



NUCLEAR SECURITY IN UKRAINE AND THE BLACK SEA REGION: NEW THREATS, NEW RISKS, NEW CONSEQUENCES

VITALY FEDCHENKO, IRYNA MAKSYMENKO, POLINA SINOVETS
AND WILFRED WAN*

I. INTRODUCTION

Questions about nuclear security—whether smuggling of nuclear material or loss of radioactive sources—have been common in the Black Sea region over the past three decades. The Russian military’s invasion of Ukraine in 2022 and its attacks on and purported annexation of Ukrainian nuclear installations presented further—and extraordinary—nuclear safety, security and safeguards challenges. As well as their significant impact on the international nuclear security regime, they necessitate changes in the national nuclear security regimes of Ukraine and the other states of the Black Sea region.¹ What are those changes? What other changes will potentially be necessary? How do the nuclear security officials in those states perceive the new nuclear security threats relevant to them? How do they plan or propose to address those threats?

This SIPRI Research Policy Paper addresses these questions, highlighting special challenges that arise from dealing with nuclear security threats in extraordinary circumstances. It continues (in section II) by providing historical context to the nuclear security threat environment in the Black Sea region. It then assesses the nuclear security challenges faced in 2022 by Ukraine (in section III) and other countries in the region (in section IV, primarily Georgia and Moldova), how they are perceived and how they have, or could be, addressed. It closes by offering conclusions in section V. This paper is based on SIPRI’s continuity of knowledge on the subject of nuclear security in the Black Sea region, including an extensive 18-month research project.² Taking that knowledge as a baseline, this paper builds on it using information from open sources, an interview campaign and two expert workshops.³

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¹ Those challenges and their potential impact at the global level are reviewed in Fedchenko, V., ‘Nuclear Security During Armed Conflict: Lessons From Ukraine’, SIPRI Research Policy Paper, Mar. 2023.

² The project culminated in publication of Fedchenko, V. and Anthony, I., *Nuclear Security in the Black Sea Region: Contested Spaces, National Capacities and Multinational Potential*, SIPRI Policy Paper no. 49 (SIPRI: Stockholm, Dec. 2018).

³ The 2 workshops were the SIPRI Virtual Workshop on Nuclear Security, 20 Jan. 2023; and a dedicated session at the Stockholm Security Conference, 10 Nov. 2022. The interviews were

SUMMARY

● Nuclear security threats in the Black Sea region went through momentous changes between the 1990s and 2023. Up to 2014 the region was known as the location for the most high-profile cases of nuclear smuggling. In 2014 Ukraine lost control of parts of its territory and borders, which exacerbated the same nuclear security challenges. Attacks on nuclear installations were still seen as unlikely.

In 2022 the Russian military did attack Ukrainian nuclear facilities. The Ukrainian nuclear security regime began to adapt, shifting focus to protecting nuclear installations in extraordinary circumstances. Black Sea states began to recognize Ukrainian territories affected by armed conflict as a source of nuclear security risks. Large nuclear security events with radiological consequences for the Black Sea region are now seen as viable risks. A companion paper describes how attacks on nuclear installations in Ukraine have changed the international nuclear security framework.



II. BACKGROUND ON NUCLEAR SECURITY IN THE BLACK SEA REGION

The area in which most high-profile nuclear smuggling cases over the past three decades have taken place is the wider Black Sea region—consisting of the six littoral states (Bulgaria, Georgia, Romania, Russia, Ukraine and Türkiye) and a hinterland including Armenia and Moldova. This is normally explained by a confluence of several factors. First, the dissolution of the Soviet Union in December 1991 led to large amounts of nuclear and other radioactive materials as well as radioactive sources and waste being left poorly guarded, abandoned and even completely forgotten across the region.⁴ Second, economic instability in the former Soviet states combined with abundant misinformation in the press about the high black market value of radioactive material provided motivation for theft or other unauthorized activities. Third, numerous territorial conflicts served as enabling factors for smugglers, who have been particularly prominent in ‘contested spaces’ such as Abkhazia, South Ossetia, Nagorno-Karabakh (Artsakh), Trans-Dniester, Donetsk and Luhansk.⁵ These territories not only hosted abandoned or poorly managed materials, but also became areas where the controls on the flow of goods over borders and the detection of illicit trade and trafficking were far more complicated, and where smugglers could seek safe haven.

Nuclear smuggling in the Black Sea region received international attention after a few high-profile interceptions of highly enriched uranium (HEU) in Bulgaria (1999), Georgia (2003, 2006 and 2010) and Moldova (2011). Approximately one-quarter of all internationally known incidents involving nuclear or other radioactive material outside regulatory control (MORC) between 1993 and 2017 were reported by the Black Sea littoral states.⁶ Nuclear smuggling has traditionally been the most visible nuclear security issue in the region, although more recent research has found that local stakeholders often focus on the significant risks associated with disused radioactive materials, orphaned radioactive sources and abandoned radioactive waste, all of which are relatively widespread across the Black Sea region.⁷ The factor that most enables and exacerbates both kinds of risk—nuclear smuggling and orphan radioactive sources—is the presence of a nearby contested space.⁸

The crisis in and around Ukraine—which began in 2014 with the annexation by Russia of the Crimea region of Ukraine and the proclamation of the breakaway Donetsk People’s Republic (Donetskaya Narodnaya Respublika, DNR) and Luhansk People’s Republic (Luganskaya Narodnaya Respublika,

conducted by the Odesa Center for Nonproliferation (ODCNP) with nuclear security officials and experts from Bulgaria, Georgia, Moldova, Ukraine and Türkiye.

