

ARMED CONFLICT AND NUCLEAR SECURITY: IMPLICATIONS FOR EUROPE

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I. INTRODUCTION

Nuclear security is among the European Union's (EU) priority issues.¹ As a result, the EU aims to maintain a high level of nuclear security and works towards strengthening international standards in this area.² The EU itself does not have a nuclear security mandate because the responsibility for nuclear security rests entirely with EU member states.³ Nevertheless, member states understand that any failure of nuclear security measures may have implications beyond national borders. These include, but are not limited to, radiation leaks that could be carried downwind beyond borders, causing harm to humans and the environment. Such leaks could result, for example, in the radioactive contamination of soil and underground water systems that could endanger ecosystems, agriculture and food security, increase short- and long-term risks of disease and death, and cause mass displacement of populations. For these reasons, states need to cooperate and look beyond their borders. However, although the International Atomic Energy Agency (IAEA), the main United Nations (UN) organization for promoting the peaceful use of nuclear technology, offers assistance

¹ For example, European Commission Decision on the Conclusion of a Memorandum of Understanding for a Partnership between the European Atomic Energy Community and the International Atomic Energy Agency on Nuclear Safety Cooperation, C(2013) 5641 final, 5 Sep. 2013, p. 2.

² European Commission, 'EU efforts to strengthen nuclear security', Joint Staff Working Document, SWD(2014) 107 final, 13 Mar. 2014; European Commission, 'EU efforts to strengthen nuclear security', Joint Staff Working Document, SWD(2016) 98 final, 16 Mar. 2016; and European External Action Service, Delegation of the European Union to the United Nations in New York, 'EU statement: 10th Review Conference on the Treaty on the Non-Proliferation of Nuclear Weapons: General statement', 1 Aug. 2022.

³ International Atomic Energy Agency (IAEA), *Objective and Essential Elements of a State's Nuclear Security Regime*, IAEA Nuclear Security Series no. 20 (IAEA: Vienna, 2013).

SUMMARY

The traditional approach to nuclear security is unlikely to be effective against the full spectrum of current threats, including those posed by state actors. The lessons learned from the Russian occupation of Ukrainian nuclear power plants, the potential radiological consequences of armed attacks against nuclear facilities and the potential increase in the number of nuclear power states in the future underscore the need for a strong international framework to address nuclear security challenges.

The European Union (EU) is committed to implementing the highest international standards for nuclear security and may therefore be in a position to lead efforts to address threats of armed attacks against nuclear installations. This paper provides a range of potential policy recommendations and actionable steps that the EU and its member states could take at legal, institutional and operational levels to minimize the nuclear security threats posed by armed conflict in the future. While they may appear politically challenging or even unrealistic at present, the conflict in Ukraine highlights the very real need for the types of actions recommended by this paper.

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and guidelines about nuclear security, there is no international authority to enforce the implementation of nuclear security measures or to impose penalties on those not complying with them. The EU is one of the few organizations within the international framework that has taken a leading role in setting nuclear security standards for its member states.⁴

The EU and nuclear security

The EU has made nuclear security one of the priorities of the European Atomic Energy Community's (Euratom) work programmes.⁵ In addition, many tools reinforce the EU's commitment to nuclear security, including the EU Common Foreign Security Policy (consolidated by the Lisbon Treaty in 2009), the 2003 European Security Strategy, the 2003 EU Strategy against Proliferation of Weapons of Mass Destruction (WMD), the 2005 EU Counter-Terrorism Strategy and the 2008 New Lines for Action in Combating the Proliferation of WMD and their Delivery Systems.⁶ The EU also assists in international efforts to enhance nuclear security through high-level cooperation with the IAEA, supporting the Group of Seven-led (G7) Global Partnership Against the Spread of Weapons and Materials of Mass Destruction and the Global Initiative to Combat Nuclear Terrorism (GICNT), and promoting the implementation of UN Security Council Resolution 1540 on the non-proliferation of WMD.⁷

Furthermore, the EU invests in nuclear security through the Instrument for International Nuclear Safety Cooperation (INSC), which is described as an external policy instrument of the EU to facilitate the implementation of international conventions and agreements related to nuclear safety and the adoption of high nuclear security standards.⁸ With increased investment in nuclear security during 2014–20 and a renewed budget for 2021–27, the INSC has been contributing to the development of third countries' (i.e. non-EU states) overall nuclear policies and regulatory frameworks related to many aspects of radioactive waste management, spent fuel, nuclear material

and radioactive sources, with implications for the improvement of nuclear security.⁹

In addition to its INSC projects, the EU has cooperated with third countries on nuclear security through the Instrument for Stability (IFS) and the Instrument for Pre-accession for EU candidate states (IPA) and through its collaboration with the IAEA, including the financing of IAEA efforts.¹⁰ As a result, the EU has successfully contributed to the reduction of nuclear security-related risks by supporting regulatory authorities in third countries, including those under its European Neighbourhood Policy (ENP), such as Armenia, Belarus, Egypt, Jordan and Morocco.¹¹

EU nuclear power capabilities

With 104 operational reactors and a net electrical nuclear capacity of 101.96 gigawatts electric (GW(e)), the EU member states combined have the largest share (25 per cent) of operational reactors worldwide. The number of nuclear facilities—and their importance to energy production—is even higher when the reactors under construction and in EU candidate states are included (see appendix A).¹² Furthermore, together EU member states have the capability to cover the entire nuclear fuel cycle and they manufacture an important percentage of the world's nuclear fuel, as well as reprocessing spent fuel from around the world and making medical isotopes used worldwide. In other words, the civilian nuclear capabilities within the EU include uranium enrichment facilities, mixed-oxide (MOX) fuel fabrication facilities, research reactors, nuclear power plants (NPPs), and spent fuel storage and reprocessing facilities.¹³ In addition, the

⁹ European Commission, 'Annex: European Instrument for International Nuclear Safety Cooperation: Multi-Annual Indicative Programme, 2021–2027', 2021.

¹⁰ European Commission Decision, C(2013) 5641 final (note 1).

¹¹ European Commission (note 8).

¹² Although Albania, North Macedonia, Moldova, Montenegro, Serbia, Türkiye and Ukraine are candidate states, only Ukraine has operational nuclear power plants. Türkiye's first nuclear power plant is still under construction. Türkiye and Ukraine are candidate states as of Dec. 1999 and June 2022, respectively. European Commission, 'Candidate countries and potential candidates', accessed 6 Jan. 2023; and IAEA, 'World statistics: In operation and suspended operation reactors', Power Reactor Information System, accessed 6 Jan. 2023.

¹³ The nuclear fuel cycle refers to the various activities associated with the production of electricity from nuclear reactors. The nuclear fuel cycle comprises the 'front end', i.e. preparation of the fuel, the 'service period' in which fuel is used during reactor operation to generate electricity, and the 'back end', i.e. the safe management of spent

⁴ European Commission, SWD(2016) 98 final (note 2); and Anthony, I., 'The role of the European Union in strengthening nuclear security', EU Non-proliferation and Disarmament Consortium, Non-proliferation Paper no. 32, Nov. 2013.

⁵ European Commission, SWD(2016) 98 final (note 2), p. 4.

⁶ European Commission, SWD(2016) 98 final (note 2), p. 4.

⁷ European Commission, SWD(2016) 98 final (note 2), pp. 4–5.

⁸ European Commission, 'Instrument for Nuclear Safety Cooperation (INSC)', Programme statement, 24 June 2020.

top 10 states in the world where nuclear energy makes up the largest proportion of the state's electricity production are all either EU member or EU candidate states. France topped the list in 2021 with 69 per cent of its electricity production coming from nuclear energy. The average nuclear share of electricity generation in 2021 for EU member and candidate states was 35.7 per cent.¹⁴

Against this backdrop, this paper considers the concept of nuclear security and how it has evolved, and examines the changing nature of nuclear security threats and their implications (section II). While the traditional nuclear security approach targets non-state actors, the scope of this paper is limited to beyond design basis threat (DBT) situations involving full-scale attacks by military forces. In this regard, the paper details existing international mechanisms to protect nuclear facilities and associated activities during armed conflict (section III). It then addresses policy gaps that have led to implementation challenges (section IV). It also provides policy recommendations and actionable steps that highlight the importance of nuclear security and dealing with threats, including new threats stemming from state actors (section V). The paper concludes by outlining how the EU, the ultimate body setting standards for its member states to follow, could contribute to these policy recommendations and actionable steps (section VI).

