



NUCLEAR SAFETY DURING MILITARY INVASION: THE UKRAINE-RUSSIA CASE STUDY

Policy Brief

presented prior to the African Union Mid-Year Coordination Meeting (AUMYC)

July 2024

Contents

<u>Executive summary</u>	2
<u>Key objectives</u>	4
<u>1. Introduction</u>	5
1.1. <u>Why Russian invasion matters for nuclear safety</u>	5
1.2. <u>Peace Formula and Nuclear Safety</u>	6
<u>2. Nuclear Safety Legislation in the African Union and African States</u>	8
2.1. <u>African Nuclear Governance Framework</u>	9
2.2. <u>Regional institutions for nuclear safety</u>	10
<u>3. Case 1. Disarmament and failed security assurances for Ukraine</u>	12
<u>4. Case 2. Nuclear safety during the Russian invasion of Ukrainian nuclear facilities</u>	15
4.1. <u>Occupation of Chernobyl NPP</u>	15
4.2. <u>Occupation of Zaporizhzhya NPP</u>	20
4.2.1. <u>Risks for personnel</u>	22
4.3. <u>Impact of Russian Occupation on IAEA's Nuclear Safety and Security Pillars</u>	28
4.4. <u>The risk of blackout</u>	30
<u>5. International regulations, mechanisms, and institutional capacity to respond to the military invasion of nuclear facilities</u>	32
<u>6. Leading the change for the safe nuclear industry on the continent</u>	37
<u>7. About the authors</u>	39

Executive Summary

Nuclear energy is one of the decarbonised options for sustainable development of the continent. The development of nuclear technology is tightly linked to nuclear weapons, and risks of proliferation should not be ignored when nuclear safety is considered. The African continent remains a Nuclear weapon-free zone, all African countries must act in solidarity when the nuclear state attacks a member of the Non-Proliferation Treaty (NPT) and is threatened with the use of nuclear weapons.

The Russian invasion of Ukraine has posed unprecedented challenges to nuclear safety, security, and safeguards, as well as the safe development of the peaceful nuclear industry on the continent.

- Firstly, it **demonstrates the lack of mechanisms to uphold security assurances provided by global nuclear powers for a state that denuclearised and joined the Non-Proliferation Treaty, thereby undermining the very concept of non-proliferation.** The invasion of Ukraine is the first instance of a state with nuclear weapons attacking a country that had given up its nuclear arsenal and joined the Non-Proliferation Treaty. Under the 1994 Budapest Memorandum, Ukraine relinquished the world's third-largest nuclear arsenal, receiving security assurances from the US, the UK, and Russia to uphold its territorial integrity and sovereignty. This invasion of a denuclearised country and the rise in nuclear threats by global powers undermine barriers against nuclear escalation and encourage proliferation.
- Secondly, **this is the first instance of an operational nuclear power plant being a direct target of military attack and occupation.** This case demonstrates the lack of legislative measures and political will to prevent similar situations in the future. The Zaporizhzhya nuclear power plant with military equipment placed on its territory, has been exposed to hostilities for an extended period. The plant, ill-equipped to handle the dangers of artillery fire and potential explosions, faces severe risks.

The experience of occupation of ChNPP and ZNPP surpasses nuclear safety and security concerns and addresses issues of global significance. It demonstrated a lack of international legislation that defends nuclear power stations from military attacks by other states. It also shows the complexity of safety issues that are linked to the operation of the NPP during the full-scale war. Besides the risk of physical damage and inability to ensure regular maintenance at ZNPP and ChNPP, the personnel faced torture, psychological pressure, and inability to rotate. Significant risks also come from the potential blackout of the country due to Russia targeting Ukraine's energy infrastructure.

It is evident that developed **Seven indispensable pillars for ensuring nuclear safety and security during an armed conflict were all violated. The later developed five principles of nuclear safety are also regularly compromised.**

The importance of regulating such matters became obvious in the 1990s; however, there has not been enough political will to enact the necessary changes. The construction of the NPP in Egypt, close to another military conflict, requires African countries to act promptly to address concerns

about the protection of nuclear power plants during armed conflict.

IAEA is unable to ensure the safety of the occupied nuclear power station as it depends on the permission of the invading state e.g. Russian authorities and Rosatom to conduct inspections.

There is, therefore, a clear recognition at the international level of the importance of protecting nuclear installations during armed conflict. However, what seems to be lacking is the political will to enact additional mechanisms to ensure this can be done, as well as addressing shortcomings in the application of international law.

The nuclear governance framework implemented on the African continent is quite instructive but requires significant revisions. The African Nuclear Weapon Free-Zone Treaty, or Pelindaba Treaty, is revolutionary in many aspects as it provides for the physical protection of nuclear installations and prohibits armed attacks on these installations.

Nevertheless, even in the case of the Pelindaba Treaty, there are no clear provisions of how this article could be applied to a state that violates its rules and, therefore, no precedent to draw from. Even where customary international law has allegedly been violated, it appears that the enforcement mechanisms are limited, and the best that can be done is to address escalation as it happens.

To be effective, the new legislation has to be binding and should not allow misinterpretation. The parties in violation could always argue that they did not deem their actions to violate international humanitarian law since, in their assessment, it would not have caused the release of dangerous forces.

African continent with established regional platforms such as AFCONE, AFRA, and FNRBA is in a strong position to speak in a united voice on peaceful nuclear technology development and safety that the provisions of physical protection of the NPPs provided in the Pelindaba agreement are integrated into international agreements on nuclear safety.

Similar to the Chernobyl catastrophe in 1986, which accelerated the development of IAEA nuclear safety standards, the Russian war on Ukraine provides an opportunity for African states, in partnership with Ukraine, to develop solutions that would prevent armed attacks on nuclear facilities, which are currently not within its UN-mandated scope.

African countries must show solidarity and support for Ukraine, as the lessons from the Russian invasion underscore the need for a robust legal and regulatory framework to protect nuclear facilities during armed conflicts.

Key objectives

- Provide an understanding of the key challenges that the Russian military occupation of Nuclear Power Stations poses for the safety of the nuclear industry on the African continent.
- Highlight the limitation of the existing international regulation, mechanisms, and institutional capacity to respond to the invasion of a nuclear installation by another state.
- Setting the agenda for dialogue on nuclear safety based on the interest of African countries.
- To provide recommendations that African countries and the AU can initiate at the regional and international level to ensure the safe development of the nuclear industry on the continent.

Abbreviations

AU – African Union

ChNPP - the Chernobyl Nuclear Power Plant

IAEA – International Atomic Energy Agency

NWFZ – Nuclear Weapon Free Zone

SNRIU - State Nuclear Regulatory Inspectorate of Ukraine

ZNPP – the Zaporizhyya Nuclear Power Plant

Figures

Figure 1. The Budapest Memorandum: Security Assurances and Ukraine's

Figure 2. Increased levels of radiation at the Chernobyl Exclusion Zone as of 25 February 2022

Photos

Photo 1: Russian tanks at the ChNPP, screenshot from the video taken by the personnel

Photo 2: Russian soldiers on the territory of the ChNPP. Photo: Konstantyn Kornoza /MIPL

Photo 3. Ukrainian civilians blocking the road to the ZNPP aiming to prevent Russian occupation

Photo 4. Satellite photo of Europe showing the blackout in Ukraine on November 23, 2023

Tables

Table 1. Ukraine Peace Formula proposed by Ukrainian President V. Zelensky

Table 2. A summary of key events at the ChNPP from February 2022 to May 2024

Table 3. A summary of key events related to the ZNPP from February 2022 to May 2024

Table 4. Examples of violations of Seven indispensable pillars for ensuring nuclear safety and security during an armed conflict: the occupation of ChNPP and the exclusion zone, and ZNPP

INTRODUCTION

Nuclear energy is one of the decarbonised options the African Union (AU) is actively exploring to promote sustainable development in Africa.

1.1. Why the Russian invasion matters for nuclear safety

The Russian invasion of Ukraine in 2014 and the subsequent full-scale invasion in 2022 have posed unprecedented challenges to nuclear safety, security, and safeguards, as well as the safe development of the peaceful nuclear industry on the continent. This is due to:

1. The invasion of an NPT member that has undergone full nuclear disarmament by a nuclear-armed state.
2. An increased number of nuclear threats were voiced in a conflict against an NPT state.
3. The first time military occupation of fully operational nuclear facilities. In 2022, Russia occupied the ChNPP during the first day of the full-scale invasion, and one week later - the largest operating nuclear power plant in Europe, the Zaporizhzhya Nuclear Power Plant (ZNPP).

Russia's annexation of Ukrainian territories marks the first instance of a nuclear-armed state attacking a country that relinquished its nuclear arsenal under the Non-Proliferation Treaty (NPT). In 1994, Ukraine gave up the world's third-largest nuclear arsenal in exchange for security assurances from the US, the UK, and Russia, who promised to uphold Ukraine's territorial integrity and sovereignty.¹

But the risks for the nuclear industry are not only due to the repeated perils of the nuclear war,² but more so due to unprecedented military assaults launched by Russia on peaceful nuclear facilities in Ukraine.

Ukraine is home to four operating nuclear power plants and carries the responsibility of maintaining the containment operations and infrastructure of one of the most well-known and catastrophic nuclear disasters in history, Chernobyl NPP (ChNPP).

Before 2022, no large, operational nuclear power plant with a substantial inventory of irradiated nuclear fuel had experienced a military attack. There are several documented cases of attacks on nuclear research reactors and other facilities (often while these were under construction) as well as a nuclear power reactor under construction, by both state and non-state actors between 1980 and 2014³. These attacks did not result in the release of radiation from these facilities.

1 Memorandum on security assurances in connection with Ukraine's accession to the Treaty on the Non-Proliferation of Nuclear Weapons (1994).

2 Vladimir Soldatkin and Andrew Osborn, 'Putin warns West of risk of nuclear war, says Moscow can strike Western targets', Reuters, 29 February, 2024.

3 John Carlson, 'Prohibition of military attacks on nuclear facilities', Vienna Centre for Disarmament and Non-Proliferation, September 2022.

1.2. Peace Formula and Nuclear Safety

Africa has been disproportionately affected by the Russia-Ukraine war because of the higher sensitivity to the interrupted supply of food, fuel, and fertilisers from the two countries. The significance of this impact is proven by the fact that the African peace mission to Ukraine and Russia in June-July 2023 became the first mission from African states that addressed a conflict outside the African continent. The delegation from African countries included leaders from Comoros, Congo-Brazzaville, Egypt, Senegal, South Africa, Uganda, and Zambia.

The mission announced a 10-point plan and indicated a willingness to work together on resolving the conflict. Many points proposed by the African peace mission correspond to the Ukraine Peace Formula points proposed by Ukrainian President Volodymyr Zelensky in November 2022.⁴ Nuclear safety is one of the major global concerns.

Table 1. Ukraine Peace Formula proposed by Ukrainian President V. Zelensky⁵

1. <u>Radiation and nuclear safety</u> , focusing on restoring security around Europe's largest nuclear power plant, Zaporizhzhia in Ukraine, which is now Russian-occupied.
2. <u>Food security</u> , including protecting and ensuring Ukraine's grain exports to the world's poorest nations.
3. <u>Energy security</u> , with a focus on price restrictions on Russian energy resources, as well as aiding Ukraine with restoring its power infrastructure, half of which has been damaged by Russian attacks.
4. <u>Release of all prisoners and deportees</u> , including war prisoners and children deported to Russia.
5. Implementation of the UN Charter and <u>restoration of Ukraine's territorial integrity</u> and the world order
6. Withdrawal of Russian troops and the cessation of hostilities, the <u>restoration of Ukraine's state borders</u> with Russia.
7. <u>Justice</u> , including the establishment of a special tribunal to prosecute Russian war crimes.
8. Immediate <u>protection of the environment</u> and the prevention of ecocide, with a focus on demining and restoring water treatment facilities.
9. Prevention of an escalation of conflict and <u>building security architecture</u> in the Euro-Atlantic space, including guarantees for Ukraine.
10. <u>Confirmation of the war's end</u> , including a document signed by the involved parties.

