, in accordance with the established procedure, financial sanctions to enterprises, institutions and organizations, and other business entities in case of violation of the legislation. (On Approval of the Regulations, 2014).

In accordance with the approved procedure (Some Issues of State Regulation, 2000), state registration of ionizing radiation sources, as well as accounting for individual radiation doses, applies to:

1) legal entities and individual entrepreneurs who are owners of ionizing radiation sources or to whom these sources are assigned on the right of economic management, or are in their use on legal grounds;

2) entities operating in the field of nuclear energy use, whose personnel, interns, students and employees of other entities operating in the field of these entities are involved in work at the facilities of these entities, during which they are exposed to occupational radiation;

3) executive authorities, whose sphere of management includes organizations, institutions and enterprises whose activities are related to the use of ionizing radiation sources or the determination of individual radiation doses. (Some Issues of State Regulation, 2000).

Also, the above-mentioned procedure for state regulation of activities on the use of ionizing radiation sources (hereinafter referred to as IRS) defines the following sources (Some Issues of State Regulation, 2000):

1) open radionuclide sources of ionizing radiation are sources during the use of which the spread of radioactive substances (radiopharmaceuticals, radioactive solutions used during calibration, in scientific research; radiochemical preparations used in radiochemical laboratories) in working premises and the surrounding natural environment is possible;

2) closed radionuclide sources of ionizing radiation are sources in which the radioactive substance is completely enclosed in a solid protective shell made of non-radioactive material or encapsulated in a solid protective shell strong enough to prevent any spread of the substance under normal operating conditions during the established operating period;

3) non-radionuclide sources of ionizing radiation – devices or installations that do not contain radioactive substances, but are capable of generating ionizing radiation (X-ray therapeutic and X-ray diagnostic devices, installations for X-ray structural and X-ray spectral analysis, X-ray flaw detectors). (Some issues of state regulation, 2000).

According to the procedure for creating a unified state system for monitoring and accounting of individual radiation doses in Ukraine, registration of ionizing radiation sources and individual radiation doses is carried out in the information and computer system of the state register of ionizing radiation sources and individual radiation doses (Some issues of state regulation, 2000, Some issues of creation, 2020). It should be noted that the information and computer system of the state register was created in accordance with the IAEA code of conduct for ensuring the safety and preservation of radioactive sources (Code of conduct, 2004).

This state register is a unified information and computer system for accounting and monitoring of ionizing radiation sources. It provides systematization of data, submission of reports, coordination of activities, etc. It contains data on the location, activity, data on the owners of ionizing radiation sources and individual radiation doses of workers. Registration and licensing of the use of ionizing radiation sources are mandatory, except for sources that are exempt from licensing, but are registered after the acquisition, import, or change in the status of the ionizing radiation source. (Some Issues of State Regulation, 2000; Some Issues of Creation, 2020).

The above-mentioned state register shall be subject to registration of sources of ionizing radiation located or produced on the territory of Ukraine, as well as sources imported or exported across the state border of Ukraine, including in the event of their transit through the territory of Ukraine. Namely, closed sources of ionizing radiation, non-radionuclide installations and devices that generate ionizing radiation are subject to registration if they are not exempt from regulatory control. (Some Issues of State Regulation, 2000).

Also, regulatory and legal documents in the field of nuclear and radiation safety provide for proper notification of changes in the location of sources of ionizing radiation. In particular, when carrying out operations with sources of ionizing radiation, the registrant (business entity) is obliged to submit to the above-mentioned state register a notification within 10 days: about the location of the source; on the transfer of IRS for maintenance, on charging-recharging, on repacking, on repair, on adjustment, on conducting leak tests, on storage; on changing the name of the registrant; on changing the legal address of the registrant; on extending the term of operation of IRS; on the transfer of radionuclide IRS after the end of their term of operation for long-term storage or disposal to a specialized enterprise for radioactive waste management (Some Issues of State Regulation, 2000). These norms confirm the importance of timely notification of a change in the location of sources, including in cases of their loss. In the event of theft, loss or absence of sources of ionizing radiation, the registrant (business entity) shall send to the state register within 10 days an act on the absence of sources of ionizing radiation (Some Issues of State Regulation, 2000). Unfortunately, today, such control is impossible in the uncontrolled Ukrainian territory occupied by Russia, especially in the frontline zone. Therefore, it is worth emphasizing the loss of control over all sources of ionizing radiation located in the occupied territory.

However, the IAEA Director General emphasizes that “the database on incidents and trade allows Member States to report on nuclear and radioactive materials that have lost control” (Grossi, 2024).

After the full-scale Russian invasion of Ukraine, the radiation hazard has increased. Indicators of this hazard have been cases of loss of control over sources of ionizing radiation with the risks of their further illicit spread (Because of the Russian invasion, 2023). This situation requires strengthening border controls and the restoration of monitoring infrastructure by Ukraine and the IAEA.

In confirmation of this, it should be noted that during the occupation of the Chernobyl Exclusion Zone in 2022, Russian troops stole and damaged 133 sources of ionizing radiation and destroyed the laboratory of the Institute for Safety Problems of Nuclear Power Plants with radioactive samples that were used for research (Due to the Russian invasion, 2023). Later, losses of ionizing radiation sources were recorded in the Odessa, Kirovohrad, Kharkiv, and Sumy regions (Due to the Russian invasion, 2023). However, there is another problem related to the fact

that in the territories of Ukraine deoccupied in 2022, the inventory of ionizing radiation sources was complicated by mining and shelling by Russian troops (Due to the Russian invasion, 2023).