II. NUCLEAR SECURITY

The IAEA defines 'nuclear security' as 'the prevention of, detection of, and response to criminal or intentional unauthorized acts involving or directed at nuclear material, other radioactive material, associated facilities, or associated activities'.¹⁵ Nuclear security focuses on protecting nuclear materials and facilities from unauthorized and malicious actions that could lead to unacceptable radiological consequences. In contrast, nuclear safety focuses on proper operating

nuclear fuel including reprocessing and recycling, and disposal. For further detail see IAEA, *The Nuclear Fuel Cycle* (IAEA: Vienna, 2019); and Fowler, M. and Carrigan, A., 'Nuclear security in European Union member states', EU Non-proliferation and Disarmament Consortium, Non-proliferation Paper no. 44, Apr. 2015, p. 3.

¹⁴ Here, 'EU member and candidate states' refers to states with operational nuclear power plants. For further detail see IAEA, 'World statistics: Nuclear share of electricity generation in 2021', Power Reactor Information System, accessed 30 Nov. 2022. See also appendix A in this paper.

¹⁵ IAEA (note 3).

conditions and the prevention of nuclear accidents in order to protect both humans and the environment from possible radiation hazards.¹⁶

However, the concepts of nuclear security and nuclear safety are not necessarily translated or expressed in the same way across languages, countries or cultures, sometimes leading to inconsistency, miscommunication and misunderstanding.¹⁷ For instance, *sikkerhet* is used for both 'security' and 'safety' in Norwegian, and there are similar examples in German, Russian and Swedish. In addition, Turkish nuclear-related authorities use the word *güvenlik* to mean 'safety', but other government authorities and the public generally use it to mean 'security'. The different uses of the same word cause confusion in Türkiye's reporting and policy debate.¹⁸ This may have negative effects on the coordination of nuclear security efforts as there is a difference between reporting a 'safety' and 'security' incident, as well as a difference between a 'safety risk' and a 'security threat'. Further, it should be noted that the protective measures and responses for issues of safety and security may also differ.¹⁹

The security of nuclear materials has been a source of concern since the development of nuclear technology but the concept has evolved over time. Initially, the focus was on acts of state-sponsored espionage.²⁰ However, the focus later widened to cover a variety of threat actors capable of unauthorized and malicious actions. These include criminal organizations, terrorist groups and other non-state actors.²¹ This traditional approach to the security of nuclear materials focused on improving physical protection, in defence against external adversaries, in short, the 'guns, guards and gates' approach.²²

¹⁶ Alkis, M. A., 'Threat of nuclear terrorism: The developing nuclear security regime', *International Journal of Nuclear Security*, vol. 7, no. 1 (2022), pp. 1–16.

¹⁷ Homan, Z., Shaban, Y. and Rane, S., 'The language of nuclear security: Language diversity in open-source internet searches', *International Journal of Intelligence and CounterIntelligence* (2022), pp. 1–22.

¹⁸ Homan, Z. and Udum, S., 'The influence of language on nuclear security education and training: An exploratory study', *60th International Nuclear Materials Management Annual Meeting* (Kings College London: London, 2019).

¹⁹ Homan, Shaban and Rane (note 17); and Homan and Udum (note 18).

²⁰ Dewey, K., Foster, G. and Hobbs, C., *Nuclear Security Culture in Practice: A Handbook of UK Case Studies* (King's College London: London, 2021).

²¹ Alkis, M. A., 'Nuclear security and nuclear security culture: An overview', *Journal of Nuclear Sciences*, vol. 8, no. 1 (2022), p. 17.

²² Dewey, Foster and Hobbs (note 20).

The nuclear security regime

Nuclear security emerged as the physical protection of nuclear facilities and materials from unauthorized acts in the 1970s. The IAEA published *Recommendations for the Physical Protection of Nuclear Material* in 1972, which became a guidance document in the following years.²³ The IAEA updated this document as INFCIRC/225 in 1975 and revised it five times—in 1977, 1989, 1993, 1997 and finally in 2011.²⁴ In addition, the Convention on the Physical Protection of Nuclear Material (CPPNM) was opened for signature in 1980 and entered into force in 1987, resulting in a legally binding framework for international cooperation on the physical protection and control of nuclear materials during international transport.²⁵ In the 1990s an escalation in terror attacks and the growing threat that terrorist organizations had the intention of acquiring nuclear materials led to discussions on the issue at the UN, which paved the way in 1996 for the opening negotiations for the 2005 International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT).²⁶

While there had long been concerns about the extent to which terrorists would go to inflict mass casualties, the attacks in the 1990s (i.e. the World Trade Center bombing and the US embassy bombings in East Africa) led to a renewed focus on the intentions and capabilities of groups such as al-Qaeda, which reportedly had shown interest both in WMD and in chemical, biological, radiological and nuclear (CBRN) material.²⁷ Al-Qaeda was reported to be trying to obtain nuclear material on the black market and to have

a military committee that was planning operations involving CBRN materials.²⁸

Despite not being nuclear or radiological in nature, the terrorist attacks on the USA of 11 September 2001 (often referred to as 9/11) reinforced the analysis that future attacks may involve nuclear or radiological materials if non-state actors had access to them.²⁹ These potential threats connected to a large number of nuclear facilities globally led to a restrengthening of security measures, known as the international nuclear security regime.³⁰

The regime consists of legally binding instruments such as conventions, resolutions and treaties. These include UN Security Council resolutions 1373 and 1540; the CPPNM and its 2005 amendment; ICSANT; and the Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation (SUA Convention) and its 2005 protocol.³¹ The regime is also made up of organizations or initiatives, such as the GICNT, the Nuclear Security Summit (NSS) and the Proliferation Security Initiative (PSI).³² In addition, the efforts of non-governmental organizations (NGOs) and civil society have strengthened the regime and been crucial to developing, implementing and sustaining norms and nuclear security culture.³³ Key NGOs include the EU Non-Proliferation and Disarmament Consortium (EUNPDC), the International Nuclear Security Forum (INSF) and the World Institute for Nuclear Security (WINS).³⁴ NGOs and civil

²³ IAEA, *The Physical Protection of Nuclear Material*, INFCIRC/225 (IAEA: Vienna, 1972).

²⁴ IAEA, *Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)*, IAEA Nuclear Security Series no. 13 (IAEA: Vienna, 2011).

²⁵ Convention on the Physical Protection of Nuclear Material (CPPNM), opened for signature 3 Mar. 1980, entered into force 8 Feb. 1987.

²⁶ International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT), opened for signature 14 Sep. 2005, entered into force 7 July 2007.

²⁷ For further detail on these terrorist attacks see US Department of State, 'Significant terrorist incidents 1961–2003: A brief chronology', accessed 7 Jan. 2023. For further detail on terrorist groups' reported interest in WMD and in CBRN material in the 1990s and early 2000s, see National Commission on Terrorist Attacks (NCTA) upon the United States, *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States* (NCTA: Washington, DC, 2004).

²⁸ NCTA upon the United States (note 27); and United States Senate, Committee on Foreign Relations, 'Dirty bombs and basement nukes: The terrorist nuclear threat', Hearing 107–575, 6 Mar. 2002.

²⁹ Bunn, M., 'Twenty years after 9/11, terrorists could still go nuclear', *Bulletin of the Atomic Scientists*, 16 Sep. 2021.

³⁰ For a detailed analysis of the history of nuclear security see Gill, A. S., 'A history of the idea of nuclear security: 1945–2006', ed. A. S. Gill, *Nuclear Security Summits: A History* (Springer International Publishing: Cham, 2020).

³¹ UN Security Council Resolution 1373 (2001), 28 Sep. 2001; UN Security Council Resolution 1540 (2004), 28 Apr. 2004; Amendment to the 1980 Convention on the Physical Protection of Nuclear Material (CPPNM), adopted 8 July 2005, entered into force 8 May 2016; ICSANT (note 26); Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, opened for signature 10 Mar. 1988, entered into force 1 Mar. 1992; and Protocol of 2005 to the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, adopted 14 Oct. 2005.

³² Proliferation Security Initiative, 'The Proliferation Security Initiative', accessed 7 Jan. 2023; Global Initiative to Combat Nuclear Terrorism (GICNT), 'Overview', 7 Jan. 2023; and Nuclear Security Summit, 'History', accessed 7 Jan. 2023.

³³ Alkis (note 16).