⁴ On the kinds of material left out of regulatory control or under inadequate controls see *Chicago Tribune*, “‘Potatoes were guarded better’”, 8 Sep. 2004; and Shields, J. M. and Potter, W. C. (eds), *Dismantling the Cold War* (MIT Press: Cambridge, MA, 1997). On the assistance provided to the states of the former Soviet Union to deal with these and related issues see Anthony, I. and Fedchenko, V., ‘International non-proliferation and disarmament assistance’, *SIPRI Yearbook 2005: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2005).

⁵ The term ‘contested spaces’ was chosen as a neutral collective term for these territories, whose political realities differ. See e.g. Fedchenko and Anthony (note 2).

⁶ Fedchenko and Anthony (note 2), p. 37.

⁷ For a list of high-profile cases of nuclear smuggling see Zaitseva, L. and Steinhäusler, F., ‘Nuclear trafficking issues in the Black Sea region’, Non-proliferation Papers no. 39, EU Non-Proliferation Consortium, Apr. 2014.

⁸ Fedchenko and Anthony (note 2), pp. 18–23.



LNR) in eastern Ukraine—had differing impacts on the nuclear security regimes of Ukraine and the other states in the region. The impact on Ukraine’s nuclear security regime was clear and severe. With Russia’s takeover of Crimea, the start of fighting in eastern Ukraine, and the formation of the DNR and the LNR, Ukraine lost control over territory, the protection of parts of its borders, and oversight of the maritime domain. Since 2014 the State Nuclear Regulatory Inspectorate of Ukraine (SNRIU) has lost regulatory control over nuclear materials, installations, radioactive sources and nuclear security infrastructure in both Crimea and the separatist-controlled areas of eastern Ukraine.⁹

Research conducted by SIPRI in 2017–18 demonstrated that the impact of these events on the nuclear security regimes of other countries in the Black Sea region was not necessarily of the same scale.¹⁰ Nuclear security stakeholders elsewhere in the region reported at the time that they had not detected significant changes in their own, local nuclear security threats after the events in Ukraine in 2014. They therefore did not significantly change their national nuclear security risk assessments, despite the changes in the wider security environment. Instead, they indicated in 2017–18 that most of the nuclear security threats that they had to deal with were connected, not to the events in Ukraine, but to the contested spaces in their own territory or their immediate neighbourhood.¹¹ In that specific sense, the events of 2014 had little impact on nuclear security threat perceptions in Black Sea states other than Ukraine.

The events of 2022 have changed perceptions of the challenges to nuclear security regimes across all states of the Black Sea region.

III. NUCLEAR SAFETY AND SECURITY CHALLENGES IN UKRAINE

Before 2014 the nuclear security threat environment and the nuclear security regime of Ukraine were arguably similar to those in nearby states. With the annexation of Crimea by Russia, fighting in the eastern parts of Ukraine, and formation of the DNR and the LNR, the new national security challenges necessitated profound alterations in the political and administrative systems of Ukraine, which had knock-on effects on the national nuclear security regime. Ukraine had to pay much closer attention than previously to protection of its nuclear installations due to the appearance of new kinds of nuclear security threat—including insider threats and potential attacks on nuclear installations.¹²

One of the foundational documents of the nuclear security regime is the 2005 Convention on the Physical Protection of Nuclear Material and

⁹ On materials and installations lost by Ukraine see Chumak, D., ‘The implications of the Ukraine conflict for national nuclear security policy’, Non-proliferation Paper no. 53, EU Non-proliferation Consortium, Nov. 2016, p. 3; and Ivko, V., ‘Ukraine: Security in nuclear sphere in hybrid warfare conditions’, Presentation at the Nuclear Security in the Black Sea Region conference, Bucharest, 24–25 Apr. 2018.

¹⁰ Fedchenko and Anthony (note 2), p. 2.

¹¹ Fedchenko and Anthony (note 2), p. 2.

¹² On the IAEA definition of a nuclear security threat—which is restricted to non-state individuals or groups—see IAEA, *Objectives and Essential Elements of a State’s Nuclear Security Regime: Nuclear Security Fundamentals*, IAEA Nuclear Security Series no. 20 (IAEA: Vienna, 2013), p. 13; and Fedchenko (note 1), section VII.