Under martial law, Ukraine continues to implement European radiation safety standards, in accordance with the signed Association Agreement with the European Union (Association Agreement, 2014). In particular, amendments to the existing legislation define: types of ionizing radiation situations (planned, existing, emergency); dose limits for personnel and the population. Also, unnecessary regulatory procedures for some sources of ionizing radiation have been abolished in order to simplify their use. (On Amendments, 2023).

Therefore, in the future, it is important to comply with nuclear and radiation safety standards and changes to legislation throughout the sovereign territory of Ukraine, which is impossible without international support and proper IAEA activity to put pressure on Russia.

The International Atomic Energy Agency is guided in its activities by its Statute (1956), which defines the Agency's objectives as the pursuit of the widespread use of atomic energy for the maintenance of peace, health and welfare throughout the world (Statute of the International Agency, 1956), including the prevention of the proliferation of nuclear weapons and the provision of nuclear and radiation safety. The Statute also stipulates that the Agency's assistance shall not be used for any military purpose. In addition, in accordance with Article III, the Agency has the right to inspect nuclear facilities of States Members of the IAEA to verify compliance with nuclear and radiation safety standards (Statute of the International Agency, 1956). Article XII of the Statute allows the Agency to request information from Member States on the condition of nuclear installations in emergency situations (Statute of the International Agency, 1956).

According to Article 14 of the Convention on Nuclear Safety (1994), the Agency may carry out inspections to assess and verify the safety of nuclear installations in terms of their compliance with the technical condition for the operating conditions. In addition, Article 5 of the Convention obliges States Parties to the Convention to adhere to the principles of nuclear and radiation safety (Convention on Nuclear Safety, 1994). In general, the above-mentioned Convention requires States Parties to ensure the physical protection of nuclear materials, prevent accidents and report on threats of nuclear and radiation hazards (Convention on Nuclear Safety, 1994).

According to paragraphs 13, 14, 15 of the Code of Conduct for the Safety and Security of Radioactive Sources (2004), the IAEA has the right to request explanations from States in the event of a breach of the safety and security of radioactive sources. In general, the code establishes standards for preventing theft, loss or unauthorized use of sources of ionizing radiation (Code of Conduct, 2004).

An additional basis for inspecting nuclear facilities in Ukraine is the Memorandum on Security Assurances in Connection with Ukraine's Accession to the Treaty on the Non-Proliferation of Nuclear Weapons (1994), but this applies to the territory controlled by the Government of Ukraine.

In its activities, the International Atomic Energy Agency, when initiating inspections, may refer to reference documents on radiation safety, namely the technical requirements for the protection of sources of ionizing radiation (Safety of Nuclear Power, 2016) and recommendations for the physical protection of these sources (Safety of Research Reactors, 2016).

It should be noted that the above-mentioned documents have limitations, which are associated with the voluntary nature of many norms, as well as the lack of enforcement mechanisms. Even the resolutions of the United Nations Security Council on nuclear and radiation safety do not oblige Russia to comply with them if it uses the right of veto. In addition, despite joint statements and reports on incidents related to the urgent need to ensure nuclear safety in Ukraine (54 delegations, 2024), they do not allow the IAEA to intervene in the situation during hostilities if the warring parties do not agree to IAEA inspection missions.

In addition, with the beginning of Russia’s full-scale invasion of Ukraine, Ukrainian nuclear scientists appealed to the IAEA leadership and the scientific community of countries with nuclear facilities to take all necessary measures to encourage the leadership of these states to direct efforts to de-escalate in the area of Ukraine’s nuclear facilities (Atomnyki Ukrainy, 2022; Shteinberg, 2022a; Shteinberg, 2022b). First of all, this concerned an immediate response to Russia’s aggressive actions: “there are situations when force and tough sanctions must be used to force compliance with the requirements of a security culture.” (Shteinberg, 2022b). Unfortunately, such appeals expressed by prominent Ukrainian nuclear scientists in the form of open letters did not lead to an immediate response from either the IAEA or the countries with nuclear facilities.

Conclusions.

The legal basis for the IAEA's actions is formed by the statute, international conventions and resolutions of the United Nations. These documents give the agency the right to monitor to record Russia's criminal actions, inspect and, based on the data received, publicly condemn the violations found. But, unfortunately, in practice, the IAEA is unable to stop Russia's military actions at and near nuclear energy facilities.

Also, during the period of Russia's full-scale invasion of Ukraine, the IAEA was unable to force the offending state to comply with the requirements for compliance with nuclear and radiation safety, including forcing Russia to return the stolen sources of ionizing radiation.

To influence Russia, the IAEA uses a combination of public pressure, technical support from Ukraine and the reaction of the world community through international institutions, where Russia does not have the right of veto. However, it should be noted that most of the IAEA's decisions are of a recommendatory nature.

We can state that today, the IAEA has limited influence on Russia, but at the same time, the IAEA leadership has effective opportunities to promote the international isolation of Russia in the nuclear industry based on incident data. In our opinion, the international isolation of Russia can be achieved through sanctions of the European Union and the United States of America, which will be adopted on the basis of the received data on criminal actions of Russia at nuclear facilities throughout the sovereign territory of Ukraine. In particular, the IAEA can recognize Russia's actions as a violation of international norms, at least on the basis of the Code of Conduct on the Safety of Sources of Ionizing Radiation (Code of Conduct, 2004).

In any further development of events, it is important for Ukraine to receive from the IAEA the necessary technical assistance to prevent accidents at nuclear energy facilities located in the territory occupied by Russia and the territory controlled by Ukraine. Therefore, cooperation with the IAEA should continue, especially in terms of documenting threats (publishing data on violations in real time, which makes it difficult to cover up accidents). Also, cooperation should be aimed at mobilizing support for Ukraine from the international community.

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