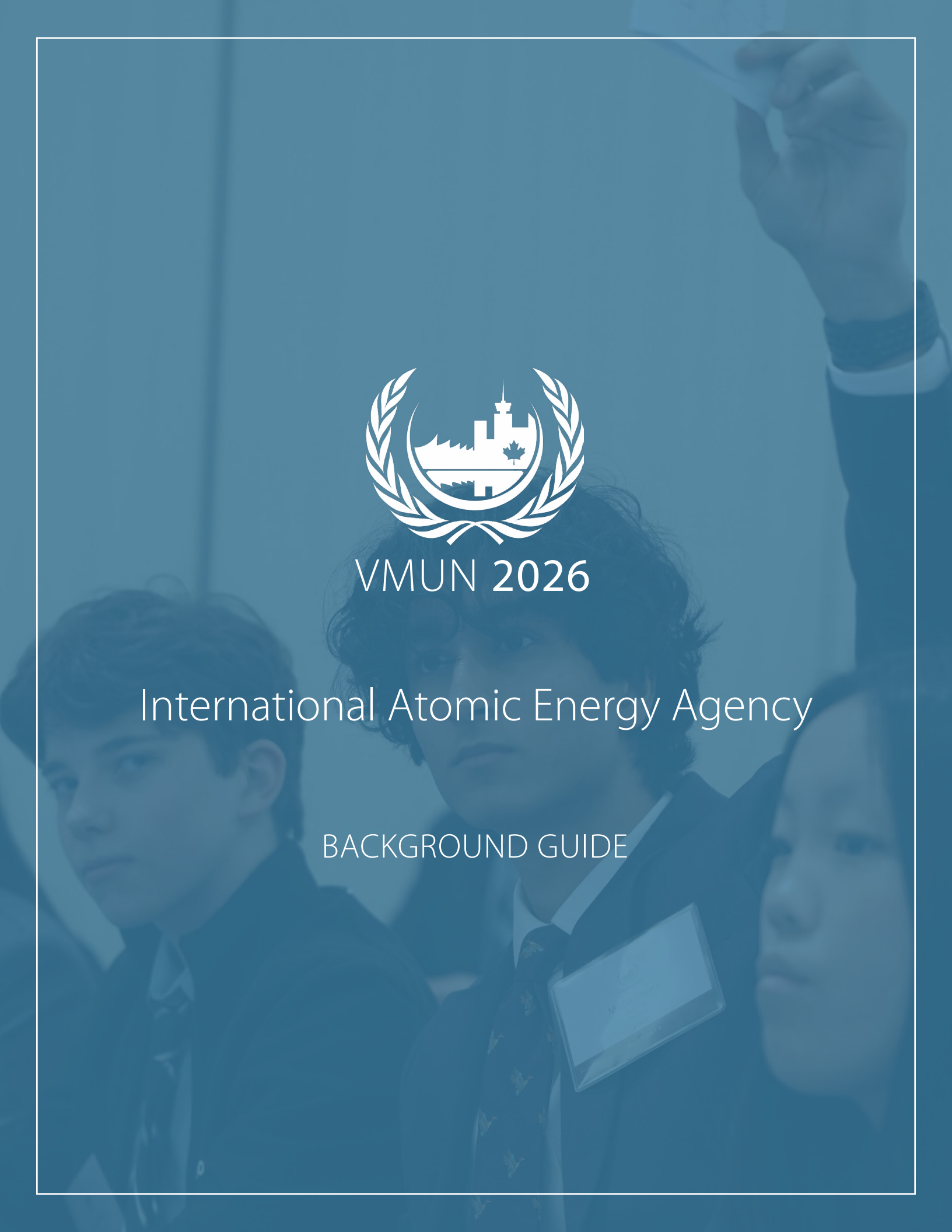

VMUN **2026**

International Atomic Energy Agency

BACKGROUND GUIDE

Vancouver Model United Nations

The Twenty-Fifth Annual Session | January 23rd-25th, 2026

Dear Delegates,

My name is Wilson Li, and I am honored to serve as the director of the International Atomic Energy Agency (IAEA) at Vancouver Model United Nations 2026. On behalf of myself, my Chair Sophia Chiu, and my Assistant Director Nyah Bates, we wish you a warm welcome to the IAEA.

Ever since my first conference in Grade 6, I have been charmed by the energetic and innovative nature of debate and discussions in MUN. As time progressed, my love for delegating grew immensely, and the creative solutions forged, fruitful debate uncovered, and numerous long-lasting connections that I have made have become some of my favorite memories of high school. Outside of this captivating environment, I can be found at dawn rowing on the Fraser River, furiously purchasing new vinyls, and hoping my science projects don't explode.

With the increasing fear of nuclear energy, the IAEA plays a pivotal role in managing and regulating all aspects of existing nuclear infrastructure, international frameworks and non-proliferation efforts. At VMUN 2026, the IAEA will discuss two emerging and pressing topics: Regulation of Small Modular Reactors and Protection of Nuclear Infrastructure in Warzones. To prepare for the conference, I highly recommend you to conduct substantive research on the two intriguing topics and to read through the background guide thoroughly, in order to develop a strong stance. I truly can not wait to see your extraordinary solutions and I hope this committee will offer you a remarkable time filled with debate and meaningful connections.

I wish you all the best of luck in your research endeavors and if you have any questions or concerns, please do not hesitate to contact me at iaea@vmun.com.

Sincerely,

Wilson Li
IAEA Director

Position Paper Policy

What is a Position Paper?

A position paper is a brief overview of a country's stance on the topics being discussed by a particular committee. Though there is no specific format the position paper must follow, it should include a description of your positions your country holds on the issues on the agenda, relevant actions that your country has taken, and potential solutions that your country would support.

At Vancouver Model United Nations, delegates should write a position paper for each of the committee's topics. Each position paper should not exceed one page and should all be combined into a single document per delegate.

For IAEA, position papers, although strongly recommended, are not required. However, delegates who wish to be considered for an award must submit position papers.

Formatting

Position papers should:

— Include the name of the delegate, his/her country, and the committee

— Be in a standard font (e.g. Times New Roman) with a 12-point font size and 1-inch document margins

— Not include illustrations, diagrams, decorations, national symbols, watermarks, or page borders

— Include citations and a bibliography, in any format, giving due credit to the sources used in research (not included in the 1-page limit)

Due Dates and Submission Procedure

Position papers for this committee must be submitted by **January 12, 2026, at 23:59 PT**. Once your position paper is complete, please save the file as your last name, your first name and send it as an attachment in an email to your committee's email address, with the subject heading as "[last name] [first name] — Position Paper". Please do not add any other attachments to the email. Both your position papers should be combined into a single PDF or Word document file; position papers submitted in another format will not be accepted.

Each position paper will be manually reviewed and considered for the Best Position Paper award. The email address for this committee is iaea@vmun.com.

Regulation of Small Modular Reactors

Overview

As the world faces growing energy demands and urgent needs to reduce carbon emissions, the development of safe and reliable sources of clean energy has become a global priority. Since 1951, humanity has consistently striven to increase both its development and usage of nuclear-powered energy reactors.[1] One such innovation was the creation of Small Modular Reactors (SMRs) in the 1900s, which were mainly used to counteract the extremely costly nature of normal nuclear facilities.[2] SMRs, built for modularity and scalability, are defined as reactors with a power output under 300 MWe, or megawatts, per unit and the potential for widespread deployment.[3] Its smaller physical and electronic footprint, compared to conventional large-scaled nuclear power plants, made it uniquely suited for remote environments or grids with limited capacity. Furthermore, SMRs offer improved safety features in comparison to modern nuclear power plants through enhancing protection mechanisms, reducing the risk of overheating, and contributing to a more secure nuclear workplace. SMRs' smaller, more adaptable size also results in a lower initial capital cost, making them easier to implement in less economically affluent regions. From their inception, SMRs have been viewed as a low-carbon option for energy transition and have strong alignment with global sustainable development goals (SDGs), making them a prospective energy source of the future.

Following the earliest deployments of SMRs, many existing frameworks have been proposed by the International Atomic Energy Agency (IAEA) regarding the management of SMRs, most notably the IAEA TECDOC series, yet such regulations fail to account for regulatory inconsistencies between nations.[4] Due to its antiquity—the majority of IAEA safeguarding structures being primarily developed for large, stationary nuclear reactors with centralized fuel cycles—SMRs create a regulatory gap that hinders the creation of an effective framework. Consequently, to ensure the safety of novel reactor designs with limited operational history, the IAEA could consider collaborating with member states, investing additional resources into researching and developing new management systems or legislations to combat the rapidly growing industry.