Nuclear Facilities.¹³ Fundamental Principle G (Threat) of the convention states that ‘The State’s physical protection should be based on the State’s current evaluation of the threat.’¹⁴ According to nuclear security guidance of the International Atomic Energy Agency (IAEA) published in 2009, a threat evaluation should take the form of a ‘design basis threat’ (DBT) document, defined as a ‘comprehensive description of the motivation, intentions and capabilities of potential adversaries against which protection systems are designed and evaluated’.¹⁵

The concept of a DBT has been in use worldwide for many years. It is also discussed in multiple IAEA nuclear security guidance documents and is the exclusive focus of a document in the IAEA Nuclear Security Series, published in 2009 and updated in 2021.¹⁶ The 2009 version contains the notion of ‘maximum threat capabilities against which protection will be reasonably ensured’, defined as ‘capabilities for all potential threats against which the State has decided to develop specific protection measures’.¹⁷ The DBT is then a subset of those maximum threat capabilities that is used as a basis for building and operating physical protection systems at a nuclear facility. According to the 2009 document, the operator has primary responsibility for protecting against threats within the DBT, while the state has the primary responsibility for protecting against nuclear security threats with capabilities higher than the DBT, but lower than the ‘maximum threat capabilities’.¹⁸ Threats with capabilities beyond ‘maximum threat capabilities’ (such as, presumably, an attack by a foreign military) are explicitly not covered in nuclear security documents.¹⁹

The events of 2014 changed the nuclear security threat environment for Ukraine in at least three ways. First, they emphasized insider threats. Until 2014 the physical protection of nuclear facilities had been the responsibility of the Internal Troops of Ukraine under the Ministry of Internal Affairs. The troops were recruited locally, and in 2014 the unit responsible for the physical protection of facilities in Crimea defected to Russia.²⁰ These and other events of 2014 motivated Ukraine to comprehensively revise its national security establishment with the objective of creating Ukrainian national capacities from which Russian influence was excluded as far as possible. As part of this project, in March 2014 the Ukrainian government established the National

¹³ Convention on the Physical Protection of Nuclear Material, opened for signature 3 Mar. 1980, entered into force 8 Feb. 1987, IAEA INFCIRC/274, Nov. 1979; and Convention on the Physical Protection of Nuclear Material and Nuclear Facilities, amendments to the 1979 convention adopted 8 July 2005, amended convention entered into force for its ratifying states 8 May 2016, IAEA INFCIRC/274/Rev.1/Mod.1, 9 May 2016.

¹⁴ Convention on the Physical Protection of Nuclear Material and Nuclear Facilities (note 13), Article 2A(3).

¹⁵ IAEA, *Development, Use and Maintenance of the Design Basis Threat: Implementing Guide*, IAEA Nuclear Security Series no. 10 (IAEA: Vienna, 2009), p. 1. See also IAEA, *Nuclear Security Series Glossary*, version 1.3 (IAEA: Vienna, Nov. 2015), p. 9. These documents were updated in 2021–22.

¹⁶ IAEA, Nuclear Security Series no. 10 (note 15); and IAEA, *National Nuclear Security Threat Assessment, Design Basis Threats and Representative Threat Statements: Implementing Guide*, IAEA Nuclear Security Series no. 10-G (Rev. 1) (IAEA: Vienna, 2021).

¹⁷ IAEA, Nuclear Security Series no. 10 (note 15), p. 5.

¹⁸ IAEA, Nuclear Security Series no. 10 (note 15), p. 5.

¹⁹ The notion of ‘maximum threat capabilities’ was dropped completely from IAEA, Nuclear Security Series no. 10-G (note 16). On threats beyond the DBT see Fedchenko (note 1), section VI.

²⁰ Ukrainian State Nuclear Regulatory Inspectorate (SNRIU), *Report on Nuclear and Radiation Safety in Ukraine for 2014* (SNRIU: Kyiv, 2015), p. 64. See also Fedchenko and Anthony (note 2), p. 8.



Guard. Among the law enforcement functions that this new service was assigned was protection of critical infrastructure such as nuclear facilities, nuclear materials, radioactive sources and nuclear waste.²¹

Second, new trafficking risks arose from Ukraine's loss of control over Crimea and the east of the country. Along with loss of territory came loss of nuclear security detection infrastructure, especially at seaports and on Ukraine's borders, loss of nuclear security training infrastructure, and the loss of control over radioactive materials and orphan sources in the territories held by the DNR and the LNR.²²

Third, two known risks relevant to attacks on nuclear installations were discussed at the time. One was a potential attack by non-state actors with heavy weapons on a Ukrainian nuclear power plant (NPP) in order to cause dispersal of radioactive material. Identification of this risk was informed by the availability of heavy weapons (including tactical missile systems) in the hands of separatists in eastern Ukraine. Zaporizhzhia NPP—the largest NPP in Europe—was specifically named as a potential target for those weapons.²³ The other identified risk was an aircraft being brought down in the vicinity of or onto an NPP. This was clearly informed by the shooting down on 17 July 2014 of Malaysia Airlines Flight 17 by a surface-to-air missile launched from a separatist-controlled part of Ukrainian territory.²⁴