⁴ Ukraine Peace Formula proposed by V. Zelensky, November 2022

⁵ Ukraine's Peace Formula Philosophy. President Zelenskyy Peace Formula. Nov 2022. https://www.president.gov.ua/storage/j-files-storage/01/19/53/32af8d644e6cae41791548fc82ae2d8e_1691483767.pdf

Russia invaded Ukraine in February 2014 and started the full-scale invasion in February 2022. Despite hundreds of rounds of negotiations, there has been no solution that would silence the guns as yet, but diplomatic efforts continue.

On 15-16 June 2024, during the Global Peace Summit in Switzerland, also known as the Summit for Peace in Ukraine among 101 countries and international organisations, there were numerous representatives from the African continent⁶. The nuclear and energy security was addressed in the Summit Communiqué signed by almost 90 countries.

“Firstly, any use of nuclear energy and nuclear installations must be safe, secured, safeguarded, and environmentally sound. Ukrainian nuclear power plants and installations, including the Zaporizhzhia Nuclear Power Plant, must operate safely and securely under full sovereign control of Ukraine and in line with IAEA principles and under its supervision.

Any threat or use of nuclear weapons in the context of the ongoing war against Ukraine is inadmissible.”⁷

The occupation of Chernobyl and Zaporizhzhya NPP has highlighted anew the threat of military attacks against nuclear installations and is expected to exert a considerable influence on the global nuclear security regime, including for those countries on the African continent actively working on developing facilities for the peaceful use of nuclear energy.

Historically, the interconnectedness between nuclear weapons and nuclear energy has been used as an instrument of influence for the colonial and post-colonial states, creating the notion of power behind those linked to the nuclear industry. The African countries have deliberately chosen to be Nuclear Weapon Free Zone and to develop only peaceful nuclear technology. The Russian invasion of Ukraine, which has many characteristics of colonial war,⁸ might significantly affect the peaceful development of nuclear energy by African countries.

This policy paper analyses the potential impact of the Russian invasion of Ukraine on nuclear governance policies on the African continent and worldwide. It provides recommendations on what should be done to improve the safety of nuclear facilities for all.

⁶ As of 11 July 2024, thirteen African states have signed the Summit Communiqué: Benin, Cabo Verde, Comoros, Côte d'Ivoire, Gambia, Ghana, Kenya, Liberia, Republic of Malawi, Republic of Mauritius, Sao Tomé and Príncipe, Somalia, and Zambia.

⁷ Summit on Peace in Ukraine: Joint Communiqué on a Peace Framework Bürgenstock, Switzerland, 16 June 2024 <https://www.eda.admin.ch/eda/en/fdfa/fdfa/aktuell/dossiers/konferenz-zum-frieden-ukraine/Summit-on-Peace-in-ukraine-joint-communique-on-a-peace-framework.html>

⁸ Summit on Peace in Ukraine: Joint Communiqué on a Peace Framework Bürgenstock, Switzerland, 16 June 2024 <https://www.eda.admin.ch/eda/en/fdfa/fdfa/aktuell/dossiers/konferenz-zum-frieden-ukraine/Summit-on-Peace-in-ukraine-joint-communique-on-a-peace-framework.html>

2. Nuclear Safety Legislation in the African Union and African States

In February 2018, the AU Commission concluded the flagship agreement with the IAEA on “Practical Arrangements for the safe, secure and peaceful use of nuclear technologies for sustainable development in Africa”.⁹ The cooperation between the two bodies has already yielded many tangible results including expanded use and development of the Sterile Insect Technique (SIT) to exterminate tsetse flies, and improved detection and management of COVID-19 through Real-Time Polymerase Chain Reaction (RT-PCR) detection.¹⁰

Apart from the cooperation expressed at the level of the AU, several African states have approached the IAEA for assistance in determining their readiness and capacity to embark on the construction and operation of nuclear power plants. Algeria, Egypt, Ghana, Kenya, Morocco, Niger, Nigeria, Sudan, Tunisia, Uganda and Zambia are all on this list of countries.¹¹

There are only two operational reactors on the continent both at the 1,9 GW Koeberg NPP in South Africa. Many African countries are looking into developing nuclear technology to meet their development needs. Of these, Egypt is the closest to joining the nuclear club, with the construction of its first NPP, Al Dabaa, with 4.8 GW of total capacity expected by 2030.¹² This plant is a flagship nuclear power project for the Russian State Nuclear Energy Corporation “Rosatom” (Rosatom).¹³

Nuclear research reactors are viewed as a first step toward nuclear power¹⁴ and are operating in Algeria, DRC, Egypt, Ghana, Libya, Morocco, Nigeria, and South Africa.¹⁵ Some African countries have been using nuclear research reactors for over five decades.

The construction of the NPP in Egypt, in close proximity to another military conflict, requires African countries to act promptly to address concerns about the protection of nuclear power plants during armed conflict. The nuclear governance framework implemented on the African continent is quite instructive but requires significant revisions.

9 Andre Ghione, ‘IAEA and the African Union Commission Sign First-Ever Practical Arrangements for Sustainable Development in Africa’, *International Atomic Energy Agency*, March 15, 2018,

10 IAEA, ‘IAEA and AU Strengthen Cooperation’.

11 Laura Gil, ‘Is Africa Ready for Nuclear Energy?’, *International Atomic Energy Agency*, September 3, 2018,.

12 Power Technology, ‘El Dabaa Nuclear Power Plant’.

13 Power Technology, ‘El Dabaa Nuclear Power Plant’, July 14, 2023

14 Marguerite Leonardi and Vincent Lukanda Mwamba, ‘Viewpoint: Why research reactors are so important for Africa’, *World Nuclear News*, October 12, 2020

15 Kachur D., Foley R. ‘African Agency: The Case of Russian Nuclear Programme’s in Egypt, Ghana, South Africa, and Zambia’, in Botha S., Van Wyk J-A. *Key Issues in African Diplomacy*, Jun 2024 <https://bristoluniversitypress.co.uk/key-issues-in-african-diplomacy>.

2.1. African Nuclear Governance Framework

The international regulatory framework to which many African states belong includes but is not limited to:

- the Treaty on the Non-Proliferation of Nuclear Weapons (NPT),
- the Treaty on the Prohibition of Nuclear Weapons (TPNW),
- the Convention on the Physical Protection of Nuclear Material and its Amendment,
- the Comprehensive Nuclear Test Ban Treaty (CTBT), and of course
- IAEA safety and safeguards measures.

The continent's homegrown nuclear governance framework is designed to complement international measures and includes:

- the African Nuclear Weapon Free-Zone Treaty (Treaty of Pelindaba),
- the African Commission on Nuclear Energy (AFCON),
- the African Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology (AFRA), and
- the Forum of Nuclear Regulatory Bodies in Africa (FNRBA).

The African continent is one of the few nuclear weapons-free zones (NWFZ) in the world established under the African Nuclear Weapon Free-Zone Treaty, more commonly referred to as the Treaty of Pelindaba¹⁶. The other NWFZ are Latin America (the Treaty of Tlatelolco¹⁷) and the Caribbean (the Treaty of Rarotonga).¹⁸

The Treaty of Pelindaba entered into force in 2009 and placed strict prohibitions on nuclear weapons research and testing as well as the possession, stockpiling, stationing, development, and production of these weapons and nuclear waste dumping. But the crux of the treaty is its promotion of the peaceful uses of nuclear energy, enshrined in Articles 8 and 9.

Article 8 also encourages member states to call on the IAEA for assistance with implementing the peaceful uses of nuclear energy and to “strengthen cooperation under the African Regional Cooperation Agreement for Research, Training, and Development Related to Nuclear Science and Technology”, AFRA.¹⁹ But what makes the Pelindaba Treaty revolutionary in many aspects is its provision for the physical protection of nuclear installations and the prohibitions it places on armed attacks on nuclear installations.²⁰

¹⁶ The African Nuclear Weapon Free-Zone Treaty, April 11, 1996, https://au.int/sites/default/files/treaties/37288-treaty-0018_-_the_african_nuclear-weaponfree_zone_treaty_the_treaty_of_pelindaba_e.pdf.

¹⁷ United Nations, ‘The Treaty of Tlatelolco’, *United Nations Platform for Nuclear-Weapon-Free Zones*

¹⁸ Nuclear Threat Initiative, ‘Treaty of Rarotonga’, <https://www.nti.org/education-center/treaties-and-regimes/south-pacific-nuclear-free-zone-spnfz-treaty-rarotonga/>.

¹⁹ The Treaty of Pelindaba, Article 9: 6.

²⁰ Isabel Bosman, ‘Legal Protection for Zaporizhzhya Nuclear Power Plant: Matters for Nuclear Installations Everywhere’, SAIIA Policy Briefing No 281, October 2023, https://saiia.org.za/wp-content/uploads/2023/11/SAIIA_PB-281_LegalProtectionZNPP.pdf.

Article 10 of the treaty calls on member states to “maintain the highest standards of security and effective physical protection of nuclear materials, facilities, and equipment to prevent unauthorised theft or unauthorised use and handling”.²¹ It then extends this protection provision in Article 11, *Prohibition of Armed Attack on Nuclear Installations*. Under Article 11²²

Each Party undertakes not to take, assist, or encourage any action aimed at an armed attack by conventional or other means against nuclear installations in the African Nuclear-Weapon-Free-Zone.

Article 11 makes the Treaty of Pelindaba the only current multilateral agreement to extend the physical protection of nuclear installations this far.²³

2.2. Regional institutions for nuclear safety

To ensure compliance with its provisions, *the African Commission on Nuclear Energy* (AFCONE) was established as the implementing body of the Pelindaba Treaty. AFCONE is headquartered in South Africa and is “uniquely mandated...to serve as the Secretariat of the Treaty, and to engender industrial and socio-economic development in Africa through the coordination and promotion of safe and secure peaceful applications of nuclear science and technology, as well as regional and inter-regional cooperation for that purpose”.²⁴

The African Regional Cooperation Agreement for Research, Training and Development Related to Nuclear Science and Technology (AFRA) is another integral part of the peaceful uses of nuclear energy in Africa.²⁵ AFRA entered into force in April 1990 and is defined as “an intergovernmental Agreement established by the African Member States to further strengthen and enlarge the contribution of nuclear science and technology to socio-economic development on the African continent”.²⁶

AFRA allows regional cooperation between the countries²⁷ and as of May 2024 united 45 members for peaceful applications of nuclear energy.²⁸ In 2020 AFCONE and AFRA joined forces and signed a Memorandum of Understanding that would allow for the strengthening of the African continent’s voice on nuclear energy issues.²⁹

²¹ The Treaty of Pelindaba, Article 10: 7

²² The Treaty of Pelindaba, Article 11: 7.

²³ Bosman, I., ‘Legal Protection for Zaporizhzhya Nuclear Power Plant’.

²⁴ African Commission on Nuclear Energy (AFCONE), ‘Who we are’, 2023, <https://www.afcone.org/who-we-are/>.

²⁵ IAEA, Regional/Cooperative Agreements, African Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology (AFRA).

²⁶ AFRA, ‘Who we are’, <https://www.afra-web.org/who-we-are>.

²⁷ Jo-Ansie van Wyk, Yarik Turianskyi and Isabel Bosman, ‘African Continental Nuclear Institutions: A Review’, SAIIA Policy Insights No 119, October 2021, <https://saiia.org.za/wp-content/uploads/2021/11/Policy-Insights-119-van-wyk-turianskyi-bosman.pdf>.