Currently, member states, such as China, Russia, and Canada, have led the development of these reactors, becoming the first countries to construct and establish working SMRs.[5] However, this fast-evolving and unregulated reactor, with growing commercial and political interest, can not only contribute heavily to the breakthrough of green energy, but also has a high risk of militarization.[6] With the growing threat of the exploitation of SMRs in the Arctic by the Chinese and Russian governments, some nations, such as Norway and the United States, have expressed their concerns of the complex and unpredictable nature of these reactors. As

[1] Outline History of Nuclear Energy." World Nuclear Association. Accessed June 20, 2025. https://world-nuclear.org/information-library/current-and-future-generation/outline-history-of-nuclear-energy.
[2] "The Story behind America's First Potential Small Modular Reactor." Energy.gov, December 13, 2018. https://www.energy.gov/ne/articles/story-behind-americas-first-potential-small-modular-reactor.
[3] Liou, Joanne, and International Atomic Energy Agency. "What Are Small Modular Reactors (Smrs)?" IAEA, September 14, 2023. https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs.
[4] International Atomic Energy Agency, Safety of Nuclear Power Plants: Design: Specific Safety Requirements, SSR-2/1 (Rev. 1), IAEA Safety Standards Series No. SSR-2/1 (Rev. 1), IAEA TECDOC-1854 (Vienna: IAEA, 2016).
[5] "SMR Technology Trends Worldwide." Enerdata, June 20, 2024. https://www.enerdata.net/publications/executive-briefing/smr-world-trends.htm.
[6] Matan. "SMR Military Installations." Small Modular Reactors, May 10, 2023. https://small-modular-reactors.org/smr-military-installations/.

such, it is the IAEA's role to respond to such controversies and implement credible and effective licensing to peacefully tackle any potential militarization attempts, while also keeping SMRs accessible for the greater good of the environment.

Timeline

September 24, 1798 — Uranium is discovered by Martin Heinrich Klaproth, a German chemist, leading to the start of nuclear science.[7]

December 1938 — At the Kaiser Wilhelm Institute for Chemistry, Otto Hahn and his colleague Fritz Strassmann record the first nuclear fission reaction by bombarding and colliding uranium atoms.[8] This reaction forms the foundation for nuclear power.

December 2, 1942 — The Chicago Pile 1 achieves the first-ever self-sustaining nuclear chain reaction, initiating nuclear energy development.[9]

January 21, 1954 — The US Navy implements the first theoretical design concepts of SMRs within the USS Nautilus, the first nuclear-powered submarine.[10] Its designs become a technical precursor to civilian SMRs.

June 27, 1954 — The Soviet Union creates Obninsk, the first nuclear power plant; it becomes the first plant to generate electricity for the Moscow grid.[11] This innovation creates a new perspective on a future energy source with nuclear infrastructure.

December 22, 1980 — The Nuclear Safety, Research, Demonstration, and Development Act of 1980, also known as Public Law 96-567, is established in the United States, laying foundational groundwork for nuclear power plant regulation and the future advancement of SMRs.[12]

March 1984 — Argentina's first concept of a small scaled reactor, the CAREM project, is presented in an IAEA conference hosted in Lima, Peru. This is one of the first conceptions for the modern SMR, an integral design.[13]

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[7] Huebner, H. "Uranium and Its Discovery by Martin Heinrich Klaproth." Isotopenpraxis; (German Democratic Republic), September 1, 1989. https://www.osti.gov/etdeweb/biblio/5454107.
[8] "The Discovery of Nuclear Fission." Startseite. Accessed June 20, 2025. https://www.mpic.de/4469988/die-entdeckung-der-kernspaltung.
[9] Nuclear Engineering Division of Argonne National Laboratory. "Argonne's Nuclear Science and Technology Legacy." The Chicago Pile 1 Pioneers - Reactors designed/built by Argonne National Laboratory. Accessed June 20, 2025. https://www.ne.anl.gov/About/cp1-pioneers.
[10] Sept. 30, 1954: The world's first nuclear-powered submarine, U.S.S. Nautilus, enters Navy service | American physical society. Accessed June 21, 2025. https://www.aps.org/apsnews/2024/08/worlds-first-nuclear-powered-submarine.
[11] Petros'yants, A M. "A Pioneer of Nuclear Power." IAEA Special Reports. Accessed June 21, 2025. https://www.iaea.org/sites/default/files/26404794246.pdf.
[12] "Nuclear Safety, Research, Demonstration, and Development Act of 1980 (1980 - H.R. 7865)." GovTrack.us. Accessed June 20, 2025. https://www.govtrack.us/congress/bills/96/hr7865.
[13] Mazzi, Ruben. "CAREM: AN INNOVATIVE-INTEGRATED PWR." NCSU, 2005. https://repository.lib.ncsu.edu/server/api/core/bitstreams/e3488c2d-47b8-4657-9f59-854bad5a2398/content.

June 1994 — The UN officially adopts the IAEA's Convention on Nuclear Safety in Vienna, establishing legal policies for high-level nuclear safety which acts as a starting point for SMR frameworks.[14]

May 31, 2001 — The IAEA hosts a seminar in Egypt tackling the status of small and medium sized reactors, addressing the design, operation, and general overview of these nuclear facilities.[15]

February 2006 — The US Department of Energy launches the Next Generation Nuclear Plant (NGNP) program, an act that advances the licensing and regulation for modular high-temperature gas-cooled reactors.[16]

December 2008 — NuScale, an American-based nuclear company highly invested in SMRs, notifies the Nuclear Regulatory Commission of its intent to qualify for a design certification of small-scale reactors.[17] This marks the earliest instance of research investment in SMRs and a breakthrough point in such technology.

March 11, 2011 — The Fukushima Daiichi nuclear disaster resets global nuclear safety strategies and boosts interest in SMRs, which are equipped with passive safety features.[18] This shocking incident creates a large-scale negative impression of nuclear energy.

December 9, 2012 — The world's first land-based modular demonstration plant is built in Shidao Bay, China. It is a proof of concept that increases the feasibility of successful and effective SMRs.[19]

July 2015 — As part of the Nuclear Energy Series, the IAEA releases a Milestone Document on SMR infrastructure development, instructing its member states on the proper deployment of SMRs.[20]

November 30, 2023 — Nations at COP28 launch an ambitious declaration to ensure that nuclear energy is tripled by 2030, a goal that aims to eliminate all carbon dioxide emissions.[21]

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[14] "Convention on Nuclear Safety - National Reports." Canadian Nuclear Safety Commission, January 26, 2024. https://www.cnsc-ccsn.gc.ca/eng/reactors/power-plants/convention-on-nuclear-safety/.

[15] "Small and Medium Sized Reactors: Status and Prospects." IAEA, 2001. https://www-pub.iaea.org/MTCD/publications/PDF/CSPS-14-P/CSP-14_part1.pdf.

[16] A review of the NGNP Project: February 2006. Accessed June 21, 2025. https://www.energy.gov/ne/articles/review-ngnp-project-february-2006.

[17] "Company History." NuScale Power. Accessed June 20, 2025. https://www.nuscalepower.com/about/history.

[18] "Fukushima Daiichi Accident." World Nuclear Association. Accessed June 20, 2025. https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-daiichi-accident.

[19] "The Shandong Shidao Bay 200 Mwe (HTR-PM) Demonstration Power Plant: An Engineering and Technological Innovation." Engineering, May 3, 2016. https://www.sciencedirect.com/science/article/pii/S2095809916301552.

[20] "MILESTONES IN THE DEVELOPMENT OF A NATIONAL INFRASTRUCTURE FOR NUCLEAR POWER." IAEA, 2015. https://www-pub.iaea.org/MTCD/publications/PDF/Pub1704_web.pdf.

[21] "At COP28, Countries Launch Declaration to Triple Nuclear Energy Capacity by 2050, Recognizing the Key Role of Nuclear Energy in Reaching Net Zero." Energy.gov, December 1, 2023. https://www.energy.gov/articles/cop28-countries-launch-declaration-triple-nuclear-energy-capacity-2050-recognizing-key.