In 2015 and later, Ukraine followed the IAEA guidance by revising and updating its DBT for nuclear facilities, nuclear material, radioactive waste and other radioactive sources to reflect the changing threat environment, focusing on the risks discussed above.²⁵ In 2022, the Russian military's fully fledged invasion of Ukraine and the ensuing warfighting, occupation and supposed annexation of territory brought risks and threats far beyond the three discussed above. Starting with the beginning of hostilities on 24 February 2022, the IAEA has been in a key position to receive timely information on the security of all nuclear installations in Ukraine. The SNRIU, serving in its capacity as national competent authority under the 1986 Convention on Early Notification of a Nuclear Accident, has direct contact with the emergency response manager at the IAEA's Incident and Emergency Centre (IEC).²⁶ The IAEA has chosen to publish a large portion of the information received from Ukraine, a wealth of data on its own actions and relevant information provided by other states.²⁷ This has effectively put the IAEA in the important position of being an international chronicler of

²¹ Закон України про Національну гвардію України [Ukrainian Law on the National Guard of Ukraine], Ukrainian Law no. 876-VII as amended, 13 Mar. 2014; Ukrainian National Security and Defence Council, Рішення про невідкладні заходи щодо забезпечення національної безпеки, суверенітету і територіальної цілісності України [Decision on urgent measures to ensure the national security, sovereignty and territorial integrity of Ukraine], 1 Mar. 2014; and Chumak (note 9), p. 11.

²² Fedchenko and Anthony (note 2), pp. 10–17.

²³ Chumak (note 9), p. 10.

²⁴ Chumak (note 9), pp. 10–11.

²⁵ Chumak (note 9), p. 5.

²⁶ Convention on Early Notification of a Nuclear Accident, opened for signature 26 Sep. 1986, entered into force 27 Oct. 1986, IAEA INFCIRC/335, 18 Nov. 1986.

²⁷ By Feb. 2023 the IAEA had published over 140 updates on nuclear safety and security in Ukraine and 4 reports by the IAEA director general. IAEA, 'Nuclear safety and security in Ukraine', [n.d.].

**Table 1.** Nuclear safety and security risks associated with attacks on nuclear installations in Ukraine

Attack type	Risks
Damage to a nuclear facility due to shelling, missile strikes, placement of mines or other hostilities	<p>Direct threat of serious radiation accident with contamination of surrounding territories</p> <p>Direct threat to lives of facility personnel</p> <p>Damage to nuclear safety and physical protection equipment</p>
Damage to power lines and other interruptions in power supply	<p>Necessity to shut down affected nuclear reactors</p> <p>Interruptions in removal of residual heat from nuclear reactors and spent fuel pools—this is particularly dangerous in case of a recently shut down nuclear power reactor and may lead to events similar to the Fukushima Daiichi accident; it is also problematic for wet spent fuel storage facilities</p> <p>Interruption or loss of the ability to control nuclear safety systems and monitor safety parameters (e.g. radiation level at the facility, water temperature and levels in spent fuel pools, hydrogen content in the ventilation systems)</p>
Military occupation or annexation	<p>Restrictions on movement and communications and severe psychological and physical pressure on nuclear facility personnel by an occupying force, leading to diminishing of the ability of personnel to perform their tasks</p> <p>Interruption of communications between the nuclear facility and the regulatory authority, including interruption of ‘reach back’ capability (e.g. for expert advice)</p> <p>Interruption of communications with the International Atomic Energy Agency</p> <p>Destructive action by the occupying forces after the occupation has taken place, including destruction of laboratories and the removal of radioactive material, computers and other electronic equipment containing sensitive data</p> <p>Interruption of delivery of equipment, spare parts, diesel fuel and other materials required for facility operation</p>

Source: Ukrainian nuclear security officials, Interviews with the Odesa Center for Non-Proliferation (ODCNP), Oct. 2022.

the nuclear security, safety and safeguards dimensions of the situation in Ukraine, and of the multiple attacks on nuclear installations there.²⁸

The attacks on nuclear installations in Ukraine documented by the IAEA can be divided into three types: (a) damage to a nuclear facility due to shelling, missile strikes or other hostilities; (b) damage to power lines and other interruptions in power supply; and (c) military occupation or annexation. In interviews with the Odesa Center for Non-Proliferation (ODCNP), Ukrainian nuclear officials detailed typical nuclear safety and security risks associated with each type of attack (see table 1).

The contents of a DBT or other documents assessing nuclear security threats are not usually made public.²⁹ It is therefore not known with certainty if any, and to what extent, the identified threats and hazards were reflected in Ukrainian DBT documents developed before 2022. According to interviewed Ukrainian nuclear security specialists with direct knowledge of the issue, nuclear facilities had no ‘action protocols’ prepared for a case of a hostile armed force taking over an NPP.³⁰ The latest DBT document was approved

²⁸ Fedchenko (note 1), section II.

²⁹ For definitions of 2 such documents—a threat statement and a threat assessment—see IAEA, *IAEA Nuclear Safety and Security Glossary: Terminology Used in Nuclear Safety, Nuclear Security, Radiation Protection and Emergency Preparedness and Response, 2022* (interim) edn (IAEA: Vienna, 2022), pp. 23, 210.