³⁴ EU Non-Proliferation Consortium (EUNPDC), 'About us', accessed 7 Jan. 2023; Stimson Center, 'International Nuclear Security Forum',

society more generally help to reinforce nuclear security by offering creative and interdisciplinary approaches. They support nuclear security efforts by holding policymakers to account and by educating, and promoting dialogue among, stakeholders (i.e. policymakers, operators and regulators, as well as civil society itself).³⁵ They highlight the dangers of nuclear terrorism, provide ideas and research, encourage governments to act, and track progress.³⁶

The regime and its elements are crucial for the international nuclear security framework, even though the responsibility for nuclear security rests entirely with the state. The regime helps states to reinforce national nuclear security and provides guidance on implementing the minimum standards to protect people and the environment from the harmful effects of ionizing radiation.³⁷ The EU supports the regime by incorporating international best practices, establishing global norms for nuclear security, complying with international legal commitments and voluntarily participating in several global initiatives. In addition, the EU imposes regulations on all member states that must be complied with (i.e. common dual-use export control regulations, lists and implementation policies), also focusing on the export of items that are not specifically on export control lists but could potentially be used in WMD programmes.³⁸ The EU has also worked to strengthen regional CBRN security. Building on the 2010–15 CBRN action plan, the EU enhanced its action plan for CBRN security in 2017 to provide a more robust framework for reducing the threat of CBRN attacks, reinforcing security measures and preparing effective responses in case of attack.³⁹

These efforts partly explain why EU member states generally fare quite well in third-party assessments of their nuclear security legislation and implementation of their legal commitments in this area. Such

assessments include, for example, the Nuclear Threat Initiative's (NTI) Nuclear Security Index 2020, which evaluates states' commitments to nuclear security.⁴⁰ In addition, all EU member states are members of the Nuclear Suppliers Group (NSG) and have complied with the reporting requirements of UN Security Council Resolution 1540.⁴¹ EU member states have also reported on their completed threat assessments, as well as on the creation and updating of their DBT documents.⁴² These documents describe 'the attributes and characteristics of potential internal and/or external adversaries that might attempt unauthorized removal of nuclear material or sabotage, against which a physical protection system is designed and evaluated'.⁴³

EU member states' comprehensive domestic policies and legislation are also in keeping with international commitments. Belgium, for example, published its National Declaration on Nuclear Safety, Nuclear Security and Radiation Protection in 2020, while Czechia has issued legislation that addresses airborne and cyber threats to nuclear facilities.⁴⁴ Denmark has revised its nuclear emergency preparedness plan and Finland and Hungary have updated their national DBT documents to include cyber threats.⁴⁵ In addition, Lithuania has updated its national legislation and guidelines on radioactive material security.⁴⁶

EU member states have established organizations authorized to manage and oversee the state's nuclear security arrangements. These include, among others, the Belgian Federal Agency for Nuclear Control (FANC), the Finnish Radiation and Nuclear Safety Authority (STUK), the French Institute for Radiological Protection and Nuclear Safety (IRSN), the Hungarian Atomic Energy Authority (OAH) and

accessed 7 Jan. 2023; and World Institute for Nuclear Security (WINS), 'About us', accessed 7 Jan. 2023.

³⁵ Earnhardt, R., 'The role of civil society in strengthening nuclear security', Commentary, Stimson Center, 29 June 2021.

³⁶ Bunn, M., 'The past and potential role of civil society in nuclear security', Project on Managing the Atom, Harvard Kennedy School, 2020.

³⁷ Alkis, M. A., 'Nuclear security during armed conflict', Policy Memo, Stimson Center, 19 Oct. 2022.

³⁸ European Commission, SWD(2016) 98 final (note 2), p. 18.

³⁹ European Commission, 'Action plan to enhance preparedness against chemical, biological, radiological and nuclear security risks', Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2017) 610 final, 18 Oct. 2017.

⁴⁰ Nuclear Threat Initiative (NTI), 'The NTI Nuclear Security Index: Results', accessed 7 Jan. 2023.

⁴¹ Fowler and Carrigan (note 13), pp. 8–10.

⁴² For example, US State Department, 'NSS National Progress Report: Belgium', 2012; US State Department, 'NSS National Progress Report: Germany', 2014; US State Department, 'NSS National Progress Report: Finland', 2012; and US State Department, 'NSS National Progress Report: The Netherlands', 2012.

⁴³ IAEA (note 24), p. 51.

⁴⁴ Belgian Federal Agency for Nuclear Control (FANC), *Second Report in the Frame of Art. 9 of the European Directive* (FANC: Brussels, July 2020); and Czech Atomic Act no. 263/2016 of 14 July 2016.

⁴⁵ Nuclear Security Summit, 'Highlights of national progress reports', 5 Apr. 2016.

⁴⁶ Lithuanian, Law on the Amendment to the Law on Radiation Protection no. XIII-1283, 21 June 2018.

the Slovakian Nuclear Regulatory Authority (UJD).⁴⁷ Additionally, EU member states have proven willing to invest in robust nuclear security measures in place both within individual states (i.e. centres of excellence working on nuclear security measures) and EU-wide (i.e. the European Commission's Joint Research Centre, which has technical expertise in fields such as forensic analysis of nuclear materials applicable to nuclear security).⁴⁸

The changing nature of threats

The changing nature of the threats against nuclear materials and associated facilities and activities has resulted in a growing recognition among stakeholders that the traditional approach to nuclear security is unlikely to be effective against the full spectrum of current threats.⁴⁹ Specifically, Russia's occupation of Ukrainian NPPs during its ongoing invasion of Ukraine has brought a new dimension to the issue, leading to discussions regarding beyond DBT situations. As the IAEA's director general, Rafael Mariano Grossi, stated, this is because, for the first time in history, a war is taking place in a nuclear power state with advanced nuclear infrastructure and operational facilities.⁵⁰ Even though there have been military attacks on nuclear facilities previously, they involved comparatively smaller facilities, and in some cases, such as Iran, Iraq and Syria, they were not operational. What sets the Ukrainian case apart from these is an ongoing conflict in and around nuclear facilities, involving tanks, heavy weaponry and constant shelling of nuclear facilities and auxiliary systems such as external power lines. In addition, the Chernobyl and Zaporizhzhia NPPs have been occupied by Russian troops, operating personnel have been detained, and the Zaporizhzhia NPP has even been declared a Russian federal asset under a

Russian presidential decree.⁵¹ The prolonged attacks on Ukrainian nuclear facilities have endangered the physical integrity of facilities; the functionality of safety and security systems; the logistical supply chains; the emergency preparedness and response measures; and the communication with the regulator and the IAEA. Furthermore, the detention of operating personnel means that they are working under duress, which also endangers the safe and secure operation of the NPP.

International humanitarian law (IHL) has provisions applicable to nuclear security during armed conflicts and acting against these provisions would be considered a violation of IHL. Nevertheless, these measures clearly need further international attention as the consequences of armed attacks on nuclear facilities may go beyond conventional warfare and the parties involved in the conflict. Even though there are international instruments that govern and are pertinent to the protection of nuclear facilities and associated activities during an armed conflict—such as Article 56 of Additional Protocol I to the 1949 Geneva Conventions and a 2009 IAEA decision prohibiting armed attacks or the threat of attacks against nuclear installations—they have implementation challenges due to the ambiguity, inadequacy and weakness of legal provisions, as well as the lack of enforcement mechanisms.⁵² These challenges have been witnessed during the Russian occupation of Ukrainian NPPs, which continues despite international laws and rules. The nuclear security crisis in Ukraine and the potential increase in the number of nuclear power states in the near term—including some that are located in regions prone to armed conflict, civil war, hostilities or insurrection (e.g. Ethiopia, Iraq, Nigeria, Sudan and Syria)—underscore the need for a robust international framework to address nuclear security challenges, including those posed by state actors.⁵³

⁴⁷ Belgian Federal Agency for Nuclear Control (FANC), *Together We Protect* (FANC: Brussels, 2019); Finnish Radiation and Nuclear Safety Authority (STUK), 'Nuclear security arrangements', accessed 9 Jan. 2023; French Institute for Radiological Protection and Nuclear Safety (IRSN), 'Security and non-proliferation', accessed 9 Jan. 2023; Hungarian Atomic Energy Authority, 'Supervision of security of nuclear facilities, nuclear and other radioactive materials', accessed 9 Jan. 2023; and Slovakian Nuclear Regulatory Authority, 'Physical protection of nuclear installations and nuclear materials', 11 Aug. 2022.

⁴⁸ Anthony (note 4), p. 3.

⁴⁹ Dewey, Foster and Hobbs (note 20).

⁵⁰ IAEA, 'IAEA Director General's introductory statement to the Board of Governors', 2 Mar. 2022.

⁵¹ [Decree of the President of Russia no. 711 of 5 Oct. 2022 on the Peculiarities of Legal Regulation in the Field of the Use of Nuclear Energy in the Zaporozhye Region] (in Russian).

⁵² IAEA, General Conference, Prohibition of Armed Attack or Threat of Attack Against Nuclear Installations, During Operation or Under Construction, Decision GC(53)/DEC/13, 18 Sep. 2009.