March 7, 2024 — The US, Poland, Canada, the United Kingdom, and South Korea commit to the development of SMRs by contributing heavily to the risked projects pipeline, a collection of SMR projects that have great vulnerability and should be addressed.[22]

June 11, 2025 — The World Bank declares that its long-established restrictions on nuclear funding has now been lifted, explicitly supporting the use of SMRs and allowing for the investment in these modular reactors.[23]

Historical Analysis

The golden nuclear age of the 1950s to 1970s coincided with the advent of large-scale reactors. These power plants, used to produce 1 gigawatt of energy throughout their total lifetime, were regarded as one of the brightest innovations of the 20th century as its generated power is unfathomable larger than previous energy sources.[24] This perception of newfound innovation changed with the Three Mile Island (1979) and Chernobyl (1986) incidents, exhibiting the more dangerous side of nuclear power plants such as its catastrophic meltdown consequences and humanitarian risks.[25] These disasters reshaped global nuclear regulation, leading to stricter safety standards and a cautious international approach to such facilities and infrastructure.[26] As a result, many nations began investing in smaller and safer reactors in the hopes of achieving the same power efficiency with lower risk. This led to the conceptual birth of Small Modular Reactors in the 1990s to the early 2000s, with national labs in the USA and Russia beginning to develop this technology.[27]

Pre-existing IAEA regulatory frameworks were built for large-scale power plants, making the emergence of SMRs a surprise to the nuclear community.[28] To make matters worse, there was an evident lack of an internationally accepted licensing regime, creating fragmented national approaches to this emerging field. As the jurisdictional authority over SMR development, the IAEA spearheaded the groundwork for regulations and began research on advanced reactors.[29] [30] The 2011 Fukushima Daiichi nuclear incident further pushed SMRs into the global spotlight, as the world now understood the hazardous risks of massive nuclear power plants.[31] In response to this disaster, the IAEA launched the Action Plan on Nuclear Safety in September of the same year, aiming to increase

[22] Mackenzie, Wood. "Global Nuclear SMR Project Pipeline Expands to 22 GW, Increasing More than 65% since 2021." Wood Mackenzie, March 7, 2024. https://www.woodmac.com/press-releases/2024-press-releases/global-nuclear-smr-project-pipeline-expands-to-22-gw-increasing-more-than-65-since-2021/.
[23] "World Bank Ends Ban on Funding Nuclear Energy." World Nuclear News. Accessed June 20, 2025. https://world-nuclear-news.org/articles/world-bank-agrees-to-end-ban-on-funding-nuclear-energy.
[24] "Infographic: How Much Power Does a Nuclear Reactor Produce?" Energy.gov, March 31, 2021. https://www.energy.gov/ne/articles/infographic-how-much-power-does-nuclear-reactor-produce
[25] "Frequently Asked Chernobyl Questions." IAEA, November 7, 2016. https://www.iaea.org/newscenter/focus/chernobyl/faqs.
[26] Nuclear energy agency (NEA) - Chernobyl: Chapter IX. lessons learnt. Accessed June 23, 2025. https://www.oecd-nea.org/jcms/pl_28391/chernobyl-chapter-ix-lessons-learnt.
[27] "Small Modular Reactors (Smrs): The Case of Russia." Handbook of Small Modular Nuclear Reactors (Second Edition), November 20, 2020. https://www.sciencedirect.com/science/article/abs/pii/B9780128239162000199.
[28] Nuclear energy agency (NEA) - advanced nuclear fuel cycles and radioactive waste management. Accessed June 23, 2025. https://www.oecd-nea.org/jcms/pl_14008/advanced-nuclear-fuel-cycles-and-radioactive-waste-management?details=true.
[29] "Fast Reactors and Related Fuel Cycles: Next Generation Nuclear Systems for Sustainable Development (FR17)." International Atomic Energy Agency, November 27, 2018. https://www.iaea.org/publications/13414/fast-reactors-and-related-fuel-cycles-next-generation-nuclear-systems-for-sustainable-development-fr17.
[30] "Technology Roadmap for Small Modular Reactor Deployment." International Atomic Energy Agency. Accessed June 23, 2025. https://www-pub.iaea.org/MTCD/publications/PDF/PUB1944_web.pdf.
[31] "Fukushima Daiichi Nuclear Accident." IAEA, November 1, 2021. https://www.iaea.org/topics/response/fukushima-daiichi-nuclear-accident

responsible usage of nuclear energy globally.[32] In the aftermath of these incidents, SMRs became the new frontier of sustainable nuclear power due to their intrinsically safer designs in comparison to traditional reactors alongside similar energy efficiency. Subsequently, SMRs were thrown under regulatory scrutiny, as energy-reliant nations critiqued and debated on its feasibility in the international market.[33] Unfortunately, the large regulatory gap that was caused by inadequate and outdated policies made it tenuous to deploy SMRs.

This recurring issue throughout the 2010s was alleviated by the IAEA's Technology Roadmap for Small Modular Reactor Deployment regulation, a crucial guideline for SMR usage during that time period.[34] This set an international precedent: in North America, the US Nuclear Regulatory Commission (NRC) and the Canadian Nuclear Safety Commission began streamlining licensing processes regarding SMRs by signing a memorandum of cooperation in 2019.[35] While such policies were put into action, nations and their respective SMRs, such as the US's NuScale, China's LingLong One ACP100,[36] and Russia's Akademik Lomonosov,[37] started gaining global evaluation and criticism, further stressing the need for proper regulation.

Past UN/International Involvement

Technology Roadmap for Small Modular Reactor Deployment

Published in 2021, The IAEA's *Technology Roadmap for Small Modular Reactor Deployment* has been the cornerstone of SMR framework, written in collaboration with over 30 IAEA member states.[38] As China, Russia, Canada, and America continue to build SMRs, the IAEA released this paper to evaluate and assess the current development of on-land and in-water reactors.[39] This roadmap was carefully crafted with the help of countries pursuing the deployment of SMRs, acting as a guideline for inexperienced member states looking to deploy their reactors.[40]

Within the paper, the IAEA covers a wide range of topics, including identifying policy gaps, promoting standardization of cross-border use, and anticipating future licensing legislation.[41] Moreover, a significant portion of the paper explains SMR creation, deployment, and usage in extreme detail, ensuring that these reactors are created without technical safety regulations such as emergency response systems, fuel qualification or waste management facilities.[42] This publication has helped establish and influence possible regulatory standards that

[32] "IAEA Action Plan on Nuclear Safety." IAEA, May 23, 2018. https://www.iaea.org/topics/nuclear-safety-action-plan.
[33] "Small Nuclear Power Reactors." World Nuclear Association. Accessed June 22, 2025. https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.
[34] IAEA, "Technology Roadmap for Small Modular Reactor Deployment."
[35] Commission, Canadian Nuclear Safety. "Government of Canada." Canadian Nuclear Safety Commission, February 2, 2022. https://www.cnsc-ccsn.gc.ca/eng/resources/international-cooperation/international-agreements/joint-report-smr-licensing-modernization-project/.
[36] Kajal, Kapil. "World's First Commercial Mini Nuclear Reactor Ready to Power 526,000 Homes in China." Interesting Engineering, May 30, 2025. https://interestingengineering.com/energy/china-mini-nuclear-reactor-power-homes.
[37] "Akademik Lomonosov Floating Nuclear Co-Generation Plant." Power Technology, November 5, 2021. https://www.power-technology.com/projects/akademik-lomonosov-nuclear-co-generation-russia/
[38] IAEA, "Technology Roadmap for Small Modular Reactor Deployment." IAEA. 2021 https://www-pub.iaea.org/MTCD/Publications/PDF/PUB1944_web.pdf.
[39] Ibid.
[40] Ibid.
[41] Ibid.
[42] Ibid.

many national bodies have adopted into their nuclear programs, making it an influential and impactful publication. In 2024, a technical meeting was hosted in the IAEA Vienna headquarters to discuss various objectives including the status of national nuclear programs and the gaps in SMR deployment.[43] This meeting emphasized that increasing deployment efficiency requires taking into account regulations and other existing factors, displaying the IAEA's urge to implement frameworks.[44] Many nations, notably Canada, have created their own roadmap resembling the IAEA's, using it to monitor their project in Ontario.[45] However, there is no binding legislation that is enforced with these recommendations, meaning that the application of SMRs and the regulation of them vary by country.[46] Moreover, the roadmap does not fully address the dual-use and potential militarization of these reactors, a factor that may not be completely recognized by all nations. Nonetheless, the IAEA's Technology Roadmap for Small Modular Reactor Deployment, despite its lack of implementation, serves as a strong step forward in SMR development globally.