³⁰ Ukrainian nuclear security officials, Interviews with ODCNP, Oct. 2022.



in April 2019.³¹ It classifies a scenario of an armed attack on a nuclear power plant by the armed forces of a foreign state as a threat beyond the DBT, and assigns the responsibility to protect against such a threat to the Ministry of Internal Affairs, the Security Service of Ukraine and the armed forces.³² On 27 August 2022 the Ukrainian government launched a new process to review the DBT, which will clearly take into account the circumstances created by the attacks on Ukraine's nuclear installations.³³

During extraordinary events, the responsibilities to address threats are allocated among national nuclear security actors.³⁴ While the operator of a nuclear facility cannot be expected to deal with threats beyond the DBT, it can have three kinds of nuclear security responsibility in extraordinary circumstances: (a) to meet the requirements for nuclear security systems and measures against threats defined in the DBT; (b) to assist the state in dealing with the nuclear security threats beyond the DBT; and (c) to assist the state in mitigating the consequences of the extraordinary events.³⁵

Discussion of nuclear security responsibilities in extraordinary circumstances within the IAEA and in most of its member states has so far been brief, at best.³⁶ The interviewed Ukrainian nuclear security officials offered insights based on their direct experience that can be useful for any further such discussion.³⁷ They recommended development of a set of regulatory documents and operational instructions ('emergency protocols') describing the nuclear security responsibilities of an operator and the actions that it must take in extraordinary circumstances, including threats beyond the DBT. According to the officials, the lack of previous experience—and therefore the lack of emergency protocols describing the operation of security systems and facilities during events beyond the DBT—had been a serious problem for Ukraine.

The officials suggested that the proposed documents should consider the limits of safe operation of nuclear facilities under threat; emergency preparedness; monitoring of radiation levels; stocks of materials necessary for reliable operation; diesel fuel stocks; existence of mobile power supply units; and options for personnel work and rotation. Development of a staffing schedule for extraordinary circumstances is most likely to reflect the need to minimize the number of personnel at a nuclear site, balancing the need to operate the nuclear facilities safely with the need to ensure personal security and allow evacuation of staff. It is unclear if and how such

³¹ President of Ukraine, Decree no. 97-4т/2019, 'Про рішення Ради національної безпеки і оборони України від 3 квітня 2019 року «Питання проектної загрози для ядерних установок, ядерних матеріалів, радіоактивних відходів та інших джерел іонізуючого випромінювання в Україні»' [On the decision of the National Security and Defence Council of Ukraine of 3 April 2019 on 'Issue of the design basis threat to nuclear facilities, nuclear materials, radioactive waste and other sources of ionizing radiation in Ukraine'], 3 Apr. 2019.

³² Ukrainian nuclear security officials (note 30).

³³ Ukrainian Cabinet of Ministers, 'Уряд визначив необхідність перегляду проектної загрози для ядерних установок, ядерних матеріалів, радіоактивних відходів та інших джерел іонізуючого випромінювання в Україні' [The government determined the need to review the design basis threat for nuclear installations, nuclear materials, radioactive waste and other sources of ionizing radiation in Ukraine], Ukrainian Government Portal, 27 Aug. 2022.

³⁴ For a discussion and recommendations see Fedchenko (note 1), sections VI–VIII.

³⁵ Fedchenko (note 1), table 2.

³⁶ Fedchenko (note 1), section VII.

³⁷ Ukrainian nuclear security officials (note 30).



protocols could prescribe any personnel actions at nuclear facilities under occupation—it is difficult to place any responsibility on the personnel under such circumstances, although their treatment should be in line with international humanitarian law.³⁸

The interviewed Ukrainian officials also recommended development of an international guidance document, potentially in the IAEA Nuclear Security Series or in a similar format, discussing a national nuclear security regime under stress from threats beyond the DBT.³⁹ Production of such guidelines would have to deal with (or explicitly put outside its scope) the difficult issue of coordination between, on the one hand, the authorities legally responsible for operation of a facility and, on the other, the occupying power that may have no internationally recognized rights to operate the facility in question but which is the only authority with the physical capacity to do so. Pressing nuclear safety issues might dictate that an international organization, such as the IAEA, must engage with an occupying power. Interviewed Ukrainian experts raised a concern that such cooperation, including practical and pragmatic interactions ‘on the ground’, may serve to inadvertently recognize territorial claims of the occupying power.⁴⁰

Based on the Ukrainian experience in 2022 the interviewed officials also suggested the following adjustments to nuclear safety and radiation-protection regulations.

1. The existing plans for the protection of personnel and the population in case of a radiation accident at an NPP caused by a threat beyond the DBT should be strengthened or revised.
2. The reliability, automation and independent operation of the technical systems that monitor radioactivity in and around nuclear facilities, in particular NPPs, as well as associated communication channels should be increased. In an ideal case, radioactivity monitoring systems would be able to transmit data to a nuclear regulator or other appropriate body without involvement of the facility personnel, who may be under attack or captured.
3. Duplicate logistics arrangements should be developed along with a backup supply of diesel fuel and spare parts in case normal logistic routes become unavailable.
4. Additional evacuation routes for a facility’s personnel should be developed.

A number of these proposed adjustments to regulations overlap with the ‘seven indispensable pillars of nuclear safety and security’ framework put forward by the IAEA director general on 2 March 2022.⁴¹

³⁸ Parkinson, J. and Hinshaw, D., “‘The hole’: Gruesome accounts of Russian occupation emerge from Ukrainian nuclear plant”, *Wall Street Journal*, 18 Nov. 2022.

