SUSTAINING ATTENTION ON THE SECURITY OF NUCLEAR MATERIALS AND FACILITIES: CHALLENGES AND STRATEGIES IN A SHIFTING GLOBAL LANDSCAPE

Laura Holgate, LSHH International Advisors

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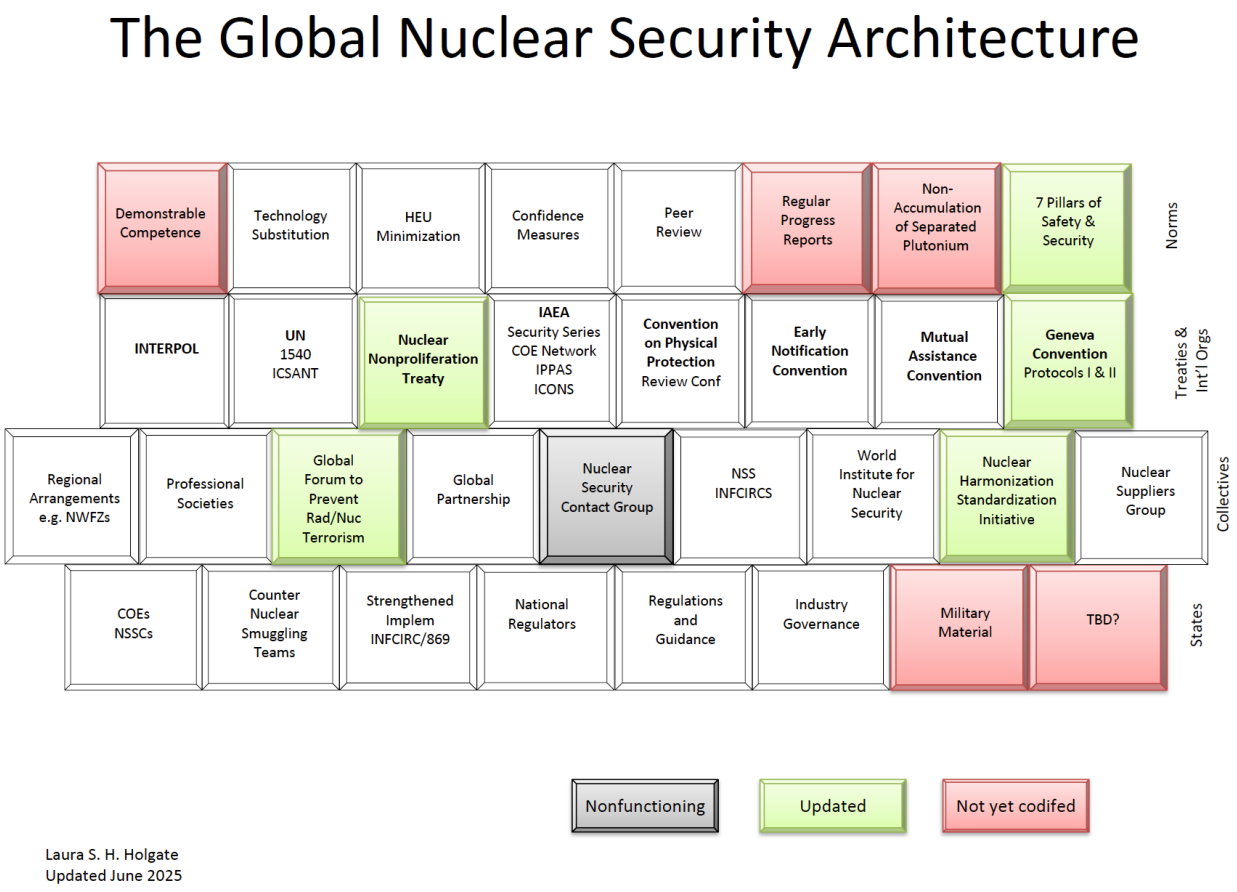
Nearly a decade has passed since the last time nuclear security routinely made headlines, whether on the occasions of four Nuclear Security Summits and the attention gatherings of world leaders can draw, or as some of the more dramatic and visible pledges made during those Summits were achieved. Away from that limelight and facing new challenges, nuclear security is in a phase of regression. In some ways, this is a natural phenomenon as novel risks and new players grab the attention of policymakers and publics. It is also a product of the enormous progress made in the decades leading up to and during the Summit era – many risks had been permanently reduced. International Atomic Energy Agency (IAEA) Director General Rafael Grossi called nuclear security after the Summits "perhaps less heroic but no less important."[1] Many of the risks that remain are less amenable to irreversible elimination; they call instead for long-term commitment to risk management and the network of cooperation and institutions that must endure after the spotlight dims (Nunn and Holgate, Cooperative Risk Management and Reduction: A New Framework for Nuclear Materials Security, 2022 at https://www.nti.org/wp-content/uploads/2022/01/NTI_Paper_CRMR_Final.pdf). The risks themselves are also shifting, as Islamic extremism manifests less as large-scale sophisticated attacks and more as self-radicalized individuals, as right-wing violent groups expand and connect globally while sharing accelerationist ideologies and playbooks with nuclear terrorism scenarios, as renewed interest in nuclear energy may expand the locations and quantities of nuclear materials, and as governments attack adversaries' nuclear facilities with missiles and drones.