SMR Regulators' Forum

First hosted and coordinated by the IAEA in 2014, the SMR Regulators' Forum is a platform designed to bring together over 20 member states' nuclear regulatory authorities to exchange general practices and identify shared challenges when facing these reactors.[47] It is the first ever international regulator-to-regulator entity, a system that provides direct inter-authority communication and information sharing worldwide.[48] This allows for collaboration on the designing of frameworks, fostering global alignment with respect to safeguarding, deploying, and managing SMRs.

Since its inception, the SMR Regulators' Forum has produced many breakthroughs in SMR regulation, which have had varying degrees of international implementation.[49] From international events to technical missions, this forum has helped manage SMRs in places such as Jordan, Poland, Estonia, and India, working towards their eventual deployment.[50] In addition, this forum has hosted large-scale projects and initiatives including the Technical Cooperation Project INT-2023 that has 34 scheduled events, and the Interregional Events in China, which engages 237 participants across 52 countries.[51] Nevertheless, as this coordinated platform strongly relies on its contributing regulators, jurisdictional issues still arise. Another shortcoming of this forum is that it has yet to resolve legal discrepancies between national licensing regimes, such as differences in design approval timelines or safety and security standards.[52] Through its annual update reports and conferences, the SMR Regulator's Forum has future potential to standardize its resolutions, ensuring that all member states comply and work together towards a more sustainable future with nuclear energy.

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[43] "Technical Meeting on Updating the Technology Roadmap" IAEA Vienna US Mission Gov. Accessed June 24, 2025. https://vienna.usmission.gov/wp-content/uploads/sites/54/2024/05/24-02103E_Encl.pdf.
[44] Ibid.
[45] "Small Modular Reactors (Smrs)." Canadian Nuclear Association, July 23, 2025. https://cna.ca/reactors-and-smrs/small-modular-reactors-smrs/#.
[46] Shobeiri, Elaheh, Filippo Genco, Daniel Hoornweg, and Akira Tokuhiro. "Small Modular Reactor Deployment and Obstacles to Be Overcome." MDPI, April 15, 2023. https://www.mdpi.com/1996-1073/16/8/3468.
[47] "Small Modular Reactor (SMR) Regulators' Forum." IAEA, January 18, 2018. https://www.iaea.org/topics/small-modular-reactors/smr-regulators-forum.
[48] "Briefing: The SMR Regulators' Forum." World Nuclear News. Accessed June 24, 2025. https://www.world-nuclear-news.org/articles/viewpoint-smr-regulators-forum-looks-to-future-after-first-10-years.
[49] IAEA SMR Platform Annual Report 2023, 2023. https://nucleus.iaea.org/sites/smr/Shared.pdf.
[50] Ibid.
[51] Ibid.
[52] Ibid.

Nuclear Harmonization and Standardization Initiative (NHSI)

The IAEA's Nuclear Harmonization and Standardization Initiative, better known as NHSI, is a program that was launched in 2022 to address fragmented policies e and globally unify them under one standardized framework.[53] This initiative jointly led between the UN, the IAEA, and industry developers follows this track-oriented framework to safely regulate SMRs.[54] The track system consists of two parts: the regulatory track, focused on increasing collaboration among Member States, and the industry track, focused on standardizing the industrial production process of SMRs. With both tracks being equally important,[55] the dual system with the IAEA and SMR giants is able to address the supply chain, cybersecurity, and safeguards integration of these new reactors, enabling a harmonized approach to SMRs.[56]

Notable actions by the NHSI regarding SMRs regulation include multiple conferences held in IAEA headquarters and the drafting of model licensing approaches and an international feedback mechanism regarding, for example, commercial off-the-shelf equipment for the nuclear industry.[57] As a result, many industrial firms, such as NuScale, have complied with the framework by sharing licensing experience and contributing to early drafts to improve such regulations. Unfortunately, as the NHSI is a novel collaboration, the initiative is still tackling various jurisdictional issues.[58] Therefore, the regulatory gap can only be closed if the solutions proposed in the regulatory track are integrated formally into the IAEA safety standards, which is what the NHSI is working towards. By pushing both tracks towards binding policies, this initiative could be adopted as part of the IAEA's Safety Standards Series, a global benchmark addressing nuclear frameworks, making it an internationally respected piece of regulation.

Current Situation

As of 2025, there are approximately 80 SMRs in development globally,[59] while China and Russia remain the only two countries to have successfully built operational projects.[60] SMRs have been globally projected to bring sustainable energy, safe nuclear power, and exceptional versatility, all of which have been unfulfilled thus far due to a lack of regulation. While international efforts on standardization do exist, most policies crafted by the IAEA remain voluntary and are not legally binding. The absence of a universal framework that all nations follow for SMR deployment delays its development drastically.[61]

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[53] "Nuclear Harmonization and Standardization Initiative (NHSI)." Nuclear harmonization and standardization initiative (NHSI), 2022. https://nucleus.iaea.org/sites/smr/SitePages/Nuclear-Harmonization-and-Standardization-Initiative.aspx.

[54] Liou, Joanne, and International Atomic Energy Agency. "IAEA Initiative Sets Ambitious Goals to Support the Safe and Secure Deployment of Smrs." IAEA, June 27, 2023. https://www.iaea.org/newscenter/news/iaea-initiative-sets-ambitious-goals-to-support-the-safe-and-secure-deployment-of-smrs.

[55] Ibid.

[56] Ibid.

[57] "Information Sheet." Technical Meeting on Current Topics in Nuclear Supply Chain and Procurement Management. Accessed June 24, 2025. https://www.iaea.org/sites/default/files/24/03/evt2303678-information-sheet.pdf.

[58] Ibid.

[59] Spencekimball. "Small Nuclear Reactors Could Power the Future - the Challenge Is Building the First One in the U.S." CNBC, September 7, 2024. https://www.cnbc.com/2024/09/07/how-small-modular-reactors-could-expand-nuclear-power-in-the-us.html.

[60] Traceyhonney. "IAEA Ups Support for Smrs." Nuclear Engineering International, February 23, 2024. https://www.neimagazine.com/advanced-reactorsfusion/iaea-ups-support-for-smrs-10528638/.

[61] Shobeiri, Elaheh, Filippo Genco, Daniel Hoornweg, and Akira Tokuhiro. "Small Modular Reactor Deployment and Obstacles to Be Overcome."

Currently, the United States, China, Russia, and Canada are leading the development of these reactors due to their abundance of technology and investments in nuclear energy.[62] Their deployment is through the collaborative IAEA-led roadmap ensures proper and safe usage of SMRs.[63] Nevertheless, existing regulatory issues inhibit SMRs from reaching their full potential, and detriment countries that are active in SMR practice. Furthermore, the fear of militarization, absence of licensing, and clear economic disparity are all barriers to the widespread adoption of SMRs.

Regulatory Systems

In the past decade, the deployment of SMRs has plateaued in the design phase due to inconsistent regulatory policies that vary from nation to nation, prompting the IAEA to create standardized solutions that can bring the benefits of these reactors to reality.[64] At the 28th annual COP conference hosted in Dubai, member states pledged to triple nuclear energy by 2030, an achievable goal if SMRs are safeguarded and properly managed.[65] This conference's purpose in the past has been to respond against climate threats under the United Nations, and nuclear energy has been a topic with increasing popularity. To respond to these obstacles mentioned in the 28th iteration, the IAEA has begun fostering frameworks and encouraging research that tackles such issues. For instance, it hosted the International Conference on Effective Nuclear and Radiation Regulatory Systems in February 2023 and published five new reports with SMR focus, demonstrating its commitment to enhance nuclear safety.[66, 67] Nevertheless, the current lack of regulation is apparent from the numerous SMR projects stuck in the licensing and design phase, and while many nations such as Canada strive to uphold nuclear standards, it is apparent that political and industrial interests lie ahead of regulatory preparedness. In order to craft effective policies with high longevity, it is crucial to understand the evolution of SMR regulation and the role of the IAEA.