²⁸ AFRA <https://www.afra-web.org/>

²⁹ AFCONE, ‘Opening Remarks: AFCONE-AFRA MoU Signing Ceremony’, September 7, 2020, <https://www.afcone.org/wp-content/uploads/2020/09/AFCONE-ES-Opening-Remarks-Signing-Ceremony-MoU-with-AFRA-Monday-07-Sept-2020.pdf>

Another African initiative is the Forum of Nuclear Regulatory Bodies in Africa (FNRBA), established in 2009 as part of the IAEA's Global Nuclear Safety and Security Network.³⁰ At the core of the FNRBA is the regulatory infrastructure dedicated to nuclear safety and security, especially across the following thematic areas: "legislative and regulatory Infrastructure, radiation and waste safety, nuclear safety infrastructure, emergency preparedness and response, transport safety infrastructure, and nuclear security infrastructure".³¹

The value of nuclear energy for achieving the development objectives of African states, in particular the AU's Agenda 2063, has been reiterated across all these initiatives and at the level of the AU. This legal and regulatory commitment to nuclear safety and security, the peaceful uses of nuclear energy, and the physical protection of nuclear installations, including from armed attack, is exemplary and strengthens the African continent's reputation as a nuclear non-proliferation and disarmament champion.

Established regional platforms such as AFCONE, AFRA, and FNRBA should be used as a strong united voice of the continent to ensure that peaceful nuclear technology develops in a safe manner and that the provisions of physical protection of the NPPs provided in the Pelindaba agreement are integrated into the international agreements on nuclear safety.

³⁰ Van Wyk, Turianskyi and Bosman, 'African Continental Nuclear Institutions'.

³¹ Van Wyk, Turianskyi and Bosman, 'African Continental Nuclear Institutions', 10.

3. Case 1. Disarmament and failed security assurances for Ukraine

In the context of Russian aggression against Ukraine, one of the major threats is the prospect of Russia using nuclear weapons against a country that relinquished its nuclear arsenal and joined the NPT, which raises significant questions. In the 1991 national referendum, 90.3% of the Ukrainian population voted in support of independence from the Soviet Union. At the time of independence, Ukraine possessed the world's third-largest nuclear arsenal - 5,000 nuclear weapons.

On 5 December 1994, Ukraine signed the [Memorandum on security assurances in connection with Ukraine's accession to the Treaty on the Non-Proliferation of Nuclear Weapons \(the Budapest Memorandum\)](#).³² The Budapest Memorandum on Security Assurances, signed in 1994, is a diplomatic agreement involving Ukraine, Russia, the United States, and the United Kingdom. This document outlines the assurances provided to Ukraine and the commitments made by the signatory parties.



Figure 1. The Budapest Memorandum: security assurances and Ukraine's nuclear arsenal

³² Memorandum on security assurances in connection with Ukraine's accession to the Treaty on the Non-Proliferation of Nuclear Weapons <https://treaties.un.org/Pages/showDetails.aspx?objid=0800000280401fbb>

Under the Budapest Memorandum, Ukraine received several key assurances from the USA, the Russian Federation, and the UK:

Territorial Integrity - paragraphs 1 and 2 of the Memorandum:

- to respect the Independence and Sovereignty and the existing borders of Ukraine.
- to refrain from the threat or use of force against the territorial integrity or political independence of Ukraine, and that none of their weapons will ever be used against Ukraine except in self-defence or otherwise per the Charter of the United Nations.

Non-Aggression including non-application of economic coercion: paragraphs 3 and 5 of the Memorandum:

- to refrain from economic coercion designed to subordinate to their own interest the exercise by Ukraine of the rights inherent in its sovereignty and thus to secure advantages of any kind.
- not to use nuclear weapons against any non-nuclear-weapon State Party to the Treaty on the Non-Proliferation of Nuclear Weapons, except in the case of an attack on themselves, their territories or dependent territories, their armed forces, or their allies, by such a state in association or alliance with a nuclear weapon state.

These assurances were made after Ukraine's specific commitments:

- Welcoming the accession of Ukraine to the Treaty on the Non-Proliferation of Nuclear Weapons as a nonnuclear-weapon State
- Taking into account the commitment of Ukraine to eliminate all nuclear weapons from its territory within a specified period.

Additionally, on 14 January 1994, a Trilateral Statement³³ was signed between Russia, Ukraine, and the United States (as a mediator). Ukraine has committed to complete disarmament, including strategic weapons, in exchange for economic support and **security assurances from the United States and Russia.**

Ukraine actively collaborates with the IAEA and other NPT members to ensure nuclear energy's safe and secure use.³⁴

- Ukraine has allowed *regular IAEA inspections* of its nuclear facilities and provides regular reports to ensure compliance with international safety standards and non-proliferation commitments. The regularly applied integrated safeguards in Ukraine allow the IAEA to achieve confidence in the absence of undeclared nuclear materials and undeclared nuclear activities in Ukraine.³⁵

³³ January 14 Trilateral Statement, 14 January 1994 <https://nsarchive.gwu.edu/document/30922-document-10-january-14-trilateral-statement-january-14-1994>

³⁴ Report on Nuclear and Radiation Safety in Ukraine for 2020. SNRIU. 2021 https://snriu.gov.ua/storage/app/sites/1/uploaded-files/%D0%94%D0%BE%D0%BF%D0%BE%D0%B2%D1%96%D0%B4%D1%8C_%D0%AF%D0%A0%D0%91_2020_EN.pdf

³⁵ Symposium on International Safeguards Linking Strategy, Implementation and People https://inis.iaea.org/collection/NCLCollectionStore/_Public/46/058/46058138.pdf?r=1

- Since its independence from the Soviet Union in 1991, Ukraine has helped to shape the global agenda on the peaceful use of nuclear technology and fostered diplomatic relations in the pursuit of common goals.
- Ukraine has undertaken comprehensive safety modernisation programs for its nuclear reactors, supported by international funding and expertise.
- Ukraine remains a committed member of the NPT, actively supporting global non-proliferation efforts and working to prevent the spread of nuclear weapons. In particular, Ukraine signed (15 August 2000) and ratified (16 November 2005) the Additional Protocol to the NPT, confirming its intentions to use nuclear materials exclusively for peaceful purposes.

Russia militarily invaded Ukrainian territory in February 2014. Vladimir Putin confirmed this in his own account, which was released in March 2015.³⁶ However, in the first year of the invasion, despite overwhelming evidence of a Russian military presence in Crimea and the eastern parts of Ukraine, Putin denied the presence of Russian military forces in Crimea.³⁷ Being a permanent member of the UN Security Council allowed Russia to veto proposed decisions despite majority support in the UN General Assembly votes.

27 March 2014, the United Nations General Assembly (UNGA) approved a resolution declaring invalid the March 16 Crimean referendum to secede territories from Ukraine (A/RES/68/262) with 100 in favour, and 11 against.

2 March 2022, UNGA adopted a resolution on Aggression against Ukraine, where it condemned Russia's invasion of Ukraine and demanded a full withdrawal of Russian forces and a reversal of its decision to recognise the self-declared People's Republics of Donetsk and Luhansk (A/RES/ES-11/1) with 141 in favour, 5 against.

UNGA resolutions are non-binding. Thus, Ukraine's experience with the Budapest Memorandum emphasises the unreliability of international agreements signed by the Russian Federation and raises important questions about the effectiveness of security assurances under existing international agreements in the modern international arena.

The Russian invasion of Ukraine has also drawn attention to protecting nuclear facilities from attack during armed conflict.

³⁶ In movie Crimea. The return home" released in March 2015 Putin explained that in Feb. 2014 he told his colleagues, 'We are forced to begin the work to bring Crimea back into Russia'.

³⁷ Vladimir Putin answered journalists' questions on the situation in Ukraine. 4 March 2014. <http://en.kremlin.ru/events/president/news/20366>

4. Case 2. Nuclear safety during the Russian invasion of Ukrainian nuclear facilities

In Ukraine, there are a total of 4 nuclear power stations with 15 operational nuclear power reactors. Another non-operational NPP is Chernobyl.³⁸ The largest man-made environmental and humanitarian disaster of the 20th century occurred in April 1986. The accident took place while Ukraine was part of the Soviet Union. At the time, information about the accident was suppressed; over five million people were affected by it.³⁹ The Chernobyl Exclusion Zone – a 30 km radius around the ChNPP was established to manage the radiation contamination.

After the collapse of the Soviet Union, Ukraine took the responsibility to the world and committed to the principles of truth in matters of international cooperation in overcoming the consequences of the Chernobyl disaster.⁴⁰ Consistently and steadfastly adhering to its international obligations, Ukraine closed the ChNPP on 15 December 2000.⁴¹

- Unprecedented in complexity and logistics, the project of a new safe confinement over the 'Shelter' facility, worth about EUR 1.5 billion, was implemented (in July 2019, the facility was officially transferred to the balance sheet of the Ukrainian side).
- A separate storage facility for the ChNPP's spent nuclear fuel costing more than EUR 400 million was built (the project was completed in 2020).

All of this underscores Ukraine's dedication to adhering to nuclear safety standards and carrying out programs to alleviate the disaster's social, ecological, and economic repercussions. Ukraine is diligently taking every possible measure to avert the recurrence of a nuclear catastrophe, continually enhancing security measures at its nuclear facilities.

4.1. Occupation of Chernobyl NPP

On 24 February 2022, the Russian army breached Ukraine's borders from the south, north, and east, entering the Chernobyl Exclusion Zone via the border with Belarus. Chernobyl NPP is only 130 km from Kyiv, and the Chernobyl Exclusion Zone borders Belarus. The Russian army crossed the border from Belarus and used the Chernobyl Exclusion Zone as one of the key routes for their offensive.

At the Chernobyl Nuclear Power Plant (ChNPP), there were nearly 150 operational and support staff on-site, along with 178 military personnel from the National Guard of Ukraine's 3041st military unit.⁴² This unit, not a combat unit, is responsible for guarding strategic objects, including the nuclear power plant.

³⁸ The name Chernobyl is a transliteration of a name of the power plant according to Ukrainian language. The Chernobyl is the same name transliterated according to Russian language. Since 1995 Ukraine is using Ukrainian transliteration of its cities.

³⁹ Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts. The Chernobyl Forum 2003-2005 <https://www.iaea.org/sites/default/files/chernobyl.pdf>

⁴⁰ State Nuclear Regulatory Inspectorate of Ukraine "NATIONAL REPORT. On Compliance of Ukraine with Obligations under the Convention on Nuclear Safety" <https://snriu.gov.ua/storage/app/sites/1/uploaded-files/9th%20National%20report%20Ukraine.pdf>

⁴¹ World Nuclear Association: Nuclear Power in Ukraine <https://world-nuclear.org/information-library/country-profiles/countries-t-z/ukraine>

⁴² "The full-scale war of russia against Ukraine". ChNPP. <https://chnpp.gov.ua/en/about/history-of-the-chnpp/the-full-scale-war-of-russia-against-ukraine>

When Russian military personnel occupied the station with tanks [Photo 1], the National Guard unit chose to lay down their weapons and not open fire to protect the nuclear facility from potential damage. They became hostages of the Russian military and some of them still remain in captivity [see Table 2].

The station's staff, who had started their shift on 23 February 2022, became hostages of the Russian military and had to work over 600 hours instead of the planned 12-hour shift. According to the IAEA report, the personnel was forced to work under armed guard without the chance of rotation. The Russian colonel explained the feelings of the head of the ChNPP: "He said that he hated us, but he swore an oath to the IAEA and would ensure the station's safety."⁴³ Personnel rotation became possible only on March 20.⁴⁴

Photo 1: Russian tanks at the ChNPP, screenshot from the video taken by the personnel. Source: MIPL⁴⁵



Photo 2: Russian soldiers on the territory of the ChNPP. Photo: Konstantyn Kornoza /MIPL⁴⁶

On the same day, Ukraine notified the IAEA that "unidentified armed forces" had seized control of all Chornobyl Nuclear Power Plant facilities in the Exclusion Zone.⁴⁷ The IAEA Director General reminded that any armed attack on nuclear facilities for peaceful purposes violates the principles of the United Nations Charter, international law, and the Agency's Statute.⁴⁸

In an updated statement on 26 February 2022, IAEA Director General Grossi reported that increased radiation levels were recorded at the Chornobyl NPP site a day earlier.⁴⁹ This was likely due to the movement of heavy military equipment loosening contaminated soil in the area.