The global nuclear security architecture

The diagram of the global nuclear security architecture analyzed in a 2021 paper by Samantha Neakrase (The Global Nuclear Security Architecture: Closing Gaps to Build Greater Assurance, Accountability, and Action, 2021 at https://www.nti.org/analysis/articles/the-global-nuclear-security-architecture-closing-gaps-to-build-greater-assurance-accountability-and-action/) offered four interlocking layers of nuclear security actors and actions: states, collectives, treaties and international organizations, and norms. That analysis found that these layers "do not yet add up to a comprehensive nuclear security system that is based on standards and best practices, that builds confidence, and that leads to reductions in overall stocks of [highly-enriched uranium] HEU and plutonium" (p. 27), while making recommendations for how each of these layers can contribute to the achievement of that comprehensive system.

[1] Remarks at "Building Bridges and Facilitating Consensus for a Successful International Conference on Nuclear Security 2020", panel discussion hosted by Vienna Center for Disarmament and Nonproliferation, January 15, 2020.

Four years later, that architecture could use some updating. Some building blocks have disappeared, some have been rebranded, and new blocks are becoming visible. For example, it is now a generally accepted principle that nuclear security measures must incorporate provisions that protect against a range of cyberthreats, whereas previously key players had argued against the inclusion of cybersecurity as an element of nuclear security. The Global Initiative to Combat Nuclear Terrorism (GICNT) has been suspended in response to the inability of the United States and Russia to maintain joint leadership of the group and the Global Forum to Prevent Radiological and Nuclear Terrorism was created in its place. The Nuclear Security Contact Group is moribund, and the Carnegie Endowment-led "Principles of Conduct for Reactor Vendors" has ceased to function. The IAEA's Nuclear Harmonization and Standardization Initiative (NHSI), initially created to connect nuclear industry and regulators to enhance commonality on safety regulations for advanced and small modular reactors (A/SMRs) has now expanded to include a working group on nuclear security. Russia's attacks on Ukrainian nuclear infrastructure and seizure of the Zaporizhzhia Nuclear Power Plant have spotlighted an additional treaty measure relevant to nuclear security: Protocol I and II to the Geneva Conventions, which prohibit intentional targeting of nuclear power plants during war.



States

By almost every measure, attention of states and leaders to nuclear security is waning. NTI's 2023 Nuclear Security Index (NTIIndex.org) quantifies the decline across multiple indicators, particularly in countries that hold weapons-usable nuclear materials. In the United States, already-declining programmatic budgets for international cooperation on nuclear security across multiple departments and agencies are now in a nosedive as the Trump Administration slashes programs and personnel and muses elimination of entire organizations contributing to the government-wide effort. Recent Executive Orders have placed the golden reputation of the U.S. Nuclear Regulatory Commission (NRC) in jeopardy by attacking its independence and directing a wholesale revision of the NRC's rules (including for security) and regulations to lower "barriers" to nuclear energy deployment. With a few exceptions, other countries are reducing their funding as well, and one Summit host has explicitly stated that its focus on nuclear security is over.

Collectives

Most of the 11 IAEA Information Circulars (INFCIRCs) flowing from the Summits are dormant. With the notable exception of INFCIRC/908 on Mitigating Insider Threats, no new countries have joined these collective pledges in the last five years[2]. Encouragingly, at the 2024 International Conference on Nuclear Security (ICONS), States Parties agreed to two new Joint Statements that have become INFCIRCs, one on the role of nuclear security in harnessing the power of nuclear energy.