⁵³ Rosatom, 'Russia and Ethiopia sign an intergovernmental agreement on cooperation in the peaceful use of atomic energy', 23 Oct. 2019; Al-Ansary, K. and Di Paola, A., Bloomberg, 'Iraq plans nuclear power plants to tackle electricity shortage', Al Jazeera, 8 June 2021; 'Russia to build nuclear power plants in Nigeria', BBC News, 31 Oct. 2017; Rosatom, 'Rosatom and the Ministry of Water Resources, Irrigation and Electric Power of the Republic of Sudan signed a number of documents for the cooperation development in the field of the peaceful use of

III. NUCLEAR SECURITY DURING AN ARMED CONFLICT

The traditional international nuclear security regime, which is built on the assumption of non-state actors as the perpetrator, focuses on efforts to minimize the threat posed by non-state actors and deny them access to nuclear facilities and materials. EU efforts have followed a similar path, focusing on non-state actors and reinforcing existing mechanisms to minimize the threat posed by them. This is seen implicitly in the 2003 European Security Strategy and explicitly in the 2005 EU Counter-Terrorism Strategy, which prioritized minimizing terrorists' access to CBRN materials due to the increasing concerns about a possible CBRN terrorist attack.⁵⁴ In 2009 the EU examined how its security strategy had been implemented in practice and what could be done to reinforce implementation. As a result, all EU member states agreed to tighten coordination arrangements against terrorism, especially CBRN terrorism, and continue to build on the work to combat the financing of terrorism.⁵⁵

As the definition mentioned above suggests, nuclear security is the protection of nuclear materials, facilities and associated activities from unauthorized and malicious actions. However, while these actions could potentially be caused by either state actors or non-state actors, the same is not reflected in the definition. In other words, the nuclear security framework currently excludes the actions of states. Thus, in the case of armed conflict, it must be explicitly recognized that state actors are also capable of actions (e.g. the Russian occupation of Ukrainian NPPs) that could result in a need to protect nuclear materials, facilities and associated activities, creating what are considered as beyond DBT situations.

However, because the traditional international nuclear security regime targets non-state actors, its scope is limited when it comes to addressing nuclear security threats posed by interstate armed conflicts, for which another strand of international law is applied. Two sets of legal instruments are then needed, working in parallel, in order to ensure the safe and secure operation of nuclear facilities.

nuclear energy of the Republic of Sudan', 16 May 2018; and IAEA, 'Syrian Arab Republic', Country Nuclear Power Profiles, 2018.

⁵⁴ European Council, 'A secure Europe in a better world: European Security Strategy', 12 Dec. 2003; and Council of the European Union, 'The European Union Counter-Terrorism Strategy', 14469/4/05 REV4, 30 Nov. 2005.

⁵⁵ European Council, *European Security Strategy: A Secure Europe in a Better World* (European Council: Brussels, 2009).

International laws and rules

Several international documents already regulate unauthorized and malicious actions by a state actor with regard to nuclear facilities. One of them is the 1977 Additional Protocol I to the 1949 Geneva Conventions, which prohibits armed attacks on nuclear facilities and places legally binding obligations on all parties to any armed conflict even if they are not parties to the protocol.⁵⁶ All EU members are parties to the 1949 Geneva Conventions, and all have ratified Additional Protocol I, with Austria, Cyprus, Denmark, Finland and Sweden among the first states to ratify it.⁵⁷

Paragraph 1 of Article 56 of Additional Protocol I, which prohibits attacking nuclear facilities and associated activities due to the possible release of radiation, states that:

Works or installations containing dangerous forces, namely dams, dykes, and nuclear electrical generating stations, shall not be made the object of attack, even where these objects are military objectives, if such attack may cause the release of dangerous forces and consequent severe losses among the civilian population.⁵⁸

Paragraph 4 also prohibits reprisals against the mentioned facilities, while Paragraph 5 urges states not to locate any military objectives in the related vicinity. In addition, Paragraph 6 calls on the parties to the protocol and the parties to the conflict to conclude agreements among themselves to provide additional protection for objects containing dangerous forces. Paragraph 7 notes that parties to the conflict may mark works or installations containing dangerous forces with a special marking, but states that the absence of such a mark does not relieve obligations arising under the protocol.⁵⁹

Additionally, Rule 42 of the 2005 International Committee of the Red Cross (ICRC) study on customary IHL establishes the following norm applicable during armed conflicts:

Particular care must be taken if works and installations containing dangerous forces,

⁵⁶ Protocol Additional to the Geneva Conventions of 12 Aug. 1949, and Relating to the Protection of Victims of International Armed Conflicts (Protocol I), 8 June 1977.

⁵⁷ International Committee of the Red Cross, 'Treaties and states parties', International Humanitarian Law Databases, accessed 24 Nov. 2022.

⁵⁸ Additional Protocol I (note 56), Article 56.

⁵⁹ Additional Protocol I (note 56), Article 56.

namely dams, dykes and nuclear electrical generating stations, and other installations located at or in their vicinity are attacked, to avoid the release of dangerous forces and consequent severe losses among the civilian population.⁶⁰

Other rules of IHL state that targets should be proportionate, necessary and distinct from civilian property and infrastructure and not cause unnecessary suffering.⁶¹ Article 48 of Additional Protocol I to the 1949 Geneva Conventions states that:

to ensure respect for and protection of the civilian population and civilian objects, the Parties to the conflict shall at all times distinguish between the civilian population and combatants and between civilian objects and military objectives and accordingly shall direct their operations only against military objectives.⁶²

In addition, Article 35 of Additional Protocol I prohibits the use of methods that might cause superfluous injury or unnecessary suffering, and any attacks that might cause widespread, long-term and severe environmental damage.⁶³ A formal interpretation of the various rules makes it clear that attacking nuclear facilities and associated activities, which are civilian, is against IHL due to the possible release of radiation. In a joint statement on the safety and security of civil nuclear facilities in armed conflicts issued in September 2022, which made reference to the situation in Ukraine, the EU and several states reiterated the need to respect IHL and the importance of the international framework for protecting nuclear facilities used for peaceful purposes, including during armed conflicts.⁶⁴

IAEA resolutions and decisions

Several IAEA General Conference (GC) resolutions and decisions focus on the protection of nuclear

⁶⁰ Henckaerts, J. and Doswald-Beck, L., *International Committee of the Red Cross, Customary International Humanitarian Law, Volume I: Rules* (Cambridge University Press: Cambridge, 2009), Rule 42.

⁶¹ Henckaerts and Doswald-Beck (note 60), Rule 14; and Additional Protocol I (note 56), articles 51(5)(b), 52, 48, 35.

⁶² Additional Protocol I (note 56), Article 48.

⁶³ Additional Protocol I (note 56), Article 35.

⁶⁴ European External Action Service, 'Nuclear safety: Joint statement on the safety and security of civil nuclear facilities in armed conflicts', 21 Sep. 2022.

installations devoted to peaceful purposes against armed attacks and the prohibition of armed attacks or threats of attack against nuclear installations. The first of these is Resolution GC(XXVII)/RES/407 (1983), which was adopted in response to a military attack on an Iraqi nuclear research centre by Israel in 1981. It refers to consensus among IAEA member states that 'any armed attacks against peaceful nuclear installations should not only be discouraged but also explicitly prohibited'.⁶⁵ It urges all member states to make 'every possible effort to adopt legally binding international rules prohibiting armed attacks against any nuclear installation devoted to peaceful purposes'.⁶⁶

The GC adopted Resolution GC(XXIX)/RES/444 (1985) after Israel stated at the GC in 1985 that it would not attack or threaten to attack any nuclear facilities and would support efforts for a binding agreement protecting nuclear facilities from attack and threat of attack.⁶⁷ The resolution emphasizes that 'any armed attack on and threat against nuclear facilities devoted to peaceful purposes constitutes a violation of the principles of the UN Charter, international law, and the Statute of the IAEA'.⁶⁸ In addition, it declares that, in the event of any armed attack on a nuclear installation, the IAEA will examine the matter based on its statute and the relevant resolutions.⁶⁹

Resolution GC(XXXI)/RES/475 (1987) was adopted in line with international developments at the time, including the entry into force of the CPPNM in 1987 and ongoing negotiations in the Conference on Disarmament (CD). In this regard, the resolution authorizes the IAEA director general to assist the

⁶⁵ IAEA, *Protection of Nuclear Installations Devoted to Peaceful Purposes against Armed Attacks*, General Conference Resolution GC(XXVII)/RES/407, 14 Oct. 1983. See also IAEA, 'Consequences of the Israeli Military Attack on the Iraqi Nuclear Research Reactor and the Standing Threat to Repeat this Attack for: (a) the Development of Nuclear Energy for Peaceful Purposes; and (b) the Role and Activities of the International Atomic Energy Agency', Explanatory memorandum submitted by Iraq, GC(XXVII)/692, 2 Sep. 1983.