⁴³ Ibid.

⁴⁴ IAEA, Update 28 – IAEA Director General Statement on Situation in Ukraine

⁴⁵ How Russia seized the ChNPP: the reconstruction of events and names of responsible The Media Initiative for Human Rights, 22 Nov. 2023 <https://mipl.org.ua/en/how-russia-seized-the-chnpp-the-reconstruction-of-events-and-names-of-responsible/>

⁴⁶ Ibid.

⁴⁷ IAEA, 'IAEA Director General Statement on the Situation in Ukraine', 24 February 2022, <https://www.iaea.org/newscenter/pressreleases/iaea-director-general-statement-on-the-situation-in-ukraine>.

⁴⁸ Ibid.

⁴⁹ IAEA, 'Update 2 – IAEA Director General Statement on Situation in Ukraine.

Monitoring data showed radiation levels increased up to 20 times in some places.⁵⁰

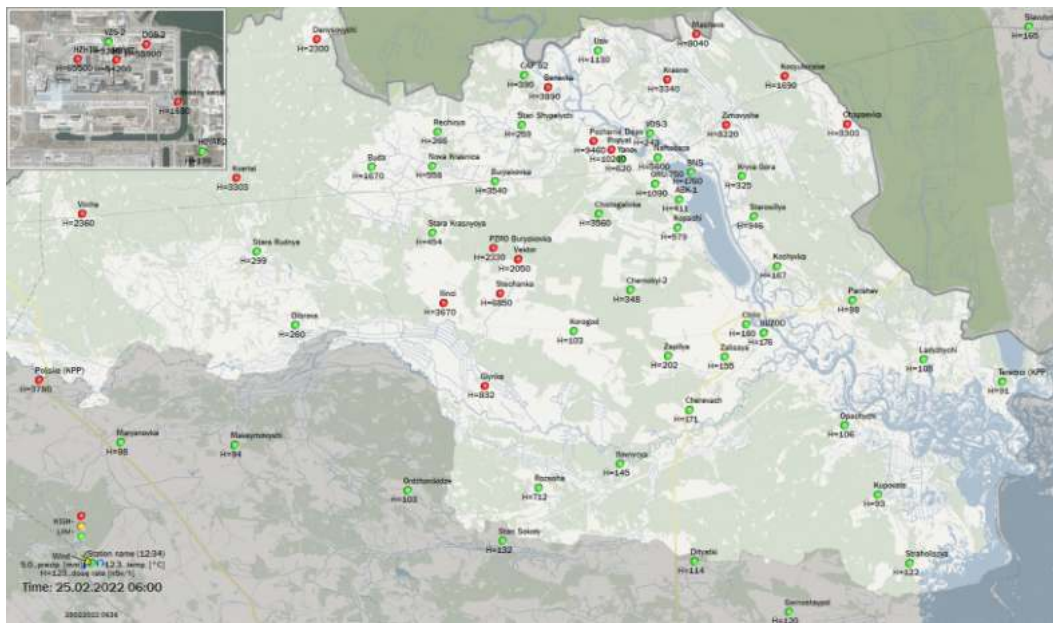


Figure 2. Increased levels of radiation at the Chernobyl Exclusion Zone as of 25 February 2022⁵¹

Many regional nuclear safety organisations have ‘urged the Russian Federation to promptly halt its unlawful activities to facilitate the reinstatement of control by competent Ukrainian authorities over all nuclear facilities and materials within the internationally recognised borders, aligning with globally acknowledged safety standards’ as well as stated that “by its illegal military actions, Russia is grossly violating international law and the principles of the UN Charter and undermining European and global security and stability”.⁵²

On 2 March 2022, Ukraine appealed to the IAEA regarding the application of specific joint actions in the form of "peer pressure", which is used by the member countries of the organisation against the parties that evade compliance with the security priority. The proposed measures included, in particular, the following:

- “Immediate ceasefire and ban for the occupation forces to approach closer than 30 km to the NPP.
- Activation of an IAEA Emergency Information Centre headquarters to coordinate activities in the prevention of acts of nuclear terrorism at the ChNPP and humanitarian and psychological assistance to its personnel with detailed documentation of events as a unique experience.

⁵⁰ SaveEcoBot. The first environmental system in Ukraine <https://web.archive.org/web/20220225165134/https://www.saveecobot.com/en/radiation-maps#10/51.3418/29.7063/gamma/comp+cams+fire>

⁵¹ State Inspection of Nuclear Regulation of Ukraine, Information on radiation safety in the exclusion zone <https://snrii.gov.ua/news/informaciya-shchodo-radiacijnoyi-bezpeki-u-zoni-vidchuzhennya>

⁵² ENSREG, Statement on the safety of nuclear installations in Ukraine following the military aggression by Russia, 27 February 2022 https://www.ensreg.eu/sites/default/files/attachments/ensreg_statement_on_ukraine.pdf

- Considering the complete disregard of the Russian Federation for the principles of peace, security, and unity for which the IAEA had been established within the UN structure, we suggest denying these countries access to intellectual and technical resources of the IAEA while strengthening control over the accounting, control, and use of nuclear material in this country...⁵³

During the time of the occupation, Rosatom personnel were present at the station⁵⁴. After five weeks of the occupation, on March 31, 2022, Ukrainian Energoatom has reported that the Russian forces that controlled ChNPP since 24 February had, in writing, transferred control of the NPP to Ukrainian personnel.⁵⁵

The estimated physical damage at the ChNPP (e.g. stolen computers, radio stations, gas masks, fire engines, and devices from radiological laboratories) is USD135 million.⁵⁶ Some of the National Guard members that were guarding the ChNPP remain in captivity as of July 2024.

Table 2. A summary of key events at the ChNPP from February 2022 to May 2024:⁵⁷

Date	Description of event
24 February 2022	The IAEA received word that Russian military forces had seized control of the ChNPP site. Connection to the IAEA's <i>International Radiation Monitoring Information System (IRMIS)</i> stops working.
25 February 2022	The detected level of radiation in some areas increased 20 times.
2 March 2022	A meeting of the IAEA Board of Governors is convened to discuss the nuclear safety, security, and safeguards situation in Ukraine.
3 March 2022	Resolution GOV/2022/17 on the safety, security, and safeguards implications of the situation in Ukraine is adopted by the Board of Governors of the IAEA.
9 March 2022	ChNPP cut-off from the external power supply and diesel generators kicked in to provide power to the site.
14 March 2022	ChNPP once again received a power supply from external sources after repairs were completed.
23 March 2022	Military activities cause damage to Ukraine's national power infrastructure with an impact on Chornobyl and other nuclear facilities in the country.

⁵³ Joint appeal of the Minister of Energy of Ukraine, Acting Chairman of the State Nuclear Regulatory Inspectorate of Ukraine - Chief State Inspector for Nuclear and Radiation Safety of Ukraine, Acting President of SE NNEGC "Energoatom" to the IAEA <https://snriu.gov.ua/storage/app/sites/1/uploaded-files/C3%20eng.pdf>

⁵⁴ Update 19 – IAEA Director General Statement on Situation in Ukraine. 12 March 2022

⁵⁵ Update 38 – IAEA Director General Statement on Situation in Ukraine 31 March 2022

⁵⁶ Yevhen Kramarenko, Head of the State Agency for Management of the Exclusion Zone, 2 June 2022 <https://www.washingtonpost.com/world/2022/06/02/ukraine-chernobyl-damage-done-by-russians/>

⁵⁷ Sources: IAEA reports; Energoatom reports and news posts

31 March 2022	Russian forces withdraw from the ChNPP site. Ukrainian authorities restored control over ChNPP 169 National Guardsmen (not combatmen) were taken captive first to Belarus and later to Russia
19-20 May 2022	Communication between Ukraine's national regulator, ChNPP, is restored. Still, specialists are unable to conduct a thorough inspection of the site due to damaged road infrastructure (bridges) and mines present in the area.
6 June 2022	Localised radiation monitoring systems are up and running and connection with <i>IRMIS</i> is restored.
29 October 2022	The first group of the National Guardsmen who guarded the ChNPP returned to the controlled territory of Ukraine.
8 January 2023	8 National Guardsmen from ChNPP returned to the controlled territory of Ukraine in a prisoner exchange
11 June 2023	21 National Guardsmen from ChNPP returned to the controlled territory of Ukraine in a prisoner exchange
31 May 2024	14 National Guardsmen from ChNPP returned to the controlled territory of Ukraine in a prisoner exchange
26 June 2024	5 National Guardsmen from ChNPP returned to the controlled territory of Ukraine in a prisoner exchange
Present	Some of the personnel from ChNPP remain captured on the territory of Russia.

The ChNPP is not a military facility; it is in the process of decommissioning and does not produce electricity. At the time of the invasion, it was not a military fortification and has been under the special control of the international community since the disaster in 1986. The Russian military forces had no right to take it under their control and were obliged to leave the possibility for the personnel and security of the station to continue to perform their work. According to the Geneva Convention subparagraph "c" of Part 3 of Article 85 of the Additional Protocol, that is part of the international humanitarian law committing an attack on installations or structures containing dangerous forces, when it is known that such an attack will cause excessive loss of life, injuries among the civilian population, or damage to civilian objects, is **considered a war crime**.⁵⁸

⁵⁸ Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 'Article 56 – Protection of works and installations containing dangerous forces', 8 June 1977, <https://ihl-databases.icrc.org/en/ihl-treaties/api-1977/article-56?activeTab=undefined> ;

4.2. Occupation of Zaporizhzhya NPP

On 1-2 March 2022, Russian military forces entered Energodar, home to Europe's largest nuclear power plant. Local residents constructed a barrier to prevent the Russian army from entering the city [Photo 3].⁵⁹ The IAEA convened an emergency meeting to discuss establishing safe zones around the nuclear reactors. Despite local defence efforts, the Zaporizhzhya NPP fell under occupation by 4 March 2022. The chronology of events at the Zaporizhzhya NPP (ZNPP) after its capture by the Russian military can be traced through IAEA reports⁶⁰, which cover the period starting from 24 February 2022 [Table 3].

The Zaporizhzhia nuclear power plant (ZNPP) was militarily seized by Russia on 4 March 2022.

ZNPP has six Soviet-designed VVER-1000/320 reactors that were generating 27% of Ukraine's electricity prior to the war.⁶¹

ZNPP was fully operational at the time of the Russian military taking over, and has been switched to shutdown mode since September 2022, but it consumes about 100 MW from the unified power grid of Ukraine for the operation of pumps for the cooling of nuclear reactors.⁶²

On 5 October 2022, Russian President Vladimir Putin signed a decree unlawfully appropriating the nuclear plant as Russian state property.⁶³ Rosatom established a joint-stock company (“JSC”) ‘Zaporozhye NPP Operational Organisation’, registered in Moscow, to manage the occupied ZNPP. The plant is now under the command of the Russian state-owned Rosatom and regulated by Rostekhnadzor.

Ukrainian personnel from Energoatom are facing constant pressure to adopt Russian citizenship and to sign contracts with Rosatom.

A permanent monitoring mission of the IAEA, the IAEA Support and Assistance Mission to Zaporizhzhya, has only started operating at the facility on 1 September 2022. Several acts of aggression against the ZNPP have been recorded since it became occupied on 4 March 2022.