³⁹ See also Fedchenko (note 1), section VIII.

⁴⁰ Ukrainian nuclear security officials (note 30); and SIPRI Virtual Workshop on Nuclear Security (note 3).

⁴¹ Grossi, R. M., IAEA Director General, Introductory statement to the IAEA Board of Governors, 2 Mar. 2022. See also Fedchenko (note 1), section IV.



IV. NUCLEAR SECURITY IN THE BLACK SEA REGION BEYOND UKRAINE

As noted above, the crisis in and around Ukraine that began in 2014 did not drastically change the nature of the nuclear security challenges for the Black Sea states other than Ukraine, although it diminished opportunities for regional nuclear security cooperation. The largest MORC-related nuclear security challenges in the region continued to originate in the contested spaces, either as a source of nuclear materials, other radioactive materials, orphan sources, and improperly stored or abandoned radioactive waste or as a nuclear smuggling route and safe haven for traffickers. None of the nuclear security experts from the region interviewed by SIPRI before 2022 disputed the importance of combatting trafficking of fissile materials.⁴² However, most of them indicated that improper storage of radioactive waste and smuggling of orphan radioactive sources represented a more immediate concern.

New threat perceptions

The Russian military's invasion of Ukraine in 2022 and attacks on nuclear installations not only aggravated the existing concerns in Black Sea states, but also changed their threat perception in several important ways.

First, war zones and occupied Ukrainian territories became a significant nuclear security concern for other states in the Black Sea region. For example, Georgian and Moldovan nuclear security officials stated that they anticipated an increase in cases of trafficking of orphan radioactive sources on their territories caused by looting of nuclear facilities and other installations in the areas of Ukraine beyond government control.⁴³ Even before 2022, the territories controlled by the DNR and the LNR hosted the highest volume of radioactive materials among the contested spaces in the Black Sea region.⁴⁴ Far larger parts of Ukrainian territory have been occupied by Russia since February 2022, some of which were subsequently liberated by Ukrainian forces and some claimed as annexed by Russia. Industrial facilities in these territories have been damaged and the inspection capacity of the SNRIU and other authorities has been diminished. This has caused nuclear security stakeholders in the Black Sea states beyond Ukraine to treat the possibility of trafficking of orphaned sources from Ukraine as a national nuclear security concern of the same magnitude as similar concerns arising in contested spaces within their own territories.⁴⁵ This was not the case before 2022.

Second, the Black Sea states beyond Ukraine took note of the previously discounted risk of attack on a nuclear installation by a state military. As discussed below, the immediate action to address this risk focused on strengthening national capabilities to detect and mitigate radiological consequences of a potential large-scale nuclear safety accident at a Ukrainian nuclear power plant caused by hostilities (e.g. a missile strike or shelling).

⁴² Fedchenko and Anthony (note 2), pp. 19–20.

⁴³ Georgian nuclear security officials, Interviews with ODCNP, Nov. 2022; and Moldovan nuclear security officials, Interviews with ODCNP, Nov. 2022.

⁴⁴ Fedchenko and Anthony (note 2), p. 14.

⁴⁵ Georgian nuclear security officials, Interviews with ODCNP, Nov. 2022.



Zaporizhzhia NPP and South Ukraine NPP, Mykolaiv oblast, were specifically mentioned by interviewed officials as a cause for concern.⁴⁶ In contrast, the interviews showed that experts from other states of the region are not yet contemplating the potential changes to their national nuclear security regimes that are likely to be needed in order to clarify the actions of facility operators and other nuclear security stakeholders in case of nuclear security threats beyond the DBT within the territory of their state.⁴⁷

In addition to these two changes in the nuclear security threat environment that apply across the region, the war has also resulted in country-specific challenges. The following are some notable examples from Georgia and Moldova.

First, the authorities of Georgia have highlighted an unintended consequence of the war and the Western sanctions on Russia: shipments of goods that would have previously gone through Russian territory are being increasingly rerouted through Georgia via the Trans-Caspian International Transport Route (TITR).⁴⁸ The TITR runs from China through Kazakhstan, across the Caspian Sea and then through Azerbaijan and Georgia before reaching Europe either through Türkiye or by crossing the Black Sea.⁴⁹ From 2018 Kazakhstan's state-owned producer and exporter of natural uranium, Kazatomprom, began to shift its uranium export routes to increasingly use the TITR. This has helped 'to mitigate the risk of the primary route through St. Petersburg being unavailable, for any reason'.⁵⁰ Georgian officials see this new development as an additional nuclear security issue, requiring significant deployment of new nuclear security systems and other measures, in particular at the borders. They also see the need to bolster the safeguards capabilities of Georgia's nuclear regulatory authority, the Agency of Nuclear and Radiation Safety, and especially the emergency preparedness capabilities for addressing potential accidents involving transported uranium ore concentrate or radioactive material.⁵¹

Second, Georgian experts and officials also highlighted the intensification of the Nagorno-Karabakh conflict as a nuclear security concern for Georgia. According to them, even though Georgia is not involved in the conflict itself, its presence in the region increases the probability of trafficking through Georgian territory. In addition, the conflict negatively affects regional cooperation and transparency—both in general terms as well as specifically in nuclear security. The IAEA has identified international cooperation as an essential element of any national nuclear security regime.⁵² Yet, interviewed Georgian officials pointed out the absence of a formalized nuclear security information-exchange mechanism between the states of the South Caucasus or in the Black Sea region. Regional information exchange is often implemented via personal contacts of the region's nuclear security officials. While this may be an adequate solution in individual cases, it is generally

⁴⁶ Georgian nuclear security officials (note 43); and Moldovan nuclear security officials (note 43).

