THE INDISPENSABLE PILLARS OF NUCLEAR SAFETY AND SECURITY

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I. Introduction

Nuclear technology is an essential part of global solutions for all humanity. Yet, nuclear technology has been seriously concerned for various reasons, some of which are recently human-made tensions. In this regard, the recent Russian invasion of Ukraine caused tensions as Ukrainian nuclear power plants (NPP) have become a part of the invasion. Although nuclear power plants have a more robust protection infrastructure, it is clear that they are not designed for war zones.

In this vein, the article evaluates the Seven Indispensable Pillars of Nuclear Safety and Security which were outlined by the Director General of the International Atomic Energy Agency (IAEA) at a meeting of the IAEA's Board of Governors on 2 March, convened to address the safety, security and safeguards implications of the situation in Ukraine. The article will highlight and overview the importance of the Seven Pillars, which gained worldwide support from the Member States.

II. Nuclear Security and Nuclear Safety

The IAEA defines nuclear security as "the prevention of, detection of, and response to, criminal or intentional unauthorized acts involving or directed at nuclear material, other radioactive material, associated facilities, or associated activities" while defining nuclear safety as "the protection of

people and the environment against radiation risks, and the safety of facilities and activities that give rise to radiation risks." [*1*]

In other words, nuclear security focuses on protecting materials and related facilities to prevent negligent and/or malicious human actions. In contrast, nuclear safety focuses on proper operating conditions and the prevention of nuclear accidents to protect both humans and the environment from possible radiation hazards. [*2*]

While nuclear security and safety have different dimensions, the aim is to protect people, society, and the environment from the harmful effects of ionizing radiation. Regardless of the cause, which might be an unsafe act or a security breach, all Member States should establish and implement a strong, sustainable, and effective nuclear safety and security regime to benefit from nuclear technology safely and securely. [*3*]

However, nuclear facilities are not designed for war zones, even though the Design Basis Threat (DBT) requires states to implement a more robust defence strategy than many other civilian structures. In other words, while NPPs have robust and resilient designs to withstand threats posed by terrorist groups, they are not designed to withstand military bombardment. [*4*]

And an NPP should not only consider consisting of reactors when it comes to safety and security. Many auxiliary systems ensure the safe and secure operation of an NPP. Irrespective of reactor technologies, all NPPs have cooling and moderating systems. For example, water works as both coolant and moderator in light water reactors (LWR), while carbon dioxide and graphite are used as coolant and moderator in gas-cooled reactors (GSR). And in case of loss of reactor coolant flow, reactor core might take extreme damages resulting in melting down of reactor core and releasing radioactive substance. [*5*]

This is why Director General Grossi outlined the Seven Pillars to address concerns related to armed conflict. These Seven Pillars highlight the essential nuclear safety and security-related issues that are of particular significance during these unprecedented circumstances in which military forces are near or on the site of nuclear facilities. They derive from the IAEA safety standards and nuclear security guidance, reflecting high levels of safety and security to protect people and the environment against the harmful effects of ionizing radiation.

The Seven pillars are:

1. ***The physical integrity of the facilities – whether it is the reactors, fuel ponds, or radioactive waste stores – must be maintained;***
2. ***All safety and security systems and equipment must be fully functional at all times;***
3. ***The operating staff must be able to fulfil their safety and security duties and have the capacity to make decisions free of undue pressure;***
4. ***There must be a secure off-site power supply from the grid for all nuclear sites;***
5. ***There must be uninterrupted logistical supply chains and transportation to and from the sites;***
6. ***There must be effective on-site and off-site radiation monitoring systems and emergency preparedness and response measures; and***
7. ***There must be reliable communications with the regulator and others.*** [*6*]

The IAEA states that the Seven Pillars have received widespread support from the Member States. And Director General Grossi argues that threats to the safety and security of nuclear facilities and

materials, such as armed conflicts, violate the Seven Pillars of Nuclear Safety and Security in his speech to the IAEA Board of Governors meeting in March 2022. [*6*]

It should also be remembered that several international documents address concerns about protecting NPPs during a military conflict. These include, but are not limited to, the Additional Protocol I to the Geneva Conventions, [*7*] Rule 42 of International Humanitarian Law (IHL), [*8*] rules within the Law of Armed Conflict (LOAC), [*9*] and several IAEA General Conference Resolutions [*10*] and Decisions. [*11*]

These international instruments prohibit armed attacks on nuclear facilities as they would severely damage people, society, and the environment. Such different international mechanisms demonstrate the need to protect NPPs during a military conflict, as its effects would be beyond the warring parties.