⁵⁹ Ukrainska Pravda, “Energodar residents form their city’s wall of defence” <https://www.pravda.com.ua/eng/news/2022/03/2/7327506/>

⁶⁰ IAEA, Nuclear Safety, Security and Safeguards in Ukraine. Documents <https://www.iaea.org/topics/response/nuclear-safety-security-and-safeguards-in-ukraine/documents>

⁶¹ Zaporizhzhya NPP. Energoatom. 2022 <https://old.energoatom.com.ua/app-eng/history-zaes.html>

⁶² Al Jazeera, ‘Russia says Ukraine attack hits Zaporizhzhya nuclear power plant’, Al Jazeera, 7 April 2024, <https://www.aljazeera.com/news/2024/4/7/russia-says-ukraine-attack-hits-zaporizhzhia-nuclear-power-plant>

⁶³ Decree of the President of the Russian Federation dated 05.10.2022 No. 711. Kremlin <http://www.kremlin.ru/acts/bank/48370>



*Photo 3. Ukrainian civilians blocking the road to the ZNPP aiming to prevent Russian occupation
Source: Ukrainska Pravda⁶⁴*

The actions of Russian troops in Ukraine represent the first instance of an operational nuclear power plant being directly targeted for military attack and occupation. The Zaporizhzhya nuclear power plant, now with military equipment stationed on its premises, has been embroiled in prolonged hostilities.

In September 2022, The Insider released a video showing artillery fire originating from the NPP's territory.⁶⁵

The station, ill-equipped for the dangers of artillery fire and potential explosive detonations, faces severe risks.

The worst-case scenario involves the destruction of the reactor core, leading to depressurization and the release of accumulated radioactivity into the environment, including water. A similar incident occurred at the Fukushima Daiichi Nuclear Power Plant in 2011, resulting in an estimated release of about 200 mega-becquerels of radioactivity.

Such destruction can result from physical impacts on the reactor's structure, such as explosions, or prolonged loss of external power for the station's own needs, particularly due to insufficient fuel reserves for diesel generators. Another perilous scenario involves the destruction of the station's cooling system, leading to reactor overheating and the release of radioactive elements into the atmosphere.

⁶⁴ Ukrainska Pravda, "Enerгодар residents form their city's wall of defence" <https://www.pravda.com.ua/eng/news/2022/03/2/7327506/>

⁶⁵ The Insider, News, 3 September 2022 <https://theins.ru/news/254676>

A comprehensive study by the Royal United Services Institute (RUSI) evaluated the risks⁶⁶ associated with the occupation of the Zaporizhzhya NPP. Beyond the aforementioned threats, RUSI highlights the potential for accidents due to personnel errors, as employees operate under constant pressure, and the overall service personnel may be insufficient. Additionally, RUSI notes that spent fuel storage facilities are less fortified than reactors, making them vulnerable to missile or artillery strikes and risking radioactive contamination over a broad area.

4.2.1. Risks for personnel

After the occupation of ZNPP representatives from the Rosatom State Corporation also arrived at the site. IAEA reports consistently document the pressure on Ukrainians employed at the Zaporizhzhya NPP who found themselves under occupation following the commencement of a full-scale invasion.

Energoatom, the legal operator of the ZNPP, officially announced on 17 July 2022, that the Russian military had abducted Ihor Kvasnin, the head of the environmental department of the ZNPP⁶⁷. On 18 July, the deputy head of the decontamination department for the operation and management of radioactive waste, Serhii Pikhtin, and the head of the decontamination department, Olena Ryabcheva, were also kidnapped. On 30 September 2022, it was reported that the Russian military had detained Igor Murashov, the general director of ZNPP. The head of the nuclear plant was only released⁶⁸ on 3 October with the assistance of the IAEA, the United Nations, and French President Emmanuel Macron.

Numerous eyewitness testimonies corroborate the Ukrainian side's reports of the torture of Zaporizhzhya nuclear plant employees to coerce loyalty and cooperation.⁶⁹ According to the latest Ukrainian intelligence data⁷⁰, as of December 2023, Russian representatives at the Zaporizhzhya NPP are demanding that all Ukrainian workers at the plant obtain Russian passports and sign contracts by 31 December 2023. It has been established that, for the purpose of coercion, the Russians subject Ukrainian specialists to psychological pressure, selectively restrict their access to workplaces without warning, and cancel their passes.

Russia announced that effective 1 February 2024, Ukrainians who have not signed employment contracts with Rosatom and accepted Russian citizenship will be denied access to ZNPP.⁷¹ In the latest staff reduction, approximately 120 personnel who refused to sign Russian contracts were reportedly removed from ZNPP rosters.⁷² This includes key positions like reactor operators, where

66 Royal Joint Defense Research Institute, Dangerous Targets: Civilian Nuclear Infrastructure and the War in Ukraine <https://rusi.org/explore-our-research/publications/special-resources/dangerous-targets-civilian-nuclear-infrastructure-and-war-ukraine>

67 JSC NNEG Energoatom, Message in the official Telegram channel https://t.me/energoatom_ua/8261

68 IAEA, Update 111 – IAEA Director General Statement on Situation in Ukraine.

69 The New York Times, Torture and Turmoil at Ukrainian Nuclear Plant: An Insider's Account <https://www.nytimes.com/2023/03/28/world/europe/ukraine-zaporizhzhia-nuclear-plant-grossi.html>

70 Defence Intelligence of Ukraine, Articles <https://gur.gov.ua/en/content/sered-zavezenykh-na-zaes-rosiiskykh-enerhetykiv-zrostaie-nevdovolennia.html>

71 Update 209 – IAEA.

72 No optimism from IAEA inspectors regarding Russia-captured nuclear plant - Ukraine official 10.02.2024 <https://www.ukrinform.net/rubric-economy/3825487-no-optimism-from-iaea-inspectors-regarding-russiacaptured-nuclear-plant-ukraine-official.html>

even the loss of a few experienced and appropriately licensed professionals can significantly impact safety. As a result, in February 2024 the Russian operating entity currently employed 4,500 staff at ZNPP, with 940 applications under consideration, while before the armed conflict began, approximately 11,500 staff were employed at ZNPP.⁷³

The concerns around staff rotations at the ZNPP also affect the IAEA. In February 2023 the Director General reported in his update on the situation in Ukraine that a planned rotation of the ISAMZ experts planned for January had been delayed for more than two weeks despite the replacement team already being in the country at that stage, ready to assume the duties of their colleagues⁷⁴. In April 2024 reactor 3 was undergoing repairs, but none of the reactors are currently being used to generate electricity. However, just because they are shut down does not mean that the risks associated with radioactive material are eliminated. The reactor fuel remains hot and active and requires continuous monitoring and oversight of cooling processes to ensure that it remains safe and stable.

What the situation at the ZNPP illustrates is that its continued safe and secure operation depends not purely on the physical integrity of the buildings and facility itself but also on the well-being of the people tasked with overseeing its operation, even in its current shutdown state.

⁷³ Update 209 – IAEA Director General Statement on Situation in Ukraine, February 2024

⁷⁴ IAEA, 'Update 147 – IAEA Director General Statement on Situation in Ukraine', International Atomic Energy Agency, 20 February 2023

Table 3. A summary of key events related to the ZNPP from February 2022 to May 2024^{75 76 77}

78 79

Date	Description of event
26 February 2022	ZNPP loses the South Donbas 750 kV line, one of its key sources of external power supply. Supply from the other 750 kV lines – Zaporizhaska, Kakhovska and Dniprovska – remain intact.
4 March 2022	Russian forces take control of Zaporizhzhya Nuclear Power Plant and Zaporizhzhya Thermal Power Plant (ZTPP). Reports to the IAEA indicate that ZNPP’s training centre was hit by a projectile and a localised fire ensued but was extinguished. Rosatom representatives arrive at ZNPP in the days following this incident.
6 March 2022	ZNPP loses Zaporizhaska external power supply line.
10 March 2022	IAEA Director General, Rafael Mariano Grossi, holds talks on nuclear safety and security with the Ukrainian and Russian Ministers of Foreign Affairs, Dmytro Kuleba and Sergei Lavrov in Türkiye.
15 March 2022	Ukraine informed the IAEA that the Russian military had detonated unexploded munitions left on the site of the ZNPP following the events of 4 March.
10 April 2022	A request for assistance for equipment is submitted by the State Emergency Service of Ukraine to the IAEA through its permanent secure communication channel.
22 April 2022	Another request for assistance is submitted to the IAEA by the SNRIU.
29 April 2022	Nuclear experts from Rosatom arrive at ZNPP.
5-7 August 2022	ZNPP is repeatedly the target of heavy shelling. Explosions caused the electrical power transformer and some backup transformers to shut down. One of the six reactor units is affected, and its backup diesel generator is activated to ensure continued power supply to the unit. Fire breaks out at the nitrogen-oxygen station on the grounds that is later extinguished. Damage to the area surrounding the spent fuel facility at ZNPP as well as an injured member of staff. The functioning of radiation detection sensors is possibly impaired.
7 August 2022	Kakhovska external power supply line is lost.
11 August 2022	Further shelling at the ZNPP site is reported; a radiation monitoring detector at the ZNPP fire station is recorded. IAEA Director General, Rafael Mariano Grossi, briefs the UN Security Council on the situation at ZNPP and informs them of the work of the IAEA at the site.

75 This is not a comprehensive list of incidents recorded but only highlights of the most important events pertaining to risks and threats to nuclear safety and security.

76 This resolution criticised “the Russian Federation’s persistent violent actions against nuclear facilities in Ukraine” and conveyed “grave concern that the Russian Federation has not heeded the call of the Board to immediately cease all actions against and at nuclear facilities in Ukraine”; see <https://www.iaea.org/sites/default/files/23/02/nuclear-safety-security-and-safeguards-in-ukraine-feb-2023.pdf>.

77 These resolutions address several factors related to nuclear safety and security including calling on all Member States to “be mindful of the importance of nuclear safety and security regarding peaceful nuclear facilities and materials in all circumstances”; see <https://www.iaea.org/sites/default/files/23/02/nuclear-safety-security-and-safeguards-in-ukraine-feb-2023.pdf>.

78 IAEA, ‘Strengthening the effectiveness and improving the efficiency of Agency safeguards: Resolution adopted on 30 September 2022 during the eleventh plenary meeting’, IAEA General Conference, GC(66)/RES/10, September 2022, <https://www.iaea.org/sites/default/files/gc/gc66-res10.pdf>.

79 IAEA, ‘The safety, security and safeguards implications of the situation in Ukraine’, IAEA Board of Governors, GOV/2022/71, November 17, 2022, <https://www.iaea.org/sites/default/files/documents/gov2022-71.pdf>.

20 August 2022	Damage to walkways, laboratory, and chemical facilities due to shelling recorded at ZNPP.
25 August 2022	The last remaining external power supply, the Dniprovka line, was temporarily disconnected (twice). ZNPP draws on nearby ZTPP to ensure grid connectivity during power interruptions. Due to the interruption of electricity supply from the Dniprovka line, two reactor units at ZNPP were disconnected, and their emergency protection systems were activated.
2 September 2022	Shelling in the area is reported.
3 September 2022	Due to the shelling of the previous day, the Dniprovka external power supply line was once again lost and ZNPP relied on ZTPP for backup power. Reactor units 5 and 6 of ZNPP are reduced to not put a higher strain on the power grid.
4 September 2022	More shelling is reported. Damage to ZNPP Special Building 1 (containing among others nuclear fuel (fresh) and a solid radioactive waste storage unit) is recorded as well as damage to the railway, walkways for personnel, and the road in front of reactor building 2.
6 September 2022	Shelling causes all reactor units at ZNPP to be shut down due to damage to internal backup power lines and the switchyard. The backup power lines were repaired and restored by 10 September. Director General Grossi of the IAEA briefs the UN Security Council on the situation in Ukraine and emphasises that it is necessary to establish a designated nuclear safety protection zone around the ZNPP while also advocating for a continued IAEA presence on the ground. On the same day, the inaugural meeting of a working group focused on reviewing the challenges to implementing IAEA-mandated safety and safeguards standards takes place.
11 September 2022	ZNPP Unit 6 (the final remaining unit) is shut down.
15 September 2022	The Board of Governors of the IAEA adopts resolution GOV/2022/58 on safety, security, and safeguards implementation in Ukraine.
21 September 2022	Shelling damages the spray cooling ponds of ZNPP Units 5 and 6 as well as the internal high-voltage power line of Unit 6.
27-29 September 2022	Mine explosions in the vicinity of ZNPP linked to broken windows of the turbine hall of ZNPP Unit 2.
30 September 2022	66th session of the IAEA General Conference takes place. Nuclear and radiation safety resolution GC(66)/RES/6 and nuclear security resolution GC(66)/RES/7 are adopted. On the same day, it also adopts GC(66)/RES/10, which inter alia "Urges all Member States to refrain from attacks or threats of attacks on, against or in the vicinity of nuclear facilities devoted to peaceful purposes in order to ensure that the Agency is able to conduct safeguards activities in accordance with relevant safeguards agreements".
8 October 2022	Dniprovka's external power supply line was damaged and ZNPP lost power from this source again. Backup diesel generators to all units kick in. The line is restored the next day.
16 October 2022	The IAEA learned that a state-run operating organisation was formed for ZNPP in Moscow and the Russian Federation announced that it was now in charge of the facility, including chief decision-making.