⁴⁷ On nuclear security threats beyond the DBT see Fedchenko (note 1), table 2.

⁴⁸ Gabritchidze, N., 'Ukraine war leads to traffic jams in Georgia', Eurasianet, 6 Oct. 2022.

⁴⁹ For details of the route see Trans-Caspian International Transport Route, 'Middle Corridor', [n.d.].

⁵⁰ JSC Kazatomprom, 'Kazatomprom announces trans-Caspian delivery', 20 Dec. 2022.

⁵¹ Georgian nuclear security officials (note 43).

⁵² IAEA, Nuclear Security Series no. 20 (note 12), p. 7.



not sustainable due to rotations of personnel.⁵³ This problem was reported by Moldovan officials as well, who also identified the need to improve coordination at a national level.⁵⁴ An earlier SIPRI study recommends that each state in the Black Sea region should maintain—and share with its neighbours—a ‘catalogue of functions and responsibilities’ (as opposed to job titles) that would clearly specify who is responsible for what within the nuclear security regime.⁵⁵ This catalogue would help to maintain mutual awareness of stakeholders with the same function in neighbouring states regardless of their title, even after governmental restructuring.

Regional responses to the new threat environment

Each of the Black Sea states responded to these new challenges to their nuclear security regimes and the intensification of traditional challenges in similar ways: focusing first and foremost on preparing to mitigate the radiological consequences of a potential large nuclear security event in Ukraine. The emergence of nuclear security threats that could result in damage to a nuclear installation in a military attack—either directly or through damage to other critical infrastructure (e.g. interruption of electricity or water supply for cooling)—featured prominently in interviews with officials across the Black Sea region. The most obvious potential consequence of such an attack is a release of radioactive isotopes into the atmosphere and its spread across national borders.

The states all report taking immediate steps to bolster their emergency response capabilities with additional tools designed to deal with radioactive contamination. For instance, Georgian officials reported reorganization at the Emergency Management Centre of the Ministry of Environmental Protection and Agriculture to create working groups on specific aspects of the emergency response to radiological events and to develop action protocols for these working groups.⁵⁶ Additional training has been offered to hospital and emergency ambulance personnel in diagnostics and treatment of radiation sickness and in hospital management of patients. Moldovan officials reported taking steps to address the same issue. This included revision of the national emergency response plan, as well as the creation of ‘reaction plans’ and dedicated groups in relevant state authorities.⁵⁷ Interviewed officials framed these emergency response measures as part of their preparedness to mitigate the consequences of a nuclear security event.

In addition, Black Sea states have frequently reported measures taken to improve outreach to the public in emergency situations involving radioactive material or contamination. For example, in September 2022 the Moldovan Inspectorate-General for Emergency Situations (Inspectoratul General pentru Situatii de Urgentă, IGSU) published guidelines for the public and

⁵³ Georgian nuclear security officials (note 43).

⁵⁴ Senior Moldovan radiation protection official, Interview with ODCNP, Dec. 2022.

⁵⁵ Fedchenko and Anthony (note 2), pp. 34–35.

⁵⁶ Georgian nuclear security officials (note 43).

⁵⁷ Moldovan nuclear security officials (note 43).



a video describing recommended action in case of a radiological or nuclear emergency.⁵⁸

Georgian authorities have noted an elevated level of concern among the public about the risks of accidents at nuclear power plants in the region. They have engaged a number of authoritative independent experts and public figures to discuss the risks, potential consequences and mitigation strategies in case of a radiological incident.⁵⁹ In October 2022 Georgia adopted an integrated nuclear security support plan (INSSP) for 2022–26, developed with the IAEA with support from the United States.⁶⁰ An INSSP is a tool with which a state can conduct a systematic review of its national nuclear security regime with advice from IAEA officials and external experts; identify priority areas for improvement; and plan specific steps to achieve it. INSSPs also describe any international assistance required for the state to strengthen its nuclear security regime.⁶¹ Georgian officials explained that one aim of the preparation of the new INSSP was to address the new nuclear security threats that emerged in 2022.⁶²

V. CONCLUSIONS

Nuclear security threats in the Black Sea region went through momentous changes between the 1990s and 2023. The Black Sea region is a location of multiple contested spaces, and they have traditionally been seen as the world's main source of nuclear security threats and challenges. Up to 2014 the region was known as the location for the most high-profile cases of nuclear smuggling, and it received a lot of international attention in terms of assistance to combat nuclear and other radioactive materials outside regulatory control and to address the problem of orphan radioactive sources. In 2014 Ukraine lost control of parts of its territory and borders, which, in terms of nuclear security, exacerbated the same set of threats and challenges. While other nuclear security threats, such as potential attacks on nuclear installations, were discussed, they did not receive the same level of attention. Full-scale attacks by state armed forces on nuclear installations, including in particular nuclear power plants, seemed unthinkable. The Ukrainian nuclear security regime does not seem to have been prepared for such an eventuality.