Outside the IAEA, the informal groups that have played critical roles in promoting nuclear security are less visible and less active and the Action Plans that came out of the final 2016 Summit have not had the hoped-for staying power to translate the political momentum into the existing and enduring initiatives. The focus of the Global Partnership against the Spread of Weapons and Materials of Mass Destruction has shifted to chemical and biological threats. U.S.-Russian disagreements have stymied further progress within the Nuclear Suppliers Group, including enhancing the role of nuclear technology exporters in eliciting and validating strong nuclear security behavior from their clients. The World Institute of Nuclear Security (WINS) remains a bright spot, with ever-increasing membership and a rich roster of publications, events, and partnerships. The pledges made during the Nuclear Industry Summits that paralleled the Nuclear Security Summits appear forgotten, and the rise of interest in reprocessing and proposed use of weapons-usable nuclear material to fuel new reactors suggests that the global nuclear industry has far to go in applying nuclear security principles into corporate practice.

Treaties and international organizations

The key nuclear security treaties, the Amended Convention on the Physical Protection of Nuclear Material (A/CPPNM) and the International Convention for the Suppression of Acts of Nuclear

[2] nscontactgroup.org/iaea-info-circulars.php

Terrorism (ICSANT), have garnered only five new ratifications apiece in the last two years. Notably, South Africa, a frequent skeptic of increased nuclear security and one of the few remaining holders of civil HEU, ratified the A/CPPNM in 2024. The Geneva Convention itself is universally ratified, but key actors including Russia and the United States are not party to its Protocols, highlighting the important goal of universal adherence to nuclear-security related conventions. None of these legally binding conventions have enforcement mechanisms by which to hold violators accountable. As for the IAEA, the resources and donor group are shrinking for the IAEA's Nuclear Security Fund, which funds the bulk of the Agency's nuclear security activities. The Agency is struggling to provide the full complement of training intended for the new Nuclear Security Training and Demonstration Center in Seibersdorf, which supports the Center's upkeep. In 2024, the IAEA conducted only three International Physical Protection Advisory Service missions, down from a pre-pandemic level of five or six annually. Politically, traditional challengers of the Agency's role in nuclear security have become more vocal and more aggressive in trying to weaken existing consensus resolutions on nuclear security and blocked consensus on the conclusions of the 2024 ICONS, which saw a decline in ministerial-level participation. A sixth revision of the underlying guidance document for nuclear security, INFCIRC/225, is currently underway – whether the result strengthens or weakens current guidelines will be an important bellwether of the health of nuclear security at the IAEA. In 2022, the United Nations Security Council extended its Resolution 1540, and the Committee of Experts that supports it, to 2032. Progress on implementing its legally binding provisions remains slow, and the work of the Committee of Experts has been hampered by political disagreements among Permanent Members of the Security Council.

Norms

The normative value of various statements from the Summits and elsewhere on peer reviews and confidence measures persists, even as support for their codification at the state level or within treaties remains slim. According to the 2023 Nuclear Security Index, only 24 of the 47 countries with significant nuclear facilities had publicly reported on their nuclear security progress in the past two years, 16 countries' reporting scores declined, and 5 countries' reporting scores increased. After some major recent achievements on HEU minimization by Japan and Norway, in practice this effort has stalled as the remaining holders of civilian HEU appear unwilling or unable to remove or eliminate material or convert facilities for political and/or technical reasons. At the same time, all new research reactors are now being fueled by low-enriched uranium (LEU), which suggests that the technology substitution norm has been broadly accepted even if not embedded in national or international commitments, and military HEU holdings are declining. Iran's recent decision to produce HEU is a concerning outlier in this trend, especially as there is no credible civilian use for 60% or higher enrichments in Iran. The current inability of the international community to have confidence in the location and security of 400 kg of Iran's HEU highlights dramatically the nuclear security risks of accumulating such stockpiles. The norm against accumulation of separated plutonium, however, is in even more danger as

plutonium production has significantly increased in France, and renewed interest in spent fuel reprocessing and plutonium fuels is accompanying the rising interest in novel nuclear reactor types, including in the United States, which has long had a policy (though not law) to encourage against civilian reprocessing. The concept of demonstrable competence seems to have disappeared entirely from nuclear security discussions. One measure of demonstrable competence – WINS Academy certification – remains popular, but it is unclear to what degree its achievement is required by national regulations or recognized in voluntary reporting. The seven indispensable pillars of nuclear safety and security promulgated by the IAEA in response to Russia's attacks on Ukraine's nuclear energy infrastructure and radiological storage sites derive from existing (nonbinding) IAEA standards and guidelines, and some efforts have sought to elevate their normative power.[3] France, Russia, the United Kingdom, and the United States have found rare common ground in rhetorically supporting the seven pillars as they relate to Ukraine while blocking their broader codification. These countries have distanced themselves from IAEA resolutions GC(XXIX)/RES/444 and GC(XXXIV)/RES/533 prohibiting armed attacks on nuclear facilities, at least in part because Iran has been the consistent promoter of such efforts.