19 October 2022	The primary internal backup power line for ZNPP was lost through shelling at the thermal power plant switchyard. On the same day, the IAEA also received a request from Ukraine's Ministry of Energy for IAEA expert missions to be sent to all nuclear power plants in the country.
27 October 2022	There were reports of arbitrary construction by the Russian Federation of a structure on the site of a dry storage facility for spent nuclear fuel.
30 October 2022	Unit 4 of ZNPP was forced to rely on a backup power supply due to a mine explosion that caused damage to the internal power supply line.
2 November 2022	The Dniprovsk power line was damaged by shelling but was repaired by 4 November.
10-11 November 2022	The fifth IAEA equipment delivery to Ukraine took place (dosimeters, contamination monitors, and personal protective equipment).
14 November 2022	The IAEA is informed that a Russian contractor has been responsible for modifications to the physical protection system of the ZNPP dry spent fuel storage facility. These upgrades were not sanctioned by the State Nuclear Regulatory Inspectorate of Ukraine (SNRIU).
17 November 2022	IAEA Board of Governors adopted resolution GOV/2022/71 which "Expresses grave concern that the Russian Federation has not heeded the calls of the Board to immediately cease all actions against and at nuclear facilities in Ukraine and requests that the Russian Federation do so immediately".
19 November 2022	Spray cooling ponds at ZNPP were hit by shelling; operation was not impaired.
20 November 2022	The area around ZNPP Unit 4 was hit by shelling and damage to several roads, railway tracks, and condensate tanks was recorded. One emergency diesel generator was disconnected from the units as a result of damage caused by shelling.
23-24 November 2022	Significant period – all NPPs in Ukraine lost external power simultaneously as a result of damage to the national power infrastructure of Ukraine. On-site diesel power generators were used to maintain the power supply to reactor units. Power was restored by 25 November.
16 December 2022	National power infrastructure was damaged in missile attacks and NPPs were required to lower their power output.
29 December 2022	All NPPs were again required to lower their power output due to damage to electrical infrastructure caused by shelling.
31 December 2022	All NPPs were again required to lower their power output due to damage to electrical infrastructure caused by missile attacks.
14 January 2023	All NPPs were again required to lower their power output due to damage to electrical infrastructure caused by missile attacks.
26 January 2023	IAEA inspectors concerned about water levels in the Kakhovka reservoir (source of cooling water for the ZNPP), reported to be 14.6 m.
8 February 2023	IAEA staff report Kakhovka reservoir levels to be at 13.9 m.
9 March 2023	ZNPP loses external power for 11 hours and is forced to rely on emergency backup diesel generators.

6 June 2023	The Nova Kakhovka Dam was critically damaged in an explosion and the water it contained was released along the Dnipro River leading to the flooding of several settlements in the area. This affected the water available in the Kakhovka reservoir from which the ZNPP drew water for cooling of reactors.
25-29 September 2023	ZNPP operators began the transition of Unit 4 from cold shutdown to hot shutdown. The unit was earlier affected by the leak caused by a hairline crack in the weld of a primary header vent pipe on the steam generator.
7 April 2024	A dome above one of the reactors at ZNPP was attacked and both sides of the conflict blame each other for this incident. Director General Grossi of the IAEA called on both sides to avoid any action that could violate the principles of nuclear safety it had put in place.
9 May 2024	In his update on the situation in Ukraine, Director General Grossi of the IAEA mentioned that IAEA staff stationed at ZNPP reported military activity most days during this particular week. Staff say they could hear small arms fire, artillery, and rocket fire not far from the plant. There were also reportedly drones present near the cooling pond leading to restrictions on movement around ZNPP.

Source: Compiled by authors from various official IAEA reports and press statements as well as various news sources.

This list of IAEA responses to the situation in Ukraine and other incidents recorded in Table 3 above is by no means an exhaustive list of the threat-and-response situation related specifically to the ZNPP but also broadly to the other nuclear facilities in Ukraine. Beginning on 13 July 2022, the IAEA has also been instrumental in delivering vital equipment to power plant operators, which have included dosimeters, spectrometers, personal protective equipment, communication systems, potassium iodide tablets, mobile laboratories, and contamination monitors.⁸⁰ Various review missions have also been conducted on top of the permanent observers stationed at nuclear sites in Ukraine. The Director General himself has also visited the sites and has briefed the Board of Governors and the UN regularly alongside public statements to keep the public abreast of developments in Ukraine and how the nuclear power plants are affected. So far, his efforts to establish a demarcated safety zone around the ZNPP have not yielded any results, and the situation continues to be monitored.

Key unresolved challenges for the ZNPP are:

- Russian authorities and Rosatom do not provide full unrestricted access of IAEA inspectors to all equipment, which limits the ability of the IAEA to confirm compliance with nuclear safety principles;
- Explosions and shellings are constantly occurring around ZNPP these include artillery fire as well as small fire.

⁸⁰ IAEA, 'Nuclear Safety, Security and Safeguards in Ukraine: February 2022-February 2023', International Atomic Energy Agency, 2023, <https://www.iaea.org/sites/default/files/23/02/nuclear-safety-security-and-safeguards-in-ukraine-feb-2023.pdf>.

4.3. Impact of Russian Occupation on IAEA's Nuclear Safety and Security Pillars

The Russian occupation of the ChNPP, the Exclusion Zone, and the ZNPP compromised all of the IAEA's Seven indispensable pillars for ensuring nuclear safety and security during an armed conflict.⁸¹

Table 4. Examples of violations of Seven indispensable pillars for ensuring nuclear safety and security during an armed conflict: the occupation of ChNPP and the exclusion zone, and ZNPP
82

Chornobyl NPP	Zaporizhzhia NPP
1. The physical integrity of facilities – whether it is the reactors, fuel ponds, or radioactive waste stores – must be maintained	
<ul style="list-style-type: none"> ● The nuclear power plant was treated as a military target in a warzone, with Russian military tanks driving through ChNPP. ● Penetration of storage for ionising radiation sources containing radioactive solutions. ● Damage to the physical protection system of the secured perimeter. 	<ul style="list-style-type: none"> ● more than 12 hits to the infrastructure of the station. ● Damage to communication overpasses, water storage tanks, steam generator systems, diesel auxiliary systems, the radioactive waste building, cooling pond sprinklers, and related equipment. ● military preparations in the area. ● reinforced positions with sandbags were set up by Russian troops on the roofs of the reactor buildings. ● Mines placed outside and within the plant, including anti-personnel mines in the buffer zone between the inner and outer fences of the occupied Zaporizhzhya NPP. ● Water leaked from the first reactor circuit into the second during the activation of the 4th power unit, caused by a breach in the integrity of the third steam generator housed within the unit's hermetic shell. ● reagents leaked from the first circuit of the reactor to the second at power unit No.5 during the illegal transfer of this power unit to a hot state.
2. All safety and security systems and equipment must be fully functional at all times	
<ul style="list-style-type: none"> ● Regulatory oversight of the nuclear and radiation safety status of nuclear installations and other facilities at the ChNPP site became impossible. ● The automated radiation control system's operation was disrupted. 	<ul style="list-style-type: none"> ● Troops, military equipment, and weapons were observed on-site, including within turbine halls. ● The blasting of the Kakhovka HPP dam, a key water source for ZNPP, led to the complete destruction of the dam and HPP engine room. This sudden drop in the Kakhovka reservoir's water level posed a significant risk to the occupied nuclear plant.

81 IAEA Director General's Introductory Statement to the Board of Governors. IAEA, 2 Mar 2022
82 Developed by authors based on IAEA, Energoatom and SNRIU reports

3. The operating staff must be able to fulfill their safety and security duties and have the capacity to make decisions free of undue pressure.	
<ul style="list-style-type: none"> ● Shift personnel are unable to rotate as scheduled. ● Ongoing restrictions on routine maintenance and repair of safety-critical equipment. ● Russian forces established multiple security checkpoints, closely monitoring station staff. 	<ul style="list-style-type: none"> ● ZNPP workers subjected to torture and intimidation by Russian occupying forces, with the knowledge of Rosatom. ● Pressure on Ukrainian operators to sign contracts with Rosatom. ● Working under pressure in close proximity to the frontlines. ● Increased risk of human error. ● Lack of rotations and inadequately trained personnel at ZNPP.
4. There must be a secure off-site power supply from the grid for all nuclear sites.	
<ul style="list-style-type: none"> ● Supply lines were repeatedly damaged, leaving only one out of three available on 14-26 March 2022. Backup diesel power had fuel for only 48 hours. ● ChNPP's power lines were disconnected, causing a complete loss of power across all facilities on 9-14 March. 	<ul style="list-style-type: none"> ● ZNPP was shelled, triggering emergency protocols and leading to Unit 5 shutdown. The 300 kV power line was damaged, causing a blackout in Unit 2. Emergency diesel generators were activated for critical areas. ● Further shelling caused a fire, cutting the last 330 kV line. Unit 6, supplying the plant's needs, was disconnected, fully isolating ZNPP from the grid. ● Damage to the 750 kV communication line led to complete blackouts on 8, 12, 17 October 2022, and again on 2 December 2023, lasting nearly 5 hours.
5. There must be uninterrupted logistical supply chains and transportation to and from the sites.	
<ul style="list-style-type: none"> ● All activities at ChNPP, including the transportation of spent nuclear fuel to the new storage facility, were temporarily halted. ● Routes for transporting personnel to ChNPP were destroyed. Previously, a 45-minute train trip from Slavutych to the site now requires 6-10 hours by bus. 	<ul style="list-style-type: none"> ● Damaged infrastructure surrounding the NPP site. ● Key supplies are provided by both Ukraine and Russia. ● Delayed non-essential maintenance work due to a lack of spare parts. ● Challenges with diesel fuel delivery.
6. There must be effective on-site and off-site radiation monitoring systems, and emergency preparedness and response measures.	
<ul style="list-style-type: none"> ● Damage to neutron flux and gamma radiation sensors at the Shelter prevented critical radiation monitoring in one area. 	<ul style="list-style-type: none"> ● Compromised response measures and unclear reporting process due to Rosatom's takeover of the NPP. ● Short-term disruptions to radiation monitoring systems.
7. There must be reliable communication with the regulator and others.	
<ul style="list-style-type: none"> ● Effective communications between the site and the regulator, SNRIU, were absent. ● Telephone communication through official channels with personnel at ChNPP was severed due to damage to relevant lines and equipment. 	<ul style="list-style-type: none"> ● Limited communication between the site and the regulator SNRIU, especially following the annexation of Ukrainian territories in October 2022. ● Restricted access to information for Ukrainian state and IAEA inspectors.

Already in September 2022, the IAEA mission concluded that all these pillars were compromised.⁸³ Specific actions were recommended, including establishing a safety protection zone around the plant without military equipment and implementing shifts of nuclear safety inspectors. Despite efforts, the demilitarized safety protection zone was not achieved. In May 2023, the UN Security Council further endorsed five concrete principles established by the IAEA, crucial for preventing a catastrophic incident at ZNPP. Besides the Seven indispensable pillars for ensuring nuclear safety and security during an armed conflict, IAEA Director General Rafael Grossi is constantly innovating on how nuclear safety can be ensured.