III. Current Challenges

The Russian invasion of Ukraine has many important aspects to discuss. Nevertheless, the article approaches the invasion from nuclear security and safety perspective, not attempting a political resolution to the current political situation in Ukraine. In this vein, the war takes place in a country with an extensive and advanced nuclear power infrastructure for the first time in history.[*12*]

Although there has been one other NPP, Krško Nuclear Power Plant in Slovenia, located in an active war zone while operational during Yugoslavia's dissolution in 1991, it was not directly targeted during the war.[*13*]

This increases the importance of the NPPs in Ukraine as they have been taken over by Russian military officers, and there has been continuous shelling on the NPPs, mainly Zaporizhzhia Nuclear Power Plant, which caused panic both in and beyond Ukraine because it is the largest NPP in continental Europe.[*12*]

IAEA

Seven Pillars of Nuclear Safety

1

The physical integrity of the facilities – whether it is the reactors, fuel ponds, or radioactive waste stores – must be maintained.

2

All safety and security systems and equipment must be fully functional at all times.

3

The operating staff must be able to fulfil their safety and security duties and have the capacity to make decisions free of undue pressure.

4

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

5

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

6

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

7

There must be reliable communications with the regulator and others.

Figure 1: Seven Pillars of Nuclear Safety and Security. (Source: the IAEA)

It can be clearly stated that it is essential for nuclear facilities to be operated and managed safely and securely under all conditions. And the IAEA safety standards and security guidelines must be upheld under even the very challenging circumstances witnessed over the last months. In this vein, although the Seven Pillars are considered essential for the safe and secure operation of NPPs, implementing the Seven Pillars is not an easy task during an ongoing invasion.

This is why the IAEA published a report after the IAEA Support and Assistance Mission to Zaporizhzhya (ISAMZ) in Ukraine. [*14*] The IAEA mission was expected to help ensure nuclear safety and security at the Zaporizhzhya NPP and undertake vital safeguards activities. Following the visit, Director General Grossi stated, "It is obvious the physical integrity of the plant has been violated several times.

This is a reality that cannot continue to happen." And he added that some members of the IAEA will be there to stay and will maintain a continued presence. [*15*] As the IAEA has no authority to order a cease-fire or create a demilitarized zone on its own, the IAEA issued recommendations to help reduce the risk of a nuclear accident concerning the Seven Pillars.