⁶⁶ IAEA General Conference Resolution GC(XXVII)/RES/407 (note 65).

⁶⁷ IAEA, *Consequences of the Israeli Military Attack on the Iraqi Nuclear Research Reactor and the Standing Threat to Repeat this Attack for: (a) the Development of Nuclear Energy for Peaceful Purposes; and (b) the Role and Activities of the International Atomic Energy Agency*, General Conference Resolution GC(XXIX)/RES/443 27, Sep. 1985.

⁶⁸ IAEA, *Protection of Nuclear Installations Devoted to Peaceful Purposes against Armed Attacks*, General Conference Resolution GC(XXVII)/RES/444, 27 Sep. 1985.

⁶⁹ IAEA General Conference Resolution GC(XXVII)/RES/444 (note 68).

efforts of the CD, which was working on concluding an international agreement about the protection of nuclear installations against armed attacks.⁷⁰ It also points out that the GC is aware that ‘an armed attack on a nuclear installation could result in radioactive releases within and beyond the boundaries of the state’.⁷¹

The GC adopted Resolution GC(XXXIV)/RES/533 (1990) in light of the Final Document of the 1990 Review Conference of the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which acknowledged the importance of the protection of nuclear facilities against armed attacks.⁷² The resolution recognizes that:

attacks or threats of attack on nuclear facilities devoted to peaceful purposes could jeopardize the development of nuclear energy and an armed attack or a threat of armed attack on a safeguarded nuclear facility, in operation or under construction, would create a situation in which the UN Security Council would have to act immediately per the provisions of the UN Charter.⁷³

Noting the possibility of radioactive release due to armed attack, the resolution also encourages all member states to be ready ‘to provide, if requested, immediate peaceful assistance per international law to any state whose nuclear facilities have been attacked’.⁷⁴

Following the Israeli attack on a Syrian nuclear facility in 2007, the GC included an agenda item, brought by Iran and Egypt, on the prohibition of armed

attacks and adopted Decision GC(53)/DEC/13 (2009) by consensus.⁷⁵ The decision emphasizes the need to prohibit armed attacks or threats of attack against nuclear installations, which constitute a violation of the principles of the UN Charter, international law and the IAEA Statute. It also restated the need to involve the IAEA in early notification and assistance in cases of radioactive release from nuclear installations.⁷⁶

In the September 2022 joint statement on the safety and security of civil nuclear facilities in armed conflicts, the EU reiterated its continuous support to the IAEA and made reference to the GC’s resolutions and decision in this area.⁷⁷

Seven pillars of nuclear safety and security

In his speech at the IAEA Board of Governors meeting in March 2022, IAEA Director General Grossi stated that threats to the safety and security of nuclear facilities and materials, such as armed conflicts, violate the global nuclear safety and security framework laid out in the seven pillars of nuclear safety and security.⁷⁸ He reiterated that the IAEA needs accurate, complete and timely data from all nuclear facilities on the safety and security of the operation, and this flow of data from facilities to the IAEA should not be interrupted, impeded or influenced.⁷⁹ The seven pillars are as follows:

1. The physical integrity of the facilities—whether it is the reactors, fuel ponds or radioactive waste stores—must be maintained.
2. All safety and security systems and equipment must be fully functional at all times.
3. The operating staff must be able to fulfil their safety and security duties and have the capacity to make decisions free of undue pressure.

⁷⁰ IAEA, Measures to Strengthen International Co-operation in Nuclear Safety and Radiological Protection, General Conference Resolution GC(XXVII)/RES/475, 25 Sep. 1987. See also IAEA, Measures to Strengthen International Co-operation in Nuclear Safety and Radiological Protection: Protection of Nuclear Installations against Armed Attacks, General Conference Draft Resolution GC(XXXI)/830, 25 Sep. 1987; and IAEA, Measures to Strengthen International Co-operation in Nuclear Safety and Radiological Protection: Convention on the Physical Protection of Nuclear Material, General Conference Draft Resolution GC(XXXI)/832, 25 Sep. 1987.

⁷¹ IAEA General Conference Resolution GC(XXVII)/RES/475 (note 70).

⁷² Fourth Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, Final Document: Part II, NPT CONF IV/45/II, Geneva, 1991.

⁷³ IAEA, Measures to Strengthen International Co-operation in Nuclear Safety and Radiological Protection: Prohibition of All Armed Attacks against Nuclear Installations Devoted to Peaceful Purposes whether under Construction or in Operation, General Conference Resolution GC(XXXIV)/RES/533, 21 Sep. 1990.

⁷⁴ IAEA General Conference Resolution GC(XXXIV)/RES/533 (note 73).

⁷⁵ IAEA, 53rd General Conference, ‘Provisional agenda: Supplementary item for inclusion in the Provisional Agenda’, GC(53)/1/Add.2 14 Aug. 2009; and IAEA, 53rd General Conference, Communication received from the Resident Representative of Egypt, on behalf of the Vienna Chapter of the Non-Aligned Movement, regarding the inclusion in the agenda of the Conference of an item entitled ‘Prohibition of armed attack or threat of attack against nuclear installations, during operations or under construction’, GC(53)/20, 31 Aug. 2009.

⁷⁶ IAEA, Prohibition of armed attack or Threat of Attack against Nuclear installations, during Operation or under Construction, General Conference Decision GC(53)/DEC/13, 18 Sep. 2009.

⁷⁷ European External Action Service (note 64).

⁷⁸ IAEA (note 50); and IAEA, ‘IAEA Director General’s introductory statement to the Board of Governors’, 7 Mar. 2022.

⁷⁹ IAEA, 7 Mar. 2022 (note 78).

4. There must be a secure off-site power supply from the grid for all nuclear sites.

5. There must be uninterrupted logistical supply chains and transportation to and from the sites.

6. There must be effective on-site and off-site radiation monitoring systems and emergency preparedness and response measures.

7. There must be reliable communications with the regulator and others.⁸⁰

The seven pillars emphasize the essential nuclear safety and security-related issues that are of particular significance during the unprecedented circumstances in Ukraine, in which military forces are near or on the site of nuclear facilities. They derive from the IAEA's safety standards and nuclear security guidance, reflecting a high level of safety and security to protect people and the environment against the harmful effects of ionizing radiation. Moreover, since March 2022, the seven pillars have received widespread support from IAEA member states, including the EU member states.

IV. SHORTCOMINGS OF THE EXISTING NUCLEAR SECURITY FRAMEWORK

The above-mentioned international instruments, which target beyond DBT situations, represent a critical framework aimed at protecting the status of nuclear facilities during an armed conflict. While there is an international nuclear security framework that has traditionally targeted non-state actors, these instruments address risks posed by state actions against nuclear facilities. As a result, two sets of legal obligations need to be applicable at the same time. Nevertheless, these international instruments do not adequately address the risks posed by state actors due to the ambiguity, inadequacy and weakness of legal provisions and the lack of enforcement mechanisms, as witnessed during the Russian occupation of Ukrainian NPPs. Thus, because armed attacks against nuclear facilities may result in consequences beyond national borders, such as radiation leaks, they should be recognized as real and global threats.

With this in mind, nuclear energy is expected to play a key role in cost-effective, low-carbon and reliable energy to achieve goals for net zero greenhouse gas emissions globally by 2050.⁸¹ The potential of nuclear

energy in this area may lead to an increase in the number of nuclear power states in the near term, including states located in regions prone to instability and inter- or intrastate hostilities. Ethiopia, for example, signed an intergovernmental agreement with Russia on cooperation in the peaceful use of atomic energy in 2019, despite the fact that Ethiopia is one of the most fragile states in the world—with around 20 000 armed conflict-related deaths in the past five years—according to third-party assessments.⁸² There are similar assessments for Iraq, Nigeria, Sudan and Syria, all of which have nuclear power plans.⁸³

The nuclear security crisis in Ukraine, the potential radiological consequences of armed attacks against nuclear facilities and the potential increase in the number of nuclear facilities in the future all point to the need for a more robust global nuclear security framework to address the impact of armed conflict. This will mean reinforcing existing international instruments to deal with their various shortcomings in light of the current and future nuclear security threats posed by armed conflict.

Shortcomings at the legal level

Additional Protocol I to the 1949 Geneva Conventions has several shortcomings. While Article 56 places legally binding obligations on all parties to an armed conflict, its scope is limited to nuclear electrical generating stations.⁸⁴ Thus, it creates a policy gap, leaving research reactors, transportation of nuclear materials, conversion and enrichment facilities, spent fuel pools and other associated activities outside the protocol's scope. The IAEA has referred to this policy gap by stating that the protocol prohibits attacks on nuclear electricity generating stations but other nuclear

9 Mar. 2022 amending Delegated Regulation (EU) 2021/2139 as regards economic activities in certain energy sectors and Delegated Regulation (EU) 2021/2178 as regards specific public disclosures for those economic activities, *Official Journal of the European Union*, L188, 15 July 2022.