[62] "Global SMR/AR Development Overview." Partnership for Global Security, September 8, 2023. https://partnershipforglobalsecurity.org/global-smr-ar-development-overview.
[63] "NRC Approves NuScale Power's Uprated Small Modular Reactor Design." Energy.gov, May 30, 2025. https://www.energy.gov/ne/articles/nrc-approves-nuscale-powers-uprated-small-modular-reactor-design.
[64] Smyth, Jamie, Ian Bott, and Rachel Millard. "Next-Generation Nuclear Developers Battle with 'Regulatory Marathons.'", April 25, 2024. https://www.ft.com/content/7b59189c-e9d3-4d74-92e7-de8597aa4bc1.
[65] At COP28, Countries Launch Declaration to Triple Nuclear Energy Capacity by 2050, Recognizing the Key Role of Nuclear Energy in Reaching Net Zero." Energy.gov, December 1, 2023. https://www.energy.gov/articles/cop28-countries-launch-declaration-triple-nuclear-energy-capacity-2050-recognizing-key.
[66] "International Conference on Effective Nuclear and Radiation Regulatory Systems: Preparing for the Future in a Rapidly Changing Environment." IAEA, February 25, 2022. https://www.iaea.org/events/regcon2023.
[67] Volha Piotukh, IAEA Department of Nuclear Safety and Security, and International Atomic Energy Agency. "Five Reports of the SMR Regulators' Forum Published." IAEA, March 4, 2024. https://www.iaea.org/newscenter/news/five-reports-of-the-smr-regulators-forum-published.

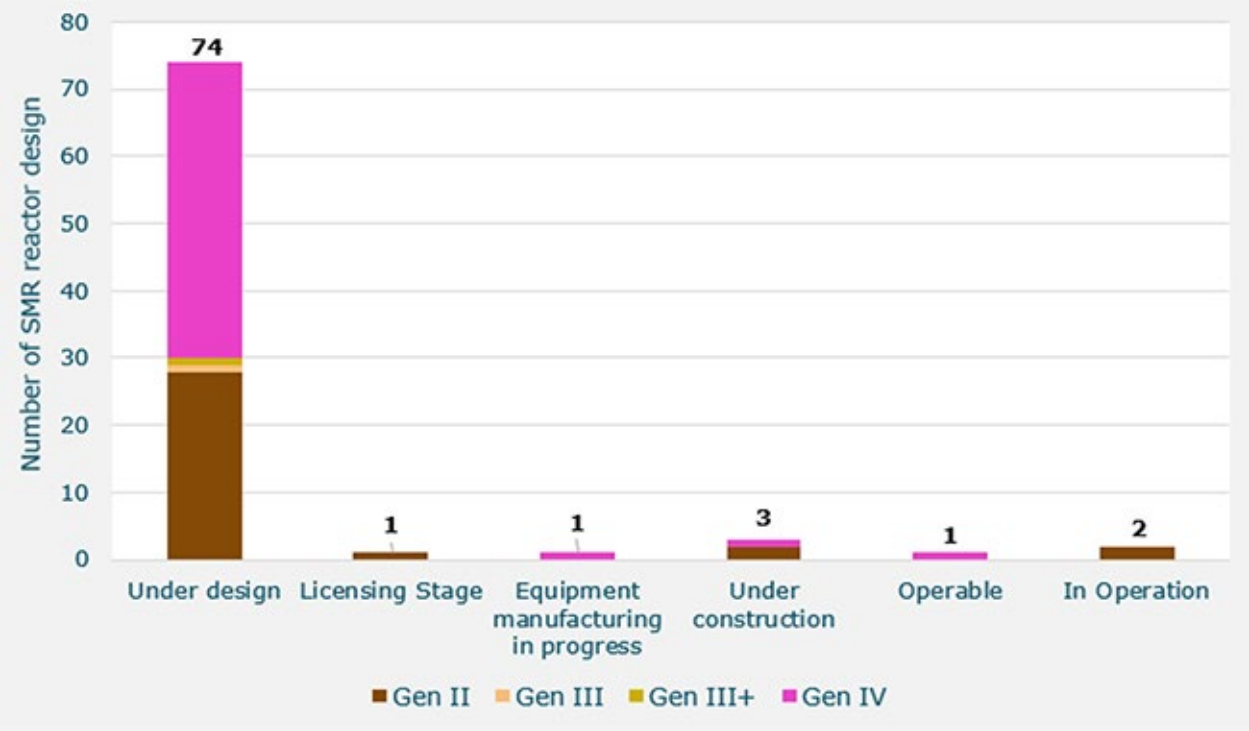

Figure 1: Number of SMRs and their respective implementation phases as of 2024.[68]

International Licensing

SMR standardization is currently hindered by the absence of a unified international license for SMR development and deployment.[69] This license has a target to gain its recognition from the UN, IAEA and its member states' regulatory authorities, in order to enforce safe SMR regulations. This can ensure legal compliance to frameworks, as well as improve credibility, efficacy, and safety amongst the nuclear energy community.[70] Moreover, this license would synergize extremely well with binding agreements, as they secure compliance with both legal policies and IAEA requirements.[71] During implementation, the IAEA would act as the provider of licenses, with professional teams conducting rigorous investigation to ensure infrastructure meets regulatory standards.

Modeled after the NHSI's licensing recommendations, this certification would focus more on establishing legally binding minimum licensing standards for SMRs, ensuring member state compliance.[72] In addition, mutually recognized IAEA certification for SMR designs could be added alongside the previously mentioned pre-deployment safeguard assessment to enforce a strong baseline of safety and non-proliferation compliance.[73] As a result of the establishment of these certifications, global SMR development should see rapid acceleration of

[68] "SMR Technology Trends Worldwide." Enerdata.
[69] "Design maturity and regulatory expectations for small modular reactors." World Nuclear Association, Accessed July 4, 2025. https://world-nuclear.org/images/articles/smr-design-maturity-report-FINAL.pdf.
[70] Djizmedjian, Mané. "What Is Regulatory Compliance? Maximizing Benefits and Preventing Non-Compliance Risks through Business Research." Infomineo, June 19, 2025. https://infomineo.com/blog/regulatory-compliance-benefits-risks-business-strategies/.
[71] "Design maturity and regulatory expectations for small modular reactors." World Nuclear Association.
[72] Liou, Joanne, and International Atomic Energy Agency. "How to Apply IAEA Design Safety Standards to Smrs." IAEA, February 2, 2021. https://www.iaea.org/newscenter/news/how-to-apply-iaea-design-safety-standards-to-smrs.
[73] Ibid.

production due to the reduction of conflicting national regulations.[74] This decrease in regulatory friction would promote the SMR market, and drastically improve company credibility from major developers such as NuScale and Rosatom.[75] Nevertheless, this solution may be expected to meet some barriers, specifically the resistance from national nuclear regulatory bodies such as China's NNSA or the US' NRC, as they often resist forced cooperation.[76] This is an issue that will recirculate around any binding framework solutions, and is one that must be overcome through global collaboration in the IAEA.[77]

Case Study: China

China has led the SMR development process since their inception. Specifically, China prioritizes its centralized acceleration model, focusing on research and progress to produce cutting-edge technology.[78] One of China's most remarkable projects is the ACP100 Linglong One: first launched in May of 2024 it is the world's first ever land-based commercial small modular reactor.[79] Due to its effective design, this reactor set the first benchmark on SMR structure and deployment, making China a leading nation in reactor innovation. The Chinese government, specifically the National Nuclear Safety Administration (NNSA), has provided feasible regulation frameworks for the ACP100 under the guidance of the Chinese Nuclear Science Committee (NSC) and the Chinese National Nuclear Corporation (CNNC).[80] These government bodies operate in a highly centralized and state-controlled fashion, and the NNSA licenses both reactor construction and operation. This makes the deployment of SMRs a streamlined and rapid process due to the quick decision-making of the NNSA. Moreover, the budget on research and infrastructure is mostly covered by the government, allowing the SMRs to reach their maximum potential under zero monetary constraints.[81]

However, because of the centralized nature of China's development policy, there are some major flaws in its SMR regulation. [82] Due to the secrecy of the CCP, there has been an evident history of limited transparency with the general public and the rest of the world, making it difficult for international observers to safely regulate its highly centralized units.[83] The lack of transparency between Chinese-operated reactors and the IAEA removes many opportunities for safety monitoring or in-person inspection, raising the risk of the reactors' vulnerability. Regulation becomes increasingly difficult as the NNSA risks misinformation due to the language barrier and limited international inspections. Therefore, although the ACP 100 aligns with most of the IAEA's Nuclear Harmonization and Standardization Initiative (NHSI), its heavily government-controlled system does not precisely follow the international framework proposed by the IAEA's roadmap.