Deteriorating global context

These mostly negative trends in nuclear security sit against a backdrop that makes progress on nuclear security both more difficult and more important to achieve. The overarching impact of the *COVID pandemic* complicated nuclear security operations and diminished much international cooperation. While the pandemic has receded, it stressed national budgets and more generally elevated biosecurity within the WMD risk management community in a zero-sum way that reduced attention and resources for nuclear security. In parallel, what is often referred to as "*the rules-based international order*" is under pressure from Russia (which desires to break it), China (which desires to coopt it), and many in the global south who ask "whose rules?". This trend weakens the general respect for existing treaties and international institutions, including those related to nuclear security, by challenging their legitimacy and effectiveness. The Treaty on the Non-Proliferation of Nuclear Weapons, the foundation upon which the very concept of nuclear security is based, is feeling these effects as some countries openly contemplate the abrogation of the non-acquisition commitments contained therein and question their value in the face of disappointing – and even reversals of – progress on the disarmament commitments of the five declared nuclear-weapons states. This creates a negative feedback loop in which countries with nuclear weapons are less likely to disarm without credible progress on nuclear security. Other drivers of decisions to acquire nuclear weapons include a *weakened trust in traditional alliances*, the lack of consequences for *attacks by nuclear weapons states on nonweapons states*, and the return of credible *threats to use nuclear weapons* after years of post-Cold War relaxation of

[3] Recognizing the IAEA's Seven Pillars in the Context of Article IV of the Treaty on the Non-Proliferation of Nuclear Weapons; Working paper submitted by Australia, Canada, Colombia, Finland, France, Ireland, Japan, the Netherlands, Norway, Slovenia, Spain, Sweden, Switzerland and the United States of America. NPT/CONF.2020/WP.69, July 29, 2022.

nuclear tensions. Irrespective of the reasons, more nuclear weapons in more hands is not only a proliferation problem but also a nuclear security problem.

In response to a decline of trust in global institutions, *regional arrangements* may become more salient. Proposals for the European Union to raise its collective defense capacity to meet the perceived weakening of the North Atlantic Treaty Organization is one such example, which is also in part related to Russia's attempt to reassemble its former Soviet neighbors into a regional platform for Moscow's influence. China has pursued greater economic alignment in the Pacific as a reaction to heightened U.S. military interests there. Regional commitments, such as those contained in nuclear-weapons-free zone conventions or in the India-Pakistan non-attack pledges, could be models for nuclear-security focused arrangements among neighbors, who often face common or similar risk environments.

The role of *non-state actors* in relation to nuclear security has evolved over the last decade from highly capable, well-resourced Islamic extremists with apocalyptic ideologies to self-radicalized individuals of various stripes on one hand, and organized right-wing groups that often include members with military training on the other hand. Democratization of technology gives individuals or small groups access to capabilities previously only available to states. The Russian attacks on and theft and occupation of nuclear facilities in Ukraine is a shocking reminder that *states may also represent nuclear security threats*. Recent attacks by Israel and the United States on Iran's nuclear facilities raise similar nuclear security concerns. These shifts in potential adversaries and techniques are important examples of why nuclear security is never "done" but rather requires continuous reassessment and improvement.

Climate change is also having a range of impacts on nuclear security. On one hand, rising water levels, droughts, and increasingly severe weather events, will require adjustments in how nuclear security is implemented at specific sites, and may suggest similar changes to international guidance and national regulations. Climate change is also likely to be a driver of civil conflict and political instability, posing a challenge to nuclear security implementation. Simultaneously, climate change is among the drivers for an *increased interest in nuclear energy* around the world, which holds both challenges and opportunities for nuclear security. Challenges include increased numbers of nuclear facilities of all types, in more countries, in some cases with inexperienced regulators and nuclear governance structures, associated increases in the transportation of nuclear materials likely in new forms, novel deployment models such as ship-borne reactors and remote operations, and the prospect of more inherently risky fuel cycles. A new generation of reactors, however, also offers the opportunity to build modern security techniques into the design, increasing their efficiency and reducing the overall cost of operating or the need to upgrade such reactors. Which technologies are selected for deployment will have a major impact on the nuclear security implications of this nuclear energy renewal.

Further complicating these trends is the still evolving impact of the United States's shifting influence in global affairs, which began to be seen in decline over the last decade but which

accelerated with the last election. The United States has driven greater global attention to nuclear security through resources and convening power and has underwritten collective defense commitments that prevented many countries from pursuing nuclear weapons. The impact of the current retreat from global commitments, and the potential withdrawal from a range of multilateral treaties and institutions, on global nuclear security remains to be seen. While progress on nuclear security is not inherently dependent on U.S. leadership, efforts to stimulate additional leaders and resources have had limited success. As the second-largest holder of nuclear materials, U.S. domestic actions will of course have significant impact on global nuclear security, both directly and indirectly.