⁸² Rosatom (note 53); Uppsala Conflict Data Program, 'Ethiopia', accessed 3 Feb. 2023; United Nations, Office for the Coordination of Humanitarian Affairs, 'Ethiopia: Data on conflict events', Humanitarian Data Exchange (HDX), accessed 3 Feb. 2023; Global Economy, 'Fragile state index: Country rankings', accessed 3 Feb. 2023; and Global Economy, 'Security threats index: Country rankings', accessed 3 Feb. 2023.

⁸³ Uppsala Conflict Data Program (note 82); UN Office for the Coordination of Humanitarian Affairs (note 82); and Global Economy, 'Security threats index: Country rankings' (note 82).

⁸⁴ Additional Protocol I (note 56), Article 56.

⁸⁰ IAEA, 7 Mar. 2022 (note 78).

⁸¹ IAEA, *Nuclear Energy for a Net Zero World* (IAEA: Vienna, 2021); and European Commission Delegated Regulation (EU) 2022/1214 of

installations devoted to peaceful uses are not covered by it.⁸⁵

Further, Additional Protocol I provides an exception to the protection of nuclear facilities during an armed conflict. Paragraph 2 of Article 56 affirms that ‘the special protection against attack on nuclear facilities ceases only if it provides electric power in regular, significant, and direct support of military operations and if such attack is the only feasible way to terminate such support’.⁸⁶ Thus, it leaves the article open to interpretation, as there is no clear guidance on how to evaluate whether an NPP provides significant and direct support for military operations. The lack of clarity could result in a party to the conflict using this exception as a legal basis for not fulfilling its obligations under the protocol.

Rule 42 of the 2005 ICRC study on customary IHL also has shortcomings. It refers to risks to the civilian population related to the results of an armed conflict around nuclear electrical generating stations and urges that combatants take particular care if such stations are attacked.⁸⁷ Thus, it does not directly prohibit armed attacks against nuclear electrical generating stations; instead, it requires particular care to be taken not to cause the release of dangerous forces and severe losses among the civilian population.

Shortcomings at the institutional level

The activities of the IAEA related to nuclear security threats posed by armed conflict have some shortcomings. It is important to note first of all that the IAEA GC does not itself have the authority to adopt international legally binding rules, as this authority is a privilege of the UN Security Council, which adopts legally binding resolutions under Chapter VII of the UN Charter. For this reason, IAEA Resolution GC(XXXIV)/RES/533 (1990) explicitly states that ‘the IAEA GC calls upon all states to abide by any decisions the Security Council takes per the UN Charter concerning the attacking state’.⁸⁸ In addition, despite the IAEA’s support for efforts at the CD meetings on a draft multilateral treaty prohibiting attacks on nuclear facilities, the CD has failed to achieve an international

treaty with this scope due to long-standing differences among states.

The Netherlands, for example, has previously stated that the emphasis of such a treaty should be on the prevention of mass destruction under any circumstances.⁸⁹ Meanwhile, some states—including Iran, Iraq, Jordan, Libya, Sweden and Yemen—have argued that armed attacks of any kind against nuclear facilities are tantamount to the use of radiological weapons, while others such as the USA and Venezuela have rejected this argument.⁹⁰ Some states, such as France and Peru, have argued that a treaty prohibiting attacks on nuclear facilities is outside the ambit of the CD.⁹¹ As a result of these differences, no progress has been made on the scope of an eventual agreement, and no final decision has been adopted as the CD adopts its decisions by consensus.⁹²

The IAEA continues to highlight the importance of concluding an international agreement and this call has been echoed by the EU, which has reiterated the need for a new legally binding international agreement focusing on the prohibition of armed attacks against any nuclear installation used for peaceful purposes.⁹³ The EU’s general support for such a treaty could create momentum among states to overcome their differences before taking the appropriate steps at the UN General Assembly.

In addition, the IAEA’s seven pillars of nuclear safety and security appear to be purely complementary to the safe and secure operation of NPPs and do not place legally binding obligations on member states. They are derived from existing IAEA nuclear safety standards and security guidance and would need further international recognition to have any real effect, despite them having member states’ support. In other words, it seems that the seven pillars merely represent perceived good practice in an environment where the IAEA has limited authority.

⁸⁵ IAEA General Conference Resolution GC(XXVII)/RES/407 (note 65).

⁸⁶ Additional Protocol I (note 56), Article 56.

⁸⁷ Henckaerts and Doswald-Beck (note 60), Rule 42.

⁸⁸ IAEA General Conference Resolution GC(XXXIV)/RES/533 (note 73).

⁸⁹ United Nations, Office for Disarmament Affairs (UNODA), *The United Nations Disarmament Yearbook* (United Nations: New York, 1992), p. 316.

⁹⁰ United Nations, Office for Disarmament Affairs (UNODA), *The United Nations Disarmament Yearbook* (United Nations: New York, 1990), pp. 286–87.

⁹¹ UNODA (note 89), p. 316; and UNODA (note 90), p. 291.

⁹² Conference on Disarmament, Rules of Procedure of the Conference on Disarmament, 22 Jan. 1992.

⁹³ IAEA General Conference Resolution GC(XXXIV)/RES/533 (note 73); and European External Action Service, ‘EU statement at IAEA Board of Governors on agenda item 9 on nuclear safety, security and safeguards in Ukraine’, 15 Sep. 2022.

Shortcomings at the operational level

As discussed above, beyond DBT situations require the application of two sets of international laws, rules and norms simultaneously, as the international nuclear security regime has traditionally targeted non-state actors while another set of international laws addresses threats posed by armed attacks against nuclear facilities. Nevertheless, there are still shortcomings at the legal and institutional levels, which pose challenges to the protection of nuclear facilities and materials, resulting in shortcomings at the operational level, too.

The lack of operational measures in the nuclear security regime could be due to the nature of previous attacks against nuclear facilities, which did not require interim measures. These attacks involved comparatively smaller facilities, some of which were not operational, such as in the cases of Iran, Iraq and Syria. In these attacks, there were no ongoing conflicts in and around nuclear facilities, and there was no constant shelling of nuclear facilities and auxiliary systems. Nor were NPPs occupied and operating personnel detained. As a result, the attacks did not prompt an urgent need to intervene. However, the Ukrainian case is unprecedented in this regard as, for the first time in history, a war is taking place in a nuclear power state with advanced nuclear infrastructure and operational facilities. As a result, the nuclear security crisis in Ukraine has highlighted the importance of having interim measures in place at the operational level in order to manage wartime threats during ongoing attacks and occupation, due to the high risk of radiation leaks.

In this context, these shortcomings show a clear need for mechanisms of international assurance to prevent and protect against armed hostilities occurring at or in the vicinity of nuclear facilities. This need is reinforced by the lessons learned from the Russian invasion of Ukraine, along with the potential radiological consequences of armed attacks against nuclear facilities and the potential rapid expansion of nuclear energy (including novel modular reactors) to new states in the future. Such mechanisms could be implemented at legal, institutional or operational levels. Indeed, based on the lessons learned in Ukraine, the EU has already stated that it is ready to cooperate with the IAEA and the international community to respond to potential future events and to work towards mitigating new threats.⁹⁴

⁹⁴ European External Action Service (note 64).

V. THE WAY FORWARD AND THE EU'S ROLE

Even though there are political gaps and implementation challenges due to legal, institutional and operational shortcomings in the current nuclear security framework involving beyond DBT situations, the existence of some international instruments shows an awareness and intention to protect nuclear facilities from the possible consequences of armed conflict. The above-mentioned shortcomings should be addressed by considering the lessons learned from the current nuclear security crisis in Ukraine and the potential consequences of future armed attacks against nuclear facilities, such as radioactive contamination of soil and underground water systems, short- and long-term risks of disease and death, and mass displacement of populations. In this regard, several practical solutions could be helpful to address these shortcomings and the EU could lay the groundwork for the required political will, as it is committed to maintaining a high level of nuclear security and applying the highest international standards.⁹⁵ In addition, the possibility that nuclear facilities in the EU could be forced to close down due to an armed conflict may impact the EU not only in terms of energy security but also in terms of climate-related policies.⁹⁶ This paper therefore presents a number of key recommendations for action that could be taken by the EU and EU member states at legal, institutional and operational levels.