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[74] "IAEA Sees Progress Made by SMR Deployment Initiative." World Nuclear News. Accessed July 4, 2025. https://www.world-nuclear-news.org/articles/iaea-sees-progress-made-by-smr-deployment-initiati.
[75] Ibid.
[76] "Design maturity and regulatory expectations for small modular reactors." World Nuclear Association.
[77] Ibid.
[78] "First Main Pump for Chinese SMR Shipped." World Nuclear News. Accessed June 28, 2025. https://www.world-nuclear-news.org/articles/first-main-pump-for-chinese-smr-shipped.
[79] Cgtn. "World's First Commercial Small Modular Reactor Powers up 'brain' in China." CGTN, May 22, 2024. https://news.cgtn.com/news/2024-05-22/World-s-first-commercial-small-modular-reactor-powers-up-in-China-1tOh34l59Sw/p.html.
[80] About NSC. Accessed June 28, 2025. https://www.chinansc.cn/about_us/about_nsc/201105/t20110513_456556.shtml.
[81] Ezell, Stephen. "How Innovative Is China in Nuclear Power?" RSS, December 16, 2024. https://itif.org/publications/2024/06/17/how-innovative-is-china-in-nuclear-power/.
[82] Speeds, Phillip. "Governance of Nuclear Power in China." The Journal of World Energy Law & Business. Accessed June 29, 2025. https://academic.oup.com/jwelb/article/13/1/23/5818940.
[83] Lee, Yunsoo. "Managed Transparency: Chinese Government Transparency." Sage Journals, 2024. https://journals.sagepub.com/doi/10.1177/20578911231199162.

Many nations have also expressed concerns about China's dual use of SMR projects, with some fearing potential militarization operations particularly due to the overlap between civilian and governmental reactors. SMRs can be used in versatile fashion; its mobility, rapid deployment, and powerful energy can be utilized as strategic leverage points in potential conflict.[84] Currently, China is planning the development of multiple off-shore SMRs to act as generators for artificial military use islands in the South China Sea. This alone is a threat that adjacent nations in the South China Sea should be wary of, as the nuclear energy generated provides the Chinese military a sustainable power source off the mainland.[85] Moreover, the Chinese government has been trading with developing countries by selling them SMRs as an act of geopolitical leverage.[86] The IAEA must monitor this to prevent long-term leveraging used as many nations start to rely on China's SMR energy, including its reactors, fuel supplies, and technical expertise.[87]

Case Study: Canada

Closely following leading SMR developers—the United States, Russia, and China—is the nation of Canada. With multiple projects set in development after the 2020s, companies such as GE Hitachi (with its BWRX-300),[88] ARC energy,[89] and Ontario Power Generation (OGP) has been investing billions of dollars into building SMR infrastructures for power production purposes.[90] In fact, the first land-based commercial SMR of North America has a projected completion date of 2030 by Ontario Power Generation at the Darlington Nuclear Site.[91]

The Canadian Nuclear Safety Commission (CNSC) federally regulates Canadian nuclear activity. As the main overseer of the SMR projects, it has been recognized in terms of standardization and methodology.[92] One of its unique features is the Vendor Design Review (VDR) system, an optional pre-licensing process in which the vendor can request CNSC inspectors to provide early feedback on a reactor's design.[93] This practical process emphasizes stakeholder consultation, and its high degree of criticality—meaning its rigorous and crucial evaluation process—is able to produce world-class nuclear facilities once passed.[94] Additionally, this early insight on reactor designs contributes to the quality regulation in the future as there is improved clarity regarding the SMR's technical standards. The CNSC has also mentioned the importance of Indigenous approval and a target

[84] "U.S. Officials Wary of Chinese Plans for Floating Nuclear Plants." The Washington Post. Accessed June 29, 2025. https://www.washingtonpost.com/national-security/2024/05/02/china-floating-nuclear-reactor-military/.
[85] Sandhu, Jonathan. "Fire and Water: China's SMR Export Gambit and the Art of Strategic Balance." LinkedIn, May 12, 2025. https://www.linkedin.com/pulse/fire-water-chinas-smr-export-gambit-art-strategic-balance-sandhu-azyac.
[86] Ibid.
[87] Ibid.
[88] "BWRX-300 Small Modular Reactor: GE Hitachi Nuclear." Gevernova. Accessed June 28, 2025. https://www.gevernova.com/nuclear/carbon-free-power/bwrx-300-small-modular-reactor.
[89] "Our Technology." Carbon Free Energy Technology ARC Clean Technology. Accessed June 28, 2025. https://www.arc-cleantech.com/technology.
[90] "Canada's First SMR Project: How Is Cad 20.9 billion Cost Calculated?" World Nuclear News, May 29, 2025. https://www.world-nuclear-news.org/articles/what-is-the-budget-for-canadas-first-smr-project.
[91] OPG. "OPG Ready to Begin Building North America's First Small Modular Reactor." OPG. Accessed June 29, 2025. https://www.opg.com/stories/opg-ready-to-begin-building-north-americas-first-small-modular-reactor/.
[92] Commission, Canadian Nuclear Safety. "Government of Canada." CNSC, June 26, 2025. https://www.cnsc-ccsn.gc.ca/eng/.
[93] Commission, Canadian Nuclear Safety. "Government of Canada." Canadian Nuclear Safety Commission, February 25, 2025. https://www.cnsc-ccsn.gc.ca/eng/reactors/power-plants/pre-licensing-vendor-design-review/.
[94] Ibid.

level of public engagement during the regulatory process.[95] This demonstrates the government's care for its citizens, and at the same time its care for the safety and framework of SMR usage.

However, with such caution brings forth drawbacks of the Canadian regulatory system. Due to the lengthy application and inspection timeline, many SMRs require an extended period of time to pass the preliminary construction approval and to complete construction.[96] This decelerates the advancement of nuclear reactors, and in some circumstances may require additional funding to ensure government approval.[97] The high levels of transparency would also counteract the deployment process as companies may face backlash from the community due to historical nuclear ethics debates, with some people doubting the credibility of SMRs. For instance, Ontario Indigenous Chiefs proposed a resolution to abandon SMR construction, citing the risk posed to the environment with its radioactive waste.[98] As Canada embarks on its journey to SMR production, the CNSC's regulatory framework strives to balance development speed with safety, innovation, and public trust.[99]

Possible Solutions and Controversies

SMR Binding Safeguarding Frameworks

Setbacks in SMR regulation are caused by many factors, but specifically the absence of a binding framework, one that every nation working on a SMR is required to follow to continue operation.[100] Many of the previous limitations by the IAEA's roadmap and the Nuclear Harmonization Standard Initiative (NSHI) revolve around its voluntary aspect of the recommendations.[101] As the IAEA is the most powerful nuclear energy management body across the globe, one of the most feasible and effective solutions would be to implement a legally-binding SMR regulatory framework.[102] The establishment of a universal IAEA-led SMR safeguarding protocol could include the incorporation of remote monitoring, modular-specific inspection guidelines, and material accounting, all of which are standardized internationally.[103]

Learning from the Canadian Nuclear Safety Commission's (CNSC's) VDR system, the IAEA could also adopt a pre-deployment or design phase safeguard assessment as part of this binding framework where nations are required to submit new prototype SMR designs to undergo professional evaluation.[104] Through this, all upcoming SMRs would need to be IAEA-approved to be built, improving the quality of infrastructure and ease of record-keeping and regulation in the future.[105] Furthermore, the creation of a real-time monitoring system would also be a major breakthrough in SMR regulation, as this enables early detection of policy breaches and contract breaks. If any entity does act outside the framework, IAEA and UN legislation would have a penalizing system that would

[95] Commission, Canadian Nuclear Safety. "Government of Canada." Canadian Nuclear Safety Commission, August 29, 2024. https://www.cnsc-ccsn.gc.ca/eng/reactors/smr/about/.
[96] Commission, Canadian Nuclear Safety. "Government of Canada." Canadian Nuclear Safety Commission, May 30, 2016. https://www.cnsc-ccsn.gc.ca/eng/acts-and-regulations/consultation/comment/d-16-04/.
[97] Ibid.
[98] Narine, Shari. "Small Modular Nuclear Reactors Denounced by Ontario Chiefs." Windspeaker, February 11, 2021. https://windspeaker.com/news/windspeaker-news/small-modular-nuclear-reactors-denounced-ontario-chiefs-part-indigenous.
[99] Ibid.
[100] Shobeiri, Elaheh, Genco, Hoornweg, and Tokuhiro. "Small Modular Reactor Deployment and Obstacles to Be Overcome."
[101] Ibid.
[102] Ibid.
[103] Ibid.
[104] Commission, Canadian Nuclear Safety. "Government of Canada."
[105] Ibid.

create serious consequences for the offender, whether through the limitations to nuclear materials or diplomatic isolation.