In 2023, the concrete principles were identified and further endorsed by UNSC 'to help ensure nuclear safety and security at ZNPP in order to prevent a nuclear accident and ensure the integrity of the plant':⁸⁴

1. There should be no attack of any kind from or against the plant, in particular targeting the reactors, spent fuel storage, other critical infrastructure, or personnel;
2. ZNPP should not be used as storage or a base for heavy weapons (i.e. multiple rocket launchers, artillery systems and munitions, and tanks) or military personnel that could be used for an attack from the plant;
3. Off-site power to the plant should not be put at risk. To that effect, all efforts should be made to ensure that off-site power remains available and secure at all times;
4. All structures, systems and components essential to the safe and secure operation of ZNPP should be protected from attacks or acts of sabotage;

No action should be taken that undermines these principles.

4.4. The risk of blackout

The risk of a blackout is currently one of the biggest threats to the continued stable and safe operation of nuclear facilities in Ukraine. Russia is deliberately bombing Ukrainian electricity-generating and distributing facilities.⁸⁵

Already on 22-23 November 2022, heavy shelling severely impacted Ukraine's national energy infrastructure, causing all nuclear power plants in the country to lose access to the main electricity grid simultaneously.⁸⁶ These facilities had to rely on their emergency diesel generator systems to maintain safe operation. This blackout followed the systematic shelling of Ukrainian power stations and networks that began on 10 August of the same year. The destruction of electrical equipment led to a widespread blackout, triggering the activation of emergency safeguards at operational nuclear power plants, which also lost external sources of electricity. Satellite images showing a darkened Ukraine were widely circulated by global media outlets.

⁸³ Nuclear Safety, Security and Safeguards in Ukraine. IAEA Report GOV/2022/52. 9 September 2022

⁸⁴ IAEA Director General Statement to United Nations Security Council. IAEA. 30 May 2023

⁸⁵ Amages and Losses to Ukraine's Energy Sector. KSE. 10 June 2024 <https://kse.ua/about-the-school/news/damages-and-losses-to-ukraine-s-energy-sector-due-to-russia-s-full-scale-invasion-exceeded-56-billion-kse-institute-estimate-as-of-may-2024/>

⁸⁶ IAEA, 'Nuclear Safety, Security and Safeguards in Ukraine', 19.

The accident at the Fukushima NPP demonstrates why the lack of a reliable electricity supply poses significant risks. Before the conflict, ZNPP had four 750kV and six 330kV lines available. Currently, it relies on one or two lines that are constantly shelled.⁸⁷



Photo 4. Satellite photo of Europe showing the blackout in Ukraine on 23 November 2023⁸⁸

⁸⁷ Update 229 – IAEA Director General Statement on Situation in Ukraine. IAEA. 23 May 2024

⁸⁸ Satellite photo showing the complete blackout in Ukraine on 23 November NASA/Reuters/Worldview <https://worldview.earthdata.nasa.gov/>

5. International regulations, mechanisms, and institutional capacity to respond to the military invasion of nuclear facilities

The occupation and targeting of ZNPP is a truly unprecedented moment in history. This is the first time that a fully functional and operational nuclear power plant has been directly threatened by an armed military attack. And these threats have not been mere verbal remarks or commentary passed. The risks entail both attacks launched at the plant as well as the possibility of attacks being launched from the plant, with ZNPP acting in essence as a base of sorts. Indeed, as the preceding section detailed, the presence of shelling in close proximity to the plant as well as the storing of military equipment on the premises indicate that these risks are real and without concrete action, potentially catastrophic.

The occupation of ZNPP (and the earlier occupation of ChNPP) has brought the world to an important moment, one fraught with risk but also opportunity. One miscalculation could prove to be the critical moment that could set in motion an irreversible process of unleashing the radioactivity contained in the ZNPP's six reactors and tons of spent fuel stored on plant grounds. Radiation knows no borders and this scenario could be deadly for Ukraine, Russia, and much of Europe and surrounds.

Along with assessments of the risk and potential scenarios that could unfold at the ZNPP, its occupation, and threat by armed attacks have also prompted a review of the legal frameworks and mechanisms designed to prevent – and mitigate – the extreme scenario of a nuclear power plant falling victim to armed attack. A thorough review of these frameworks reveals that the present scenario has been on the minds of policymakers for some time (decades) but that enforcement and follow-through, often impeded by a lack of political will, is falling short.

The Treaty on the Non-Proliferation of Nuclear Weapons does not speak to the physical protection of nuclear installations; however, it does sanction the peaceful uses of nuclear energy. It is for this reason that it should be considered here. The NPT entered into force in 1970 and is the only non-proliferation treaty to which the nuclear weapons states (albeit not all of them) belong. Under Article IV of the NPT states are provided the “inalienable right” to the peaceful uses of nuclear energy which entails the development of research, “production and use of nuclear energy for peaceful purposes” provided that it does not violate the principles of non-proliferation. Furthermore, under Article IV, all parties to the NPT “undertake to facilitate, and have the right to participate in the fullest possible exchange of equipment, materials and scientific and technological information for the peaceful uses of nuclear energy”.⁸⁹

Because of this *inalienable right* to the peaceful uses of nuclear energy, and seeing how the NPT already makes provisions for preventing the further proliferation of nuclear weapons, the legal framework also requires mechanisms that will ensure the safety and security of nuclear facilities linked to the peaceful uses of nuclear energy. Indeed, this is an area not left uncovered by international law and several mechanisms are in place that speak precisely to the protection of nuclear installations from armed attack. However, these are situated in customary international law rather than in the body of treaty law and a binding, multilateral treaty specifically centred

⁸⁹ United Nations Office for Disarmament Affairs (UNODA), ‘Treaty on the Non-Proliferation of Nuclear Weapons’, UN Office for Disarmament Affairs Treaties Database, <https://treaties.unoda.org/t/npt>.

on this purpose is yet to be created. This does, however, not detract from the weight carried by customary international law.⁹⁰ In addition, there are also regional mechanisms – like the Pelindaba Treaty, for example – that address this issue and strengthen the international mechanisms to which state parties adhere.

The International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT), in force since 2007, is one of the key instruments that form part of the international legal framework for the physical protection of nuclear installations. ICSANT has 124 states parties and both Ukraine and the Russian Federation are parties to this treaty.⁹¹ This treaty criminalises acts of nuclear terrorism, including its planning or threatening to use nuclear terrorism. Still, according to Article 4 of ICSANT, the activities of armed forces during conflict are not covered by the treaty.

Article 4 of the treaty states that⁹²

The activities of armed forces during an armed conflict, as those terms are understood under international humanitarian law, which are governed by that law are not governed by this Convention, and the activities undertaken by military forces of a State in the exercise of their official duties, in as much as other rules of international law govern them, are not governed by this Convention.

This treaty is, therefore, not applicable to the current situation in Ukraine. Another instrument linked to the protection of peaceful uses of nuclear energy is the Convention on the Physical Protection of Nuclear Material (CPPNM), in force since 1987. 163 states have ratified the treaty. The CPPNM applies directly to “nuclear material used for peaceful purposes while in international nuclear transport”.⁹³ It is also not applicable to the current situation in Ukraine since it “does not apply to nuclear materials used for military purposes or to those used for peaceful purposes but not in international transport”.⁹⁴ Nuclear material in use or storage (i.e. not in transport) is covered by a revision to the CPPNM contained in the document INFCIRC/225/Rev.4. These revisions, however, do not speak specifically to the incident of *armed attack* but relates its mechanisms to the protection of nuclear material during use and storage against sabotage. It covers nuclear power reactors specifically (but does briefly speak to other nuclear facilities) and advises states that:⁹⁵

⁹⁰ See Bosman, I., ‘Legal Protection for Zaporizhzhya Nuclear Power Plant’.

⁹¹ Nuclear Energy Agency (NEA), ‘International Convention for the Suppression of Acts of Nuclear Terrorism (Nuclear Terrorism Convention or ICSANT)’, International Conventions and Agreements: Nuclear Law, no date, https://www.oecd-nea.org/jcms/pl_29143/international-convention-for-the-suppression-of-acts-of-nuclear-terrorism-nuclear-terrorism-convention-or-icsant.

⁹² United Nations, ‘International Convention on the Suppression of Acts of Nuclear Terrorism’, 2005, 4 <https://treaties.un.org/doc/db/Terrorism/english-18-15.pdf>.

⁹³ Nuclear Threat Initiative (NTI), ‘Convention on the Physical Protection of Nuclear Material (CPPNM)’, 2023, <https://www.nti.org/education-center/treaties-and-regimes/convention-physical-protection-nuclear-material-cppnm/#:~:text=The%20amended%20CPPNM%20legally%20binds,use%2C%20storage%2C%20and%20transport>.

⁹⁴ NTI, CPPNM.

⁹⁵ IAEA, ‘The Physical Protection of Nuclear Material and Nuclear Facilities’, INFCIRC/225/Rev.4, <https://www.iaea.org/sites/>

The concept of physical protection to protect against sabotage requires a designed mixture of hardware (security devices), procedures (including the organisation of guards and the performance of their duties), and facility design (including layout). The level of the physical protection measures should be specifically designed to take into account the nuclear facility or nuclear material, the State's design basis threat, and the radiological consequences. Emergency procedures should be prepared to counter effectively the State's design basis threat.

The only international legal instruments in which the physical protection of nuclear installations against armed attack finds expression are in the two additional protocols to the Geneva Conventions and the Rules of International Humanitarian Law. In other words, customary international law.⁹⁶

In the absence of a multilateral treaty prohibiting armed attacks against nuclear installations, customary international law is the authority with the most weight on the subject.⁹⁷ In the first place, the Rules of International Humanitarian Law prohibit armed attacks against installations containing “dangerous forces” such as radioactive material. Specifically, Rule 42 states that:⁹⁸

Particular care must be taken if works and installations containing dangerous forces, namely dams, dykes and nuclear electrical generating stations, and other installations located at or in their vicinity are attacked, in order to avoid the release of dangerous forces and consequent severe losses among the civilian population.

These sentiments are echoed in Article 56(1) of Additional Protocol I to the Geneva Conventions and Article 15 of Additional Protocol II to the Geneva Conventions. Under these articles:⁹⁹

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. Other military objectives located at or in the vicinity of these works or installations shall not be made the object of attack if such attack may cause the release of dangerous forces from the works or installations and consequent severe losses among the civilian population.

However, in 2019, the Russian Federation withdrew its earlier ratification of the Protocol, which had been ratified in 1989.

[default/files/infcirc225r4c.pdf](#).

⁹⁶ See Bosman, I., ‘Legal Protection for Zaporizhzhya Nuclear Power Plant’.

⁹⁷ Bosman, I., ‘Legal Protection for Zaporizhzhya Nuclear Power Plant’.

⁹⁸ Rules of International Humanitarian Law, ‘Rule 42. Works and Installations Containing Dangerous Forces’, International Humanitarian Law Databases, International Committee of the Red Cross, <https://ihl-databases.icrc.org/en/customary-ihl/v1/rule42>

⁹⁹ Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), ‘Article 56 – Protection of works and installations containing dangerous forces’, June 8, 1977,

<https://ihl-databases.icrc.org/en/ihl-treaties/api-1977/article-56?activeTab=undefined> ; see also Bosman, I., ‘Legal protection for Zaporizhzhya Nuclear Power Plant’.

In addition to these instruments, the safety of nuclear facilities is also regulated at the IAEA level by the resolutions of the General Conference:

GC(XXVII)/RES/407 (1983)¹⁰⁰ - Implementation of safety principles in all phases of the life cycle of nuclear facilities, determination of requirements for nuclear safety at a level that ensures an adequate level of protection for workers, population and the environment, implementation of technical and organizational measures to ensure the safety of nuclear facilities, ensuring continuous improvement of the safety management system.