Recommendations at the legal level

As discussed above, there are legal gaps and conceptual ambiguities, as well as a lack of political commitment, in the current nuclear security framework. A key legal recommendation to address these shortcomings is to reinvestigate discussions at the CD and conclude an international agreement that would cover the prohibition of armed attacks against nuclear facilities and associated activities devoted to peaceful use, including not only NPPs and research reactors but also conversion and enrichment facilities, advanced as well as small modular reactors, and the transportation and waste management of nuclear materials and other

⁹⁵ European Commission Decision, C(2013) 5641 final (note 1); European Commission, SWD(2014) 107 final (note 2); European Commission, SWD(2016) 98 final (note 2); and European External Action Service (note 2).

⁹⁶ The EU's energy security and climate policies are not considered within the scope of this paper. European Commission Delegated Regulation (EU) 2022/1214 (note 81).

radioactive sources. As noted, the IAEA continues to highlight the importance of such an agreement—a view that is shared by the EU. The agreement would be a direct and formal method of creating international rules to prohibit attacks and regulate protection during an armed conflict. It would place legally binding obligations on states and should not leave any provisions open to misinterpretation. Indeed, an international agreement of this scope could prevent future aggression and deny the justification of the use of force against nuclear facilities. Introducing new rules and norms for protecting nuclear facilities may not necessarily result in direct enforcement but it would prevent the legitimization of acts of aggression against such facilities and the exploitation of current policy gaps by states.⁹⁷

However, the negotiations for an international agreement of this scope would require painstaking diplomacy on the part of the EU. The EU could hold initial talks with EU member, candidate and potential candidate states, as well as states included in the ENP and like-minded and strategic partners in Asia, Africa and the Americas. This could create momentum, under the leadership of the EU, among states that are already cooperating on nuclear security before taking the appropriate steps in the UN General Assembly.

In case of failure to achieve an international agreement, the EU could facilitate negotiations for a regional agreement, which could cover the European region, including EU member, candidate and potential candidate states, as well as ENP states. Such an agreement could include provisions not to take, assist or encourage any armed action targeting nuclear facilities within the border of states parties to the agreement, as in the case of Article 11 of the 1996 African Nuclear Weapon Free Zone Treaty (Treaty of Pelindaba).⁹⁸ A regional agreement that prohibits any armed attack on nuclear facilities devoted to peaceful use could act as a confidence-building measure and set a precedent for other regions and a global agreement to follow in the future.

A final recommendation at the legal level is related to bilateral agreements. An invasion, occupation or armed attack by a foreign state force is defined as a beyond DBT situation; therefore, the responsibility

for prevention, protection, preparedness and response rests with the state rather than the operator.⁹⁹ In this context, the EU could encourage member states to conclude bilateral agreements with non-member states not to undertake, encourage or participate in any action aimed at causing the destruction of, or damage to, nuclear facilities, as such facilities are not designed to withstand military bombardment or operations. The bilateral agreement between India and Pakistan dating back to 1988, according to which they exchange lists of their nuclear facilities every year, is a good reference point in this regard.¹⁰⁰ Bilateral agreements could be beneficial as confidence-building measures to strengthen international cooperation for the protection of nuclear installations against armed attacks and to reinforce the political will for global or regional agreements.

Recommendations at the institutional level

The status of existing instruments at the institutional level (i.e. resolutions, decisions and the IAEA's seven pillars) shows that the IAEA has limited authority to manage wartime threats involving nuclear facilities. In this context, a practical recommendation at the institutional level is to legally empower the IAEA to send a mission to nuclear facilities under a new nuclear security and safety protocol concluded between the IAEA and member states. This would help the IAEA to overcome the challenges of gaining the consent of states to send a technical mission for nuclear security and nuclear safety. Simply by informing the parties to a conflict of its intention to make an official visit to nuclear facilities, the IAEA mission would then be legally empowered to do so, under military protection, in order to offer technical assistance without being limited by the sovereign rights of member states.

In addition, the proposed protocol would reinforce the objectives of the seven pillars to maintain the safe and secure operation of nuclear facilities and associated activities. It would also ensure the complete and accurate flow of information from facilities to the IAEA, which is crucial to allow a timely response to any nuclear emergency. Furthermore, the proposed

⁹⁷ Rodriguez, L. and Sukin, L., 'Russian actions at Zaporizhzhia show need for better legal protections of nuclear installations', *Bulletin of the Atomic Scientists*, 28 Oct. 2022.

⁹⁸ African Nuclear Weapon Free Zone Treaty (Treaty of Pelindaba), opened for signature 11 Apr. 1996, entered into force 15 July 2009.

⁹⁹ Finnish Radiation and Nuclear Safety Authority (STUK), *Design Basis Threat for the Use of Nuclear Energy and Use of Radiation*, 1/Y42217/2020 (STUK: Vantaa, 2020).

¹⁰⁰ Agreement on the Prohibition of Attack against Nuclear Installations and Facilities Between the Republic of India and the Islamic Republic of Pakistan, 31 Dec. 1988.

protocol could include an article for compensation for denying the inalienable right to use nuclear technology peacefully in case the parties to a conflict cause interruption or damage to nuclear facilities. The IAEA could calculate the level of compensation by taking into consideration the operating capacity of the reactors in question and the costs of interruption and repair.¹⁰¹ The EU has expressed support for the continued presence of the IAEA at nuclear facilities to achieve the IAEA's nuclear safety, security and safeguard objectives even during an armed conflict.¹⁰²

As an institutional recommendation, a new nuclear security and safety protocol would enable the IAEA to establish a continuous presence at nuclear facilities in an emergency. The EU has already shown its support for a similar mission in Ukraine: the IAEA Support and Assistance Mission to Zaporizhzhya (ISAMZ). ISAMZ was the result of long negotiations, facilitated by France (an EU member state), to provide the IAEA with access to the Zaporizhzhya NPP to assess the physical damage caused by shelling and determine whether safety and security systems are operational.¹⁰³ The EU could use the success of this mission as a baseline for the promotion of a nuclear security and safety protocol, which would ensure similar technical access for the IAEA to nuclear facilities during future emergencies. As such a protocol needs to be signed by the IAEA and states individually, the EU could promote signature of the protocol among EU member states as part of its commitment to implementing the highest international standards for nuclear security. Such an institutional recommendation would also help overcome the shortcomings at the legal level (i.e. implementation and enforcement of legal provisions) of the current international mechanisms regarding nuclear security during an emergency.

Although these legal and institutional recommendations cannot be taken by the EU alone, the EU could play a leading role in promoting the prohibition of armed attacks on nuclear facilities and associated activities to help to align the political

willingness of other states. As nuclear security is one of the EU's priorities, it could facilitate the efforts being made to devise a solution.¹⁰⁴ However, recommendations at the legal and institutional levels come with the challenges and difficulties that would be associated with achieving positive outcomes. The differing political interests of states make the signing of legally binding obligations and empowering the IAEA very difficult. Overcoming differences between states concerning armed attacks against nuclear facilities will probably be the hardest challenge. In this context, it is important to note that both legal and institutional recommendations are not likely to achieve the intended outcomes any time soon due to political differences. Thus, recommendations at the operational level may be practical as interim measures until legal and institutional steps are taken.

Recommendations at the operational level

As mentioned earlier, previous attacks against nuclear facilities did not require interim measures as they did not involve ongoing conflict in and around the nuclear facilities or occupation of these facilities. Instead, these attacks triggered discussions, focusing on legal and institutional measures to prevent future attacks. However, there are shortcomings at the legal and institutional levels and addressing these shortcomings is likely to take time and face resistance due to political differences. Thus, operational recommendations could fill in the gap as interim measures during a nuclear security emergency that can take place without addressing legal authority.

In this context, the first recommendation at the operational level relevant to future conflicts and even to the current crisis in Ukraine is to establish a nuclear safety and security protection zone around nuclear facilities, which is something that IAEA Director General Grossi has already suggested.¹⁰⁵ Such a zone would mitigate the risks associated with an armed conflict, while offering an interim solution that ensures the physical integrity of a facility is not compromised due to military engagements. A nuclear safety and security protection zone would also reinforce the seven pillars' objectives until a political solution is found to end a conflict and re-establish stable conditions for a facility's safe and secure operation. The EU has already

¹⁰¹ This would be applicable only to interstate conflicts and not to intrastate conflicts. It should be noted that the operating capacity of a reactor should be calculated based on the average capacity factor, which was 82.5% in 2019, as most power plants do not operate at full capacity every hour of every day of the year. Data is taken from World Nuclear Association, 'Global average capacity factor', accessed 3 Feb. 2023.

¹⁰² European External Action Service (note 64).

¹⁰³ Liou, J., 'French President Macron reiterates support for IAEA mission to Ukraine's Zaporizhzhya nuclear power plant', IAEA, 26 Aug. 2022.

¹⁰⁴ European Commission Decision, C(2013) 5641 final (note 1), p. 2.