In 2022 the Russian military did attack Ukrainian nuclear facilities, and the Ukrainian nuclear security regime began to adapt to this new reality. The Ukrainian government launched the process of reviewing its DBT, which is likely to have a transformative effect on large parts of the national nuclear security regime. It will shift attention from dealing with materials outside

⁵⁸ Moldovan Ministry of Internal Affairs (MIA), 'MAI informează despre ghidurile acțiunilor în situații de urgență' [The MIA informs about the guidelines for action in emergency situations], 28 Sep. 2022.

⁵⁹ Georgian nuclear security officials (note 43); and SIPRI Virtual Workshop on Nuclear Security (note 3).

⁶⁰ Georgian nuclear security officials (note 43). The previous version of the plan is discussed in Georgian Ministry of Environmental Protection and Agriculture, [Integrated nuclear security support plan 2015–19], 2015 (in Georgian).

⁶¹ IAEA, 'Integrated Nuclear Security Support Plan (INSSP)', [n.d.].

⁶² Georgian nuclear security officials (note 43).



regulatory control to protecting nuclear installations in extraordinary circumstances.

The Ukrainian experience has demonstrated that a nuclear security regime should develop practical guidance at the operational level (‘emergency protocols’) describing the actions and responsibilities of a facility operator under extraordinary circumstances, including armed conflict. Development of such emergency protocols can be assisted by an IAEA guidance document but will inevitably be a responsibility of each state. The emergency protocols will have to be written not only with the aim of achieving nuclear safety, nuclear security and radiation protection goals, but also with the aim of achieving those goals in compliance with international humanitarian law.

Before 2022 other states of the Black Sea region did not see events in Ukraine as a major driver of their nuclear security policies. This changed in 2022 in two ways. First, in terms of trafficking of nuclear and other radioactive materials, Black Sea states now see Ukrainian territories affected by conflict as being a potential source of nuclear security risks on a par with local contested spaces. Second, nuclear security events in Ukraine have increased the impetus for emergency preparedness in the rest of the Black Sea region. Potential large nuclear security events with significant releases of radioactivity and radiological consequences for the region are now seen as very likely risks.

So far the response by Black Sea states beyond Ukraine has mostly focused on protection of the population against releases of radiation, with a few initial changes in national nuclear security regimes. In addition to this, the states in the region, as well as international nuclear security donor states and organizations providing assistance to them, need to reassess the risks of nuclear and other radioactive material falling out of regulatory control due to changes in trade routes caused by war and sanctions, intensification of the Nagorno-Karabakh conflict, and devastation of Ukrainian territories. The mechanisms of nuclear security assistance to the Black Sea states have developed well since the 1990s. They should be further adjusted to the new threat environment.



ABBREVIATIONS

DBT	Design basis threat
DNR	Donetskaya Narodnaya Respublika (Donetsk People's Republic)
IAEA	International Atomic Energy Agency
INSSP	Integrated nuclear security support plan
LNR	Luganskaya Narodnaya Respublika (Luhansk People's Republic)
MORC	Material out of regulatory control
NPP	Nuclear power plant
SNRIU	State Nuclear Regulatory Inspectorate of Ukraine
TITR	Trans-Caspian International Transport Route



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**STOCKHOLM INTERNATIONAL
PEACE RESEARCH INSTITUTE**

Signalistgatan 9

SE-169 72 Solna, Sweden

Telephone: +46 8 655 97 00

Email: sipri@sipri.org

Internet: www.sipri.org

SIPRI RESEARCH POLICY PAPER

NUCLEAR SECURITY IN UKRAINE AND THE BLACK SEA REGION: NEW THREATS, NEW RISKS, NEW CONSEQUENCES

VITALY FEDCHENKO, IRYNA MAKSYMENKO, POLINA SINOVETS
AND WILFRED WAN

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ABOUT THE AUTHORS

Vitaly Fedchenko (Russia) is a senior researcher with SIPRI's Weapons of Mass Destruction Programme, where he is responsible for nuclear security issues and the political, technological and educational dimensions of nuclear arms control and non-proliferation.

Dr Iryna Maksymenko (Ukraine) is a senior researcher with the Odesa Center for Nonproliferation (ODCNP), Odesa I.I. Mechnikov National University, where she is responsible for Ukrainian and European security issues and the educational dimension of ODCNP's activity.

Dr Polina Sinovets (Ukraine) is founder and head of ODCNP. In this role, she leads the education, training, research and outreach activities of ODCNP. She is the author or co-author of multiple publications on the nuclear weapon policy of the United States and Russia, nuclear deterrence, strategic stability, and European security.

Dr Wilfred Wan (United States) is director of SIPRI's Weapons of Mass Destruction Programme. His recent research has focused on nuclear weapon risk reduction, nuclear disarmament verification, and other issues related to arms control and disarmament.