Opportunities for improving attention

Most of the recommendations in the 2021 architecture paper and the 2023 Nuclear Security Index referenced above remain unfulfilled or are generally evergreen, and will not be repeated here.

Looking ahead, the multilateral calendar shows some key moments to draw attention to risks and progress in nuclear security. Governments, non-government organizations, civil society, and nuclear industry groups can use these opportunities to provide updates on nuclear security activities and achievements, to make new individual or collective commitments, to raise public awareness of nuclear security issues, and to link progress and public trust on related issues (nuclear energy, climate, development) to high-quality security for nuclear energy uses and for other peaceful applications of nuclear technology. Some of these events may also be opportune moments to continue or expand the use of scenario-based policy discussions to expose senior leaders and practitioners to the real-world implications of nuclear security risks and related mitigation tools. Often, major gatherings are bolstered by booths and side events that can highlight organizations and individuals working on nuclear security.

Annually

- G7 Summit & Global Partnership updates – highlight key areas of cooperation and success stories in Summit statements from leaders and in Nonproliferation Directors Group statements
- IAEA General Conference – national statements, joint statements and commitments, booths, side events
    - IAEA Nuclear Security Resolution– deploy effective tactics to defend existing language from further backsliding and build support for specific advances
    - IAEA treaty event– celebrate ratifications of A/CPPNM, Early Notification Convention, and Mutual Assistance Convention
- IAEA Nuclear Harmonization and Standardization Initiative – promote meaningful outcomes from Working Group on nuclear security in A/SMRs
- Institute for Nuclear Materials Management Annual Meeting – more thematic sessions on nuclear security topics, increased participation of nuclear industry

- American Nuclear Society Annual Meeting – more thematic sessions on nuclear security topics, increased participation of nuclear security experts

2025

- 20th anniversary of ICSANT opening for signature – op-eds, panels, social media campaign, announcement of key implementation successes, IAEA General Conference side event
- 45th anniversary of CPPNM opening for signature – op-eds, panels, social media campaign, announcement of key implementation successes, IAEA General Conference side event
- 20th anniversary of adoption of A/CPPNM– op-eds, panels, social media campaign, announcement of key implementation successes, IAEA General Conference side event
- IAEA Atomic Technology Licensed for Applications at Sea (ATLAS) launch event – highlight unique nuclear security implications of commercial maritime nuclear propulsion and related activities

2026

- 10th anniversary of entry into force (EIF) of A/CPPNM – op-eds, panels, social media campaign, announcement of key implementation successes, IAEA General Conference side event
- 20th anniversary of ICSANT EIF – op-eds, panels, social media campaign, announcement of key implementation successes, IAEA General Conference side event
- 20th anniversary of launch of IAEA Nuclear Security Series – IAEA General Conference side event
- NPT RevCon – side events highlighting contributions of nuclear security to achieving all three pillars, national statements, joint statements and commitments
- NTI Nuclear Security Index – launch event, press outreach, road show involving partners and advocates
- Center for Energy and Security Studies Moscow Nonproliferation Conference – panel discussion, expert consultations
- IAEA International Ministerial Conference on Nuclear Power in the 21st Century – national statements, President's statement, side events on nuclear security by design, joint statements and commitments

2027

- A/CPPNM RevCon – early preparation of meaningful declaration and high-level outreach to likeminded advocates to hold firm in negotiations on consensus documents, set

expectations for delivery of Art 14 reports and progress reports, joint statements and commitments
- 25th anniversary of first IAEA Nuclear Security Plan and founding of Nuclear Security Fund – side event at RevCon
- 40th anniversary of CPPNM EIF – incorporate references into RevCon statements

2028

- ICONS – early preparation of meaningful declaration and high-level outreach to likeminded advocates to hold firm in negotiations, set expectations for ministerial participation

Upcoming/Ad hoc

- Publication of INFCIRC/225 rev 6 – briefing to Member States on changes, discussion in NGOs and educational bodies
- IAEA International Conference on Computer Security in the Nuclear World
- IAEA International Conference on Small Modular Reactors and their Applications
- IAEA International Conference on the Safe and Secure Transport of Radioactive Materials
- Special session of UN Security Council on Resolution 1540
- Carnegie Endowment for International Peace International Nuclear Policy Conference
- Related news event – put out statements/interviews/quotes describing linkage to nuclear security