GC(XXIX)/RES/444 (1985)¹⁰¹ - Establishment of requirements for nuclear safety for work with the processing of nuclear materials, including storage, processing, and transportation.

GC(XXX3)/RES/475 (1987)¹⁰² - Establishment of requirements for nuclear safety for work with the production and use of nuclear fuel materials, including storage, processing, and transportation.

GC (XXXIV)/RES/533 (1990)¹⁰³ - Establishment of requirements for nuclear safety for work with disposal of nuclear waste, including storage, processing, and transportation.

GC(53)/DEC/13 (2009)¹⁰⁴ - Establishment of requirements for nuclear safety for work with the safety of nuclear materials during their transportation, including storage, processing, and transportation.

There is, therefore, a clear recognition at the international level of the importance of protecting nuclear installations during armed conflict. But what seems to be lacking is political will to enact additional mechanisms to ensure that this can be done as well as shortcomings in the application of international law. Even in the case of the Pelindaba Treaty, where armed attack is specifically prohibited, there is no indication of how this article could be applied to a state that violates its rules and, therefore, no precedent to draw from.

What is also clear is that the threat of armed attack against nuclear installations is something that has concerned the international community for some time, but it has not done enough to ensure the necessary legal framework is drafted. For example, as far back as 1990 with resolution 533 of the IAEA General Conference, the threat linked to the armed attack on nuclear installations and the need for a multilateral legal mechanism to prohibit it was recognised.

100 IAEA, Resolutions and other decisions of the General Conference, XXVII General sessions 10-14 October 1983 https://inis.iaea.org/collection/NCLCollectionStore/_Public/40/087/40087663.pdf

101 IAEA, Protection of nuclear installations devoted to peaceful purposes against armed attacks, XXIX General conference 27 September 1985 https://www.iaea.org/sites/default/files/gc/gc29res-444_en.pdf

102 IAEA, Measures to strengthen international co-operation in nuclear safety and radiological protection, XXXI General conference 5 October 1987 https://www.iaea.org/sites/default/files/gc/gc31res-475_en.pdf

103 IAEA, Measures to strengthen international co-operation in matters relating to nuclear safety and radiological protection, XXXIV General conference October 1990 https://www.iaea.org/sites/default/files/gc/gc34res-533_en.pdf

104 IAEA, Prohibition of armed attack or threat of attack against nuclear installations, during operation or under construction, GC(53), September 2009 https://www.iaea.org/sites/default/files/gc/gc53dec-13_en.pdf

GC(XXXIV)/RES/533, the resolution adopted at the conference in 1990, states the following:¹⁰⁵

The General Conference...aware of the fact that an armed attack on a nuclear installation could result in radioactive releases with grave consequences within and beyond the boundaries of the State which has been attacked, convinced of the need to prohibit armed attacks on nuclear installations from which such releases could occur and of the urgency of concluding an international agreement in this regard, and aware of the ongoing work of the Conference on Disarmament with a view to concluding an international agreement in this regard, 1. Recognizes that attacks or threats of attack on nuclear facilities devoted to peaceful purposes could jeopardize the development of nuclear energy; 2. Considers that the safeguards system of the Agency is a reliable means of verifying the peaceful uses of nuclear energy; 7. Urges all States to cooperate in achieving a successful resolution of the issue in the near future.

The gap in the legal framework was therefore identified decades ago, but no concrete action on further enhancing the regulatory framework to address the issue of armed attacks against nuclear installations has been taken. In addition, even where customary international law has apparently been violated, it seems that the enforcement mechanisms are limited and the best that can be done is to address escalation as it happens. There are, therefore, questions remaining regarding whether any additional legal frameworks will have any real impact. Interpretation of the law is also a tricky subject, and parties in violation could always argue that they did not deem their actions to be in violation of international humanitarian law since, in their assessment, it would not have caused the release of dangerous forces.¹⁰⁶

105 IAEA. Measures to Strengthen International Co-operation in Matters Relating to Nuclear Safety and Radiological Protection. Resolution adopted during the 332nd plenary meeting on 21 September 1990. Prohibition of All Armed Attacks Against Nuclear Installations Devoted to Peaceful Purposes, Whether Under Construction or in Operation. https://www.iaea.org/sites/default/files/gc/gc34res-533_en.pdf.

106 See Bosman, I. 'Legal Protection for Zaporizhzhya Nuclear Power Plant'.

6. Leading the change for the safe nuclear industry on the continent

It is in the interest of the African countries to have a clear mechanism that can prevent the military aggression of one state against the NPP of another state. AU should work towards establishing mechanisms that would ensure the liability of the aggressor and that would prevent the potential occupation of nuclear power facilities.

African countries can initiate the UN Resolution on "Safety and Protection of Nuclear Power Plants in Wartime" and consider dispatching peacekeepers to protect nuclear facilities in Ukraine. This would be in line with Director General R. Grossi's call for a "Nuclear Safety and Security Protection Zone."

African countries can benefit from being involved in the securing peace mission to the Ukrainian Zaporizhzhya NPP as this would provide them with first-hand experience in managing the military aggression on the NPP.

The case of military aggression of the country with the nuclear weapon against the country that gave up nuclear weapons and joined NPT creates additional risk for the African continent that has joined NPT as it stimulates countries to focus on developing nuclear weapons to defend their sovereignty and territorial integrity.

The involvement of Rosatom in the military occupation of nuclear facilities and support for human rights violations against ZNPP and ChNPP personnel raise questions about Rosatom's integrity and dedication to nuclear safety. This situation also jeopardizes African countries who are planning to cooperate with Rosatom in peaceful nuclear development.

The development of nuclear weapons is closely linked to the expression of power and domination in global governance. The African continent has deliberately chosen to be a Nuclear-Weapon-Free Zone and to develop only peaceful nuclear technology. However, the Russian invasion of Ukraine - a country that relinquished its nuclear weapons and joined the Non-Proliferation Treaty - challenges the notion that NPT member states can be assured of safety from aggression.

Recommendations:

1. The nuclear disasters at the Chornobyl NPP and Fukushima NPP illustrate that once radiation is released from reactor cores, it is irreversible and incredibly difficult to contain. Therefore, it is imperative that the African Union develops the necessary legislation to ensure that all member states uphold the highest level of nuclear safety, particularly the essential pillars for ensuring nuclear safety and security during an armed conflict. Immediate action must be taken if any country violates these nuclear safety principles.
2. The occupation of the Chornobyl NPP by the Russian military violates international legislation and breaches the Nuclear Safety Pillars. The occupation of the Zaporizhzhya NPP poses a daily risk of a nuclear accident. The African Union and the members of the IAEA Board (Algeria, Burkina Faso, Kenya, Namibia, South Africa) should advocate for international legislation to make the protection of nuclear safety facilities during armed

conflicts binding international law. They should also support the UN General Assembly Resolution demanding that the Russian Federation immediately return full control of the Zaporizhzhya Nuclear Power Plant to Ukrainian authorities.

3. To prevent the dramatic militarisation of all countries in the world, the AU and African states should be strong voices in defending any NPT member under military attack.
4. The construction of a nuclear power station in Egypt, in close proximity to military conflict, makes it urgent for the African continent to propose legislation that ensures nuclear safety across the continent.
5. In the 1990s, resolution GC(XXXIV)/RES/533 recognised that attacks or threats of attack on nuclear facilities dedicated to peaceful purposes could jeopardise the development of nuclear energy technology. However, there has been a lack of political will within the international community to define what constitutes a military attack on such facilities clearly. It is now high time to muster the courage and approve international legislation that ensures the protection of nuclear power plants.
6. Russian State Corporation Rosatom, a key partner in developing nuclear energy on the African continent, has been involved in and witnessed violations of nuclear safety principles at the Chornobyl and Zaporizhzhya NPPs. Rosatom's breach of these principles threatens the safe development of the nuclear industry in its partner countries on the continent. The partnership with Rosatom should be reassessed, and suspension should be considered until effective measures are implemented by the IAEA and the UN to protect nuclear facilities.
7. The African Peace Mission can implement the following steps to support the peaceful resolution of the war and ensure nuclear safety:
 - a. Negotiate Russia's agreement in the UNSC to introduce a peacekeeping contingent around the Zaporizhzhya Nuclear Power Plant (ZNPP).
 - b. Secure permanent consent from Russia for the IAEA to access all areas of the ZNPP.
 - c. Initiate an agreement to enforce a no-fly zone over all nuclear installations in Ukraine.
 - d. Support the return of all personnel detained at the Chornobyl Nuclear Power Plant (ChNPP) and ZNPP who remain in Russia as prisoners of war.
 - e. Establish a human rights observation mission at the ZNPP.
 - f. Approve a proposal similar to one of China's 12-point peace proposals, which clearly opposes attacks on nuclear facilities: "China opposes armed attacks against nuclear power plants or other peaceful nuclear facilities."

7. About the authors

ISABEL BOSMAN

Isabel Bosman is a Researcher at the South African Institute of International Affairs' African Governance and Diplomacy Programme. She holds an MA in Political Studies from the University of the Witwatersrand in Johannesburg, South Africa. From 2020, she worked on SAIIA's Atoms for Development Project, which focused more broadly on the peaceful use of nuclear energy in Africa and nuclear governance issues. Her work also focuses on the nexus between technology and politics, democracy, elections, security, and non-proliferation.

OLENA LAPENKO

Olena Lapenko is an energy security expert at the Ukrainian think tank DiXi Group. Olena has 15 years of practical experience in the energy industry, both in the operation of electrical equipment and in commercial operations in the electricity market. She is working on issues related to strengthening Ukraine's energy resilience and the security of energy resource supplies. At the same time, she is an external consultant to the Ministry of Energy of Ukraine.

Dzvinka Kachur

is a research fellow at the Centre for Sustainability Transitions at Stellenbosch University, South Africa, and co-founder of the NPO 'Ukrainian Association of South Africa'. Her research interests include disinformation in South Africa and Russian influences in Sub-Saharan Africa. She has published works on the Nuclear Deal in South Africa, Russian nuclear diplomacy on the continent, and Russian presence in Mozambique, Zimbabwe, Tanzania, and Zambia. Dzvinka holds degrees from the University of Oxford (MSc) and the National University of Kyiv-Mohyla Academy (MSc). Since the full-scale invasion of Ukraine in February 2022, she has focused on South African responses to the Russian war in Ukraine and its influence on the African continent.

This policy brief is one of three collaboratively developed by experts from South Africa and Ukraine to support the African peace mission to Ukraine, Russia, and the Ukraine Peace Formula.

The platform for expert collaborations was initiated by the Institute of Justice and Reconciliation, the Desmond and Leah Tutu Legacy Foundation, the Democratic Initiatives Foundation (DIF), and the Ukrainian Association of South Africa (UAZA).

The topics and experts involved:

Regional Security Architecture and Just Peace - power disbalance of the countries with the veto rights at the UN Security Council and under-representation of the African continent.

Experts from the following institutions involved: the Institute of Justice and Reconciliation, Political Department of the University of Cape Town, Centre for Sustainability Transitions, Stellenbosch University, Democratic Initiatives Foundation, National University of Kyiv-Mohyla Academy

Nuclear safety - risks related to the occupation of the Zaporizhzhia Nuclear Power Station.

Experts from the following institutions involved: South African Institute of International Affairs, Dixi Group, Centre for Sustainability Transitions, Stellenbosch University

Forceful deportation of children – which international and regional mechanisms can be used to prevent children's unlawful and forceful deportation and transfer to Russian territories, and how the national identity of children can be protected during the war.

Experts from the following institutions involved: the Centre for Human Rights, the Centre for Child Law, the Regional Centre for Human Rights, and the Centre for Civil Liberties

If you have suggestions or recommendations about the topics presented in these case studies, please do not hesitate to contact Dzvinka Kachur at info@uaza.co.za