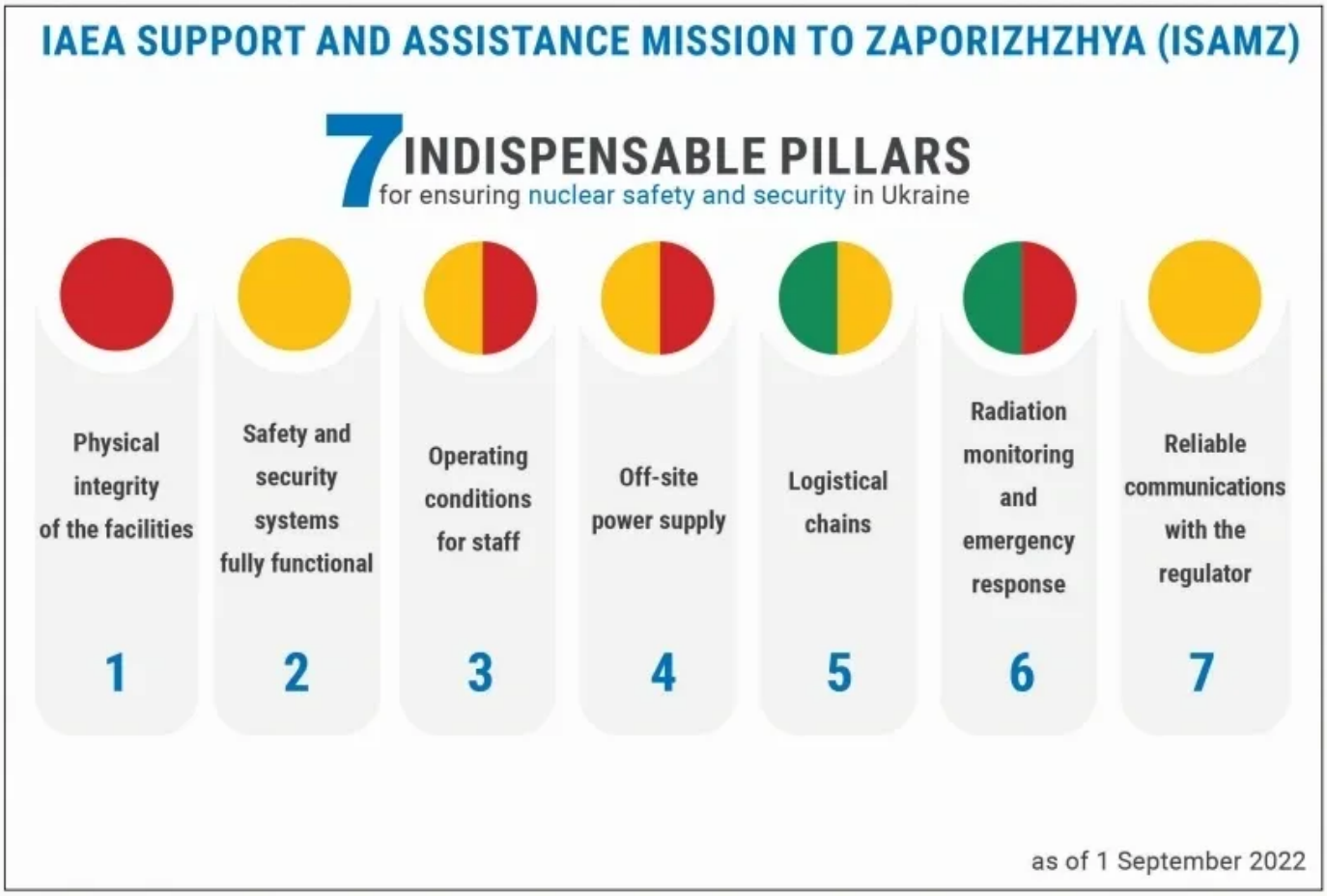

Figure 2 Nuclear Safety and Security Status in ZaporizhzhiNuclear Power Plant Source: the IAEA

The first recommendation is that shelling on site and in its vicinity should be stopped immediately to avoid any further damages to the plant and associated facilities for the safety of the operating staff and to maintain the physical integrity to support safe and secure operation. This requires agreement by all relevant parties to establish a nuclear safety and security protection zone around the ZNPP. [*14*]

The second recommendation is that the physical protection system should be operated as designed and licensed and that the continued functioning of safety and security systems and operability of the systems and equipment at ZNPP be ensured. This requires the removal of vehicles from areas that could interfere with the operation of safety and security systems and equipment. **[*14*]**

The third recommendation is that an appropriate work environment, including family support, for operating staff should be re-established. Furthermore, as the operator has the prime responsibility for nuclear safety and security, it should be able to fulfil its mission with clear lines of responsibility and authority.**[*14*]**

The fourth recommendation is that the off-site power supply line redundancy, as designed, should be re-established and available at any time and that all military activities that may affect the power supply systems end.**[*14*]**

The fifth recommendation is that all concerned parties should commit and contribute to ensuring effective supply chains for continued nuclear safety and security of the plant under all conditions, including safe transportation corridors, taking advantage of the IAEA assistance and support program as appropriate.**[*14*]**

The sixth recommendation is that the emergency response functions should be drilled and exercised, the emergency response facilities to support these functions should be re-established, and preparedness should be re-established through regular training, transparent decision-making chains, and readily available communication means and logistical support. ISAMZ can assist in the preparation and support for such training.**[*14*]**

The last recommendation is that reliable and redundant communication means and channels, including internet and/or satellite connectivity, should be ensured with all external organizations necessary for the safe and secure operation of the facility.**[*14*]**

As clearly seen in these recommendations, the assessment of the safety and security situation at the Russian-controlled ZNPP highlights that physical integrity, along with other pillars, has been violated amid weeks of fighting nearby. Accordingly, the IAEA proposed establishing a nuclear safety and security protection zone around the ZNPP, which is receiving strong international support. Detailed talks for such a zone have now begun with Ukraine and Russia aimed at agreeing and implementing it as soon as possible. It is safe to state that establishing such a zone will reinforce the Seven Pillars.

III.Conclusion

Nuclear technology has the potential to offer solutions to the global problems faced today. Instead of focusing on how it could serve the needs of humanity, the focus on nuclear technology has been diverted from its peaceful use since the beginning of the Russian invasion of Ukraine, either with a threat of nuclear weapons or a threat of nuclear due to the active armed conflict which violates the essential Seven Pillars of Nuclear Safety and Security.