While this solution would be the most effective and will encourage global transparency among the IAEA, success depends strongly on universal participation, political will, privacy-sharing commitments, and technical cooperation.[106] This is a significant undertaking which could lead to controversies surrounding national sovereignty and where it conflicts with international oversight.[107] Many states would likely refuse the heavy inspection and regulation on their SMR properties due to the jurisdiction they would have to grant to regulatory bodies over their citizens' rights, creating an ethical dilemma surrounding whether extensive surveillance is justified to ensure peaceful use of nuclear technology.

Training Programs

A less aggressive approach to SMR regulation, contrasting that of binding policies, lies within solving the core regulation. The introduction of IAEA-led training programs will not only assist in decreasing usage failures of SMRs, but also ensure all engineers, scientists, and construction personnel receive adequate training.[108] While this does not target immediate regulation, new and innovative programs tailored specifically for the IAEA will reduce the burden of future regulations. The IAEA has previously explored a wide range of nuclear programs, from the Spearheading Training Programmes on SMRs,[109] to an Integral Pressurized Water Reactor Simulator,[110] aimed to help countries better comprehend the principles of SMRs. However, despite its benefits, there has not been a globally binding training program as proposed here.

Firstly, a standardized IAEA-created curriculum must be made available to all active personnel working on existing projects within SMR-holding states. Secondly, by creating regional training hubs, the IAEA can better target emerging countries that wish to create SMRs. The guidelines for each demographic will be adapted to local languages, infrastructure, and energy goals, breaking out of the one-size-fits-all trope. This plan will also counteract a phenomenon known as brain drain, where talented scientists migrate to more developed nations, by utilizing national incentives for staying in-country, and academic partnerships with local universities. Lastly, exchange programs for regulators and operators, similar to the IAEA Regulators' Forum, would enhance nuclear training and promote the sharing of knowledge across an international chain of specialists.[111]

While this solution is simple, it still faces some issues, such as a lack of accessibility for LEDCs, and the time required to incorporate all programs in all nations. This is caused by the lack of the necessary funding, technical facilities, and trained personnel in emerging nations to host or participate in this program, and is an issue that must be addressed by the IAEA.

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[106] Lee, Sarah. "Sovereignty in International Relations." Number Analytics // Super Easy Data analysis tool for Research. Accessed July 4, 2025. https://www.numberanalytics.com/blog/sovereignty-in-international-relations

[107] Ibid.

[108] "Nuclear Reactor Simulators for Education and Training." IAEA, January 31, 2017. https://www.iaea.org/topics/nuclear-power-reactors/nuclear-reactor-simulators-for-education-and-training.

[109] Krikorian, Shant, and International Atomic Energy Agency. "IAEA Spearheading Training Programmes on Small Modular Reactors." IAEA, December 18, 2019. https://www.iaea.org/newscenter/news/iaea-spearheading-training-programmes-on-small-modular-reactors.

[110] "Nuclear Reactor Simulators for Education and Training." IAEA

[111] "Small Modular Reactor (SMR) Regulators' Forum." IAEA

Integrating Research and Development

Integrating ongoing R&D into regulatory frameworks for SMRs is a small but impactful step that will drastically improve the policies at hand. By utilizing live scientific findings to adapt safety protocols, licensing standards, and technical requirements in real time, the IAEA's foundational framework will be tailored to current issues that SMR regulators face.[112] This regulatory tool can be implemented within the IAEA through a centralized, open-access SMR R&D database, filled with recent scientific data on reactor designs and operational statistics. Through coordinated research projects and working groups, findings can be made available rapidly, enabling the IAEA to continuously improve their regulatory frameworks with recent data.[113] Despite this straightforward approach, disparities in R&D capacity may exclude emerging nations without adequate resources, and the rapidly evolving information may overwhelm national regulatory firms. Many of these nations would have little access to novel research and unable to effectively utilize R&D in supporting SMRs. Therefore, in order to achieve great success in this solution, international cooperation and data-sharing commitments should be well established, and there should exist sufficient funding for global research.

Bloc Positions

Advanced Nuclear Nations

This bloc mainly consists of leading nuclear nations with a strong history in nuclear development, many being among the first pioneers in developing SMRs. This includes the United States, Canada, China, Russia, and Japan, all of which are industrial giants in the field of nuclear reactors, and are constantly paving the path for emerging nations.[114] With mature nuclear sectors and strong national regulatory systems, these nations are the main exporters of SMRs, meaning this topic heavily addresses their framework methods.[115] Due to their prior development of SMRs, this bloc will openly support international licensing harmonization and prefer frameworks that lean towards vendor-led design approvals for their companies to flourish.[116] These large companies are the main producers and researchers on SMRs, with responsibilities such as reactor designing and energy engineering. On the other hand, this bloc would be hesitant regarding the implementation of binding policies to a large extent as it may ruin their governments' SMR objectives, creating unnecessary roadblocks and breaching their nation's sovereignty.[117] Nevertheless, if such regulations are merely for safety purposes, these countries would consider if solutions regarding nuclear safety or NHSI align with their perspective.118 Ultimately, this bloc aims to achieve maximum efficiency when producing SMRs while also advocating for international licenses for global safety.

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[112] Josephs, Rachael E., Thomas Yap, Moones Alamooti, Toluwase Omojiba, Achouak Benarbia, Olusegun Tomomewo, and Habib Ouadi. "Regulation of Small Modular Reactors (Smrs): Innovative Strategies and Economic Insights." MDPI, March 22, 2025. https://www.mdpi.com/2673-4117/6/4/61.

[113] "Advances in SMR Developments 2024." IAEA, 2024. https://www-pub.iaea.org/MTCD/Publications/PDF/p15790-PUB9062_web.pdf.

[114] "Nuclear Power in the World Today." World Nuclear Association. Accessed July 4, 2025. https://world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today

[115] Liou, Joanne, and International Atomic Energy Agency. "What Are Small Modular Reactors (Smrs)?"

[116] "IAEA Sees Progress Made by SMR Deployment Initiative." World Nuclear News.

[117] Lee, Sarah. "Sovereignty in International Relations." Number Analytics // Super Easy Data analysis tool for Research.

[118] Commission, Canadian Nuclear Safety. "Government of Canada." Canadian Nuclear Safety Commission, September 11, 2024. https://www.cnsc-ccsn.gc.ca/eng/resources/international-cooperation/.

Emerging Nuclear Nations

Within the IAEA, the majority of the member states are emerging nuclear nations, focused on researching SMRs, building nuclear capacity, and implementing nuclear energy.[119] Some of the more prominent nations in this bloc are Argentina, Cuba, Indonesia, and Turkey, but any states that are currently building nuclear infrastructure are included in this bloc.[120] These nations often face financial or technical barriers during their development process, and as a result, rely on advanced nuclear nations for collaborative initiatives and monetary support.[121] In terms of SMR regulation, this bloc will strive for flexible and scalable regulatory models, and advocate strongly for equitable technology transfer to speed up their expansion of nuclear infrastructure.[122] Moreover, this bloc emphasizes domestic customization, preferring regional demographic-tailored regulations instead of a one-size-fits-all international policy. This is because many of the emerging nuclear nations are scattered geographically, meaning a standardized framework would not meet environment-specific needs.[123] As a result, this bloc would support solutions that involve collaborative nuclear training programs, as well as international licensing that aligns with the IAEA's regional regulator forum. Financial and technical assistance from the IAEA would also be highly favorable, as it helps nations within this bloc build the foundational groundwork for future growth.