¹⁰⁵ United Nations, Security Council, 'Threats to international peace and security', S/PV.9124, 6 Sep. 2022.

welcomed and expressed support for the creation of such a zone to protect nuclear facilities.¹⁰⁶

The modalities of this operational recommendation could be negotiated at the IAEA Board of Governors for future emergencies. As the EU supports the idea of a protection zone, member states in the current Board of Governors can reaffirm the EU's commitment to making it a practical solution. The election of Ambassador Ivo Sramek, an IAEA governor from Czechia, as chair of the IAEA's Board of Governors for 2022–23 could prove helpful in this regard; the IAEA director general prepares the provisional agenda for meetings in consultation with the chair.¹⁰⁷ Sramek's appointment, along with the personal commitment of Director General Grossi, could therefore facilitate negotiations for a protection zone for the EU.¹⁰⁸

A second operational recommendation for addressing the challenges arising from armed conflict involving nuclear facilities is a limited EU-led Common Security and Defence Policy (CSDP) mission. Through the CSDP, the EU has had a leading role in conflict prevention and peacekeeping operations and has worked to strengthen international security since 2003. With 37 completed missions and operations, the CSDP has promoted peace and security by providing stability in fragile and conflict-affected situations in Europe's neighbourhood.¹⁰⁹ A CSDP mission could, for example, protect nuclear facilities during an armed conflict to prevent the release of radioactive substances that may have grave consequences within and beyond the boundaries of the state under attack. As CSDP missions are tailored to the different needs on the ground, a CSDP mission at or in the vicinity of a nuclear facility could help to mitigate the risks associated with an armed conflict. By taking a comprehensive approach to stabilizing the fragile environment around a nuclear facility caused by armed conflict in a partner country, such a mission could also contribute to European security.

Furthermore, the decision-making process regarding the deployment and management of CSDP missions is more streamlined than the process for UN peacekeeping missions, since EU member states can

make such decisions at the Foreign Affairs Council. This overcomes several obstacles to negotiations around the deployment of UN peacekeeping missions, which can only be deployed in two ways. One is with the consent of the state where the intervention will take place, within the scope of its sovereignty, as an intervention by invitation.¹¹⁰ The other, in the case of an ongoing conflict, is to receive the consent of all parties to the conflict. In addition, in all cases, UN peacekeeping missions are deployed based on mandates from the UN Security Council in which five permanent member states have a veto right. As CSDP missions are outside this process, they can bypass the political challenges stemming from these veto rights.

It is important to note here that recommendations at the operational level do not offer solutions to prevent attacks against nuclear facilities. Instead, these recommendations target managing wartime threats during a nuclear security emergency. Thus, they should be seen as complementary to recommendations at the legal and institutional levels, which primarily target preventing and then managing wartime threats against nuclear facilities. Nevertheless, as interim measures, operational recommendations could serve as practical solutions during beyond DBT situations when legal and institutional recommendations may require more time and effort to be put into place.

VI. CONCLUSION

As a cost-effective, low-carbon and reliable energy source, nuclear energy will play a key role in achieving net zero goals for the EU and the world.¹¹¹ This will likely lead to the expansion of nuclear facilities to new states, possibly in regions prone to armed conflict, civil war, hostilities or insurrection. As a result, there will be a greater need to protect nuclear facilities and associated activities, including preventing where possible and otherwise managing wartime threats. Because such threats to nuclear facilities may lead to nuclear incidents with radiological consequences beyond national borders, they must be recognized as real and global challenges. In due time, there will be a review of lessons learned from the current nuclear

¹⁰⁶ European External Action Service (note 93).

¹⁰⁷ IAEA, *Provisional Rules of Procedure of the Board of Governors*, GOV/INF/500/Rev.1 (IAEA: Vienna, 1989).

¹⁰⁸ Liou, J., 'IAEA Board of Governors elects 2022–2023 chairperson from Czech Republic', IAEA, 3 Oct. 2022.

¹⁰⁹ European External Action Service, 'EU missions and operations', Mar. 2022.

¹¹⁰ Visser, L., 'Intervention by invitation and collective self-defence: Two sides of the same coin?', *Journal on the Use of Force and International Law*, vol 7, no. 2 (July 2020), pp. 292–316.

¹¹¹ European Commission Delegated Regulation (EU) 2022/1214 (note 81); and IAEA (note 81).

security crisis in Ukraine that may help to prepare for and respond to similar events in the future.

Although the practical solutions to these challenges are actually global needs, they would particularly benefit the security of the EU, as many EU member states have advanced nuclear capabilities and infrastructure. Thus, this paper has argued that the EU could take a leading role at legal, institutional and operational levels to minimize future nuclear security threats from armed conflict. The policy recommendations given may appear politically challenging or even unrealistic today, but the grave potential radiological consequences of armed attacks against nuclear facilities mean that they must be kept safe and secure, including during military conflict. Further, the conflict in and around Ukrainian NPPs has highlighted the very real need for the types of actions recommended. Introducing new rules and norms for protecting nuclear facilities may not necessarily result in direct enforcement, but it would prevent states from seeking to legitimize acts of aggression against such facilities and exploiting current policy gaps. Ideally, the policy recommendations and actionable steps detailed here would be considered before—rather than in the destabilizing aftermath of—a nuclear or radiological event caused by armed conflict.

Appendix A. Nuclear reactors in European Union member and candidate states

States	Operational		Under construction		Total		Nuclear share (%)
	No.	MW(e)	No.	MW(e)	No.	MW(e)	
Belgium	7	5942			7	5942	50.8
Bulgaria	2	2006			2	2006	34.6
Czechia	6	3934			6	3934	36.6
Finland	5	4394			5	4394	32.8
France	56	61 370	1	1630	57	63 000	69.0
Germany	3	4055			3	4055	11.9
Hungary	4	1916			4	1916	46.8
Netherlands	1	482			1	482	3.1
Romania	2	1300			2	1300	18.5
Slovakia	4	1868	2	880	6	2748	52.3
Slovenia	1	688			1	688	36.9
Spain	7	7123			7	7123	20.8
Sweden	6	6885			6	6885	30.8
Türkiye ^a			4	4456	4	4456	
Ukraine ^a	15	13 107	2	2070	17	15 177	55.0
Total	119	115 070	9	9036	128	124 106	

MW(e) = megawatt electric.

^a Türkiye and Ukraine are EU candidate states as of Dec. 1999 and June 2022, respectively.

Source: International Atomic Energy Agency, 'World statistics', Power Reactor Information System, accessed 30 Nov. 2022.

ABBREVIATIONS

CBRN	Chemical, biological, radiological and nuclear
CSDP	Common Security and Defence Policy
CPPNM	Convention on the Physical Protection of Nuclear Material
DBT	Design Basis Threat
EU	European Union
GC	General Conference
GICNT	Global Initiative to Combat Nuclear Terrorism
IHL	International humanitarian law
INSC	Instrument for International Nuclear Safety Cooperation
IAEA	International Atomic Energy Agency
ICSANT	International Convention for the Suppression of Acts of Nuclear Terrorism
NGO	Non-governmental organization
NPP	Nuclear power plant
UN	United Nations
WMD	Weapon(s) of mass destruction

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A EUROPEAN NETWORK

In July 2010 the Council of the European Union decided to support the creation of a network bringing together foreign policy institutions and research centers from across the EU to encourage political and security-related dialogue and the long-term discussion of measures to combat the proliferation of weapons of mass destruction (WMD) and their delivery systems. The Council of the European Union entrusted the technical implementation of this Decision to the EU Non-Proliferation Consortium. In 2018, in line with the recommendations formulated by the European Parliament the names and the mandate of the network and the Consortium have been adjusted to include the word 'disarmament'.

STRUCTURE

The EU Non-Proliferation and Disarmament Consortium is managed jointly by six institutes: La Fondation pour la recherche stratégique (FRS), the Peace Research Institute Frankfurt (HSFK/PRIF), the International Affairs Institute in Rome (IAI), the International Institute for Strategic Studies (IISS-Europe), the Stockholm International Peace Research Institute (SIPRI) and the Vienna Center for Disarmament and Non-Proliferation (VCDNP). The Consortium, originally comprised of four institutes, began its work in January 2011 and forms the core of a wider network of European non-proliferation and disarmament think tanks and research centers which are closely associated with the activities of the Consortium.

MISSION

The main aim of the network of independent non-proliferation and disarmament think tanks is to encourage discussion of measures to combat the proliferation of weapons of mass destruction and their delivery systems within civil society, particularly among experts, researchers and academics in the EU and third countries. The scope of activities shall also cover issues related to conventional weapons, including small arms and light weapons (SALW).

www.nonproliferation.eu

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