In this regard, the article offered an overview of the Seven Pillars and detailed the recommendations that the IAEA offered to provide safe and secure operation of nuclear power plants. Accordingly, it can be stated that although Seven Pillars are essential for the safe and secure operation of NPPs, they merely represent perceived good practices in an environment about which the IAEA has limited jurisdiction at present.

About the Author

Ali Alkis is the World Institute for Nuclear Security (WINS) Ambassador to Turkiye, a Nuclear Scholar in the UK's Nuclear Security Culture Programme (NSCP), and a PhD student at the Department of International Relations at Hacettepe University. And he has been recently appointed as an affiliated researcher and Gender Champion at the Odesa Center for Non-Proliferation (OdCNP). His research interests are nuclear security, non-proliferation and arms control, as well as Turkish nuclear and foreign policies.

He strongly supports that only with a robust nuclear security culture and a well-established nuclear security approach we can enjoy the benefits of nuclear energy. In this regard, he believes that Turkiye, as a newcomer nuclear-power state, has a considerable potential to contribute to both regional and global nuclear security structure, while his role would be to support Turkiye in achieving a robust nuclear security culture.

REFERENCES

1. IAEA, "Objective and Essential Elements of a State's Nuclear Security Regime," *IAEA Nuclear Security Series No. 20* (International Atomic Energy Agency, Vienna, 2013), (available at https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1590_web.pdf).

2. M. A. Alkış, Threat of Nuclear Terrorism: The Developing Nuclear Security Regime. *Int. J. Nucl. Secur.* **7**, 1–16 (2022).

3. M. A. Alkış, NUCLEAR SECURITY: A CASE STUDY OF ZAPORIZHZHIA. *Indian Strategic Studies Forum*, (available at https://issf.org.in/read/f/nuclear-security-a-case-study-of-zaporizhzhia).

4. M. Sparkes, Zaporizhzhia Nuclear Power Plant "not designed to withstand fighting." *New Scientist*, (available at https://www.newscientist.com/article/2333578-zaporizhzhia-nuclear-power-plant-not-designed-to-withstand-fighting/).

5. M. A. Alkış, *Threat of Nuclear Terrorism: Towards an Effective Nuclear Security Regime* (Hacettepe University, Ankara, 2017; http://hdl.handle.net/11655/3794).
6. IAEA Director General's Introductory Statement to the Board of Governors. *IAEA* (2022), (available at https://www.iaea.org/newscenter/statements/iaea-director-generals-introductory-statement-to-the-board-of-governors-02-03-2022).
7. Article 56, Additional Protocol I to the Geneva Conventions. *International Committee of the Red Cross*, (available at https://ihl-databases.icrc.org/applic/ihl/ihl.nsf/4e473c7bc8854f2ec12563f60039c738/3376730ecd9df7b1c12563cd0051dd37).
8. J.-M. Henckaerts, L. Doswald-Beck, in *Customary International Humanitarian Law* (Cambridge University Press, Cambridge, 2005; https://www.icrc.org/en/doc/resources/documents/publication/pcustom.htm), vol. I: Rules, pp. 139–142.
9. T. Normand, J. Poarch, The Law of Armed Conflict (LOAC). *LOACBlog.com*, (available at https://loacblog.com/loac-basics/4-basic-principles/).
10. IAEA, "General Conference Resolution GC(XXXIV)/RES/533" (International Atomic Energy Agency, 1990), (available at https://www.iaea.org/sites/default/files/gc/gc34res-533_en.pdf).
11. IAEA, "General Conference Decision GC(53)/DEC/13" (International Atomic Energy Agency, 2009), (available at https://www.iaea.org/sites/default/files/gc/gc53dec-13_en.pdf).
12. A. Smith, Why is the world so worried about Ukraine's Zaporizhzhia nuclear plant? *CNBC*, (available at https://www.cnbc.com/2022/08/13/why-is-the-world-so-worried-about-ukraines-zaporizhzhia-nuclear-plant.html).
13. A. Kovynev, Nuclear plants in war zones. *Nuclear Engineering International*, (available at https://www.neimagazine.com/features/featurenuclear-plants-in-war-zones-4536247/).
14. IAEA, "NUCLEAR SAFETY, SECURITY AND SAFEGUARDS IN UKRAINE" (International Atomic Energy Agency, Vienna, 2022), (available at https://www.iaea.org/sites/default/files/22/09/ukraine-2ndsummaryreport_sept2022.pdf).
15. Ukraine: 'Physical integrity' of Zaporizhzhya nuclear plant 'has been violated several times.' *The United Nations* (2022), (available at https://news.un.org/en/story/2022/09/1125981).