Energy-Focused Nations

A smaller portion of nations within the IAEA, energy-focused nations are neutrally-aligned countries which possess a mix of nuclear experience and new interest towards SMRs. These nations are predominantly located within the Middle East, such as the United Arab Emirates, Egypt, or Saudi Arabia, where they have ample access to energy resources with the goal of eventual diversification.[124] This bloc will also try to improve their geopolitical flexibility, focusing on energy security as well as increasing accessibility of new technology. In the past, members of this bloc have collaborated with a variety of SMR vendors, such as Egypt's partnership with Rosatom,[125] indicating their interest in this new field of nuclear energy. These nations strive for non-aligned and tech-neutral global standards—similar to the IAEA Regulators' Forum in terms of its neutral unified standards—and wish to promote regional adaptability to further expand their own energy economy.[126] Therefore, this bloc supports the creation of diverse international SMR licenses,[127] and enforce clear binding regulations to maintain non-proliferation standards.[128]

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[119] "Emerging Nuclear Energy Countries." World Nuclear Association. Accessed July 4, 2025. https://world-nuclear.org/information-library/country-profiles/others/emerging-nuclear-energy-countries.
[120] Ibid.
[121] "The Canada-Poland Nuclear Energy Cooperation Agreement." Prime Minister of Canada, April 4, 2025. https://www.pm.gc.ca/en/news/news-releases/2025/01/28/canada-poland-nuclear-energy-cooperation-agreement.
[122] Atuhaire, Emma, and International Atomic Energy Agency. "Nuclear Energy in the Clean Energy Transition." IAEA, May 20, 2025. https://www.iaea.org/newscenter/news/nuclear-energy-in-the-clean-energy-transition.
[123] "Emerging Nuclear Energy Countries." World Nuclear Association.
[124] Hansberry, Cate. "An Energy and Sustainability Road Map for the Middle East." Atlantic Council, February 12, 2025. https://www.atlanticcouncil.org/in-depth-research-reports/report/an-energy-and-sustainability-road-map-for-the-middle-east.
[125] Agency, SabaNet - Yemen News. "Egyptian Electricity Minister, Rosatom Chairman Discuss Nuclear Station Development." سبأ اليمنية سبأ - وكالة سبأ نت - وكالة الانباء, July 3, 2025. https://www.saba.ye/en/news3510311.htm.
[126] "Our-Work." Nucleus. Accessed July 4, 2025. https://gnssn.iaea.org/regnet/SMR-Forum/Pages/Our-Work.aspx.
[127] Ibid.
[128] "UAE Nuclear Energy Policy." ENEC: UAE Nuclear Energy Policy. Accessed July 4, 2025. https://web.archive.org/web/20150403122308/https://www.enec.gov.ae/nuclear-energy-in-the-uae/uae-nuclear-energy-policy/.

Low-Infrastructure Nations

On the opposite side of the spectrum to the advanced nuclear nations, low-infrastructure nations are member states of the IAEA that have little nuclear power available, either due to safety purposes or lack of financial support. This bloc mainly consists of smaller-market European countries such as Austria, Denmark and Greece, as well as Australia, Nepal and Malaysia, which all highly oppose the use of nuclear energy.[129] A common trend amongst this bloc is advocacy for non-proliferation, as many member-states are deeply concerned about fuel enrichment, waste storage, and the civilian-military dual-use risks of SMRs.[130] There is increasing skepticism regarding the international establishment of SMRs, with this bloc supporting national sovereignty in rejecting SMR technologies. Potential environmental hazards caused by SMRs are a major concern for these countries,[131] who would promote stronger IAEA guardrails on SMR exports and stricter SMR regulation globally.[132] Some nations, depending on its stance, may even go as far as to argue for the abolishment of SMR usage, as it raises many liability concerns that are detrimental to the globe. With that in mind, this bloc advocates for a rigorous binding regulatory framework focused on ensuring the safest SMR usage, prioritizing international security over energy production efficiency.

Discussion Questions

1. To what extent should the IAEA create an international licensing framework for SMRs, and how can it respect national sovereignty while doing so?
2. How should regulatory systems adapt to accommodate different demographics, ensuring that all emerging nuclear nations can be included effectively?
3. What role should technology transfer and international collaboration play in SMR regulation, particularly between nuclear-advanced states and those with limited regulatory capacity?
4. What challenges or barriers arise when deploying SMRs in remote, politically unstable, or low-infrastructure regions, and how can the IAEA tackle such issues efficiently with its frameworks?
5. Given the dual-use nature of nuclear technologies, how can the IAEA utilize safeguards and inspection mechanisms to mitigate and abolish the militarization of SMRs?
6. In cases where national regulations conflict with IAEA recommendations, what mechanisms should exist to resolve disputes without undermining a country's sovereignty?

Additional Resources

Canadian Nuclear Safety Commission
https://www.cnsc-ccsn.gc.ca/eng/

World Nuclear Association, Small Modular Reactors

[129] "When the Steam Clears." The Economist. Accessed July 4, 2025. https://www.economist.com/briefing/2011/03/24/when-the-steam-clears.

[130] Nuclear legislation in OECD Countries: Austria (EN). Accessed July 4, 2025. https://www.oecd.org/content/dam/oecd/en/publications/reports/2006/03/nuclear-legislation-in-oecd-countries-austria_g1ghacbf/9789264061583-en.pdf.

[131] "Safeguarding a Nuclear Energy 'Boom.'" The Nuclear Threat Initiative, December 12, 2024. https://www.nti.org/analysis/articles/safeguarding-a-nuclear-energy-boom/.

[132] Ibid.

https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors

U.S. Department of Energy, Advanced Small Modular Reactors
https://www.energy.gov/ne/advanced-small-modular-reactors-smrs

Economics and Finance of Small Modular Reactors: A systematic review and research agenda
https://www.sciencedirect.com/science/article/pii/S1364032119307270

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Agency, SabaNet - Yemen News. "Egyptian Electricity Minister, Rosatom Chairman Discuss Nuclear Station Development." اليمنية سبأ - وكالة سبأ سبأ نت - وكالة الانباء, July 3, 2025. https://www.saba.ye/en/news3510311.htm#

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Atuhaire, Emma, and International Atomic Energy Agency. "Nuclear Energy in the Clean Energy Transition." IAEA, May 20, 2025. https://www.iaea.org/newscenter/news/nuclear-energy-in-the-clean-energy-transition.

"Briefing: The SMR Regulators' Forum." World Nuclear News. Accessed June 24, 2025. https://www.world-nuclear-news.org/articles/viewpoint-smr-regulators-forum-looks-to-future-after-first-10-years.

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Nuclear Infrastructure in Conflict Zones

Overview

The usage of nuclear infrastructure within nations worldwide is rapidly rising, with a record high number of reactors, facilities, waste storage sites, and power plants established in the present day.[133] However, in times of conflict, the increase in nuclear infrastructure can contribute to increased transnational hostility, imposing risks to their surroundings.[134] The IAEA defines "conflict zones" as active war zones, occupied territories, or considerably politically unstable regions experiencing any aspect of warfare. Within these areas, nuclear infrastructures are uniquely vulnerable to threats as they react with unpredictable volatility to damage, hindering protection efforts.[135] Furthermore, increased damages in cases including core meltdown, radioactive leaks, and explosions increase environmental and social impacts, which explains why the protection of such infrastructure is such a complex issue to tackle.[136] With recent hostilities, there have been numerous attacks on nuclear infrastructure, including Russia's attacks on Ukraine's Zaporizhzhia nuclear power plant and Trump's strikes on numerous Iranian nuclear sites.[137, 138] This indicates that the protection of nuclear infrastructure in active conflict zones remains a pressing and significant issue that, if solved, will reduce mortality in these conflict zones.[139]

While there have been numerous attempts to establish policies combatting this issue, safeguarding frameworks have shown no success in eliminating direct attacks.[140] The violation of previous agreements, limited factors of enforcement, and the disruption of existing policies all contribute to the list of high-profile security challenges that nuclear infrastructure faces.[141] As a result, it is the IAEA's responsibility to safeguard these facilities internationally through undeviating surveillance, collaborations with other agencies, or capacity building within more fragile nations. These nations would therefore receive support from international communities, making them less susceptible to direct attacks as they are backed with resources and manpower. Member states should work towards a non-proliferation standard regarding protecting nuclear facilities in active war zones.

Alongside these collaborative efforts there are legal and ethical questions regarding national sovereignty and IAEA intervention.[142] On top of that, accountability mechanisms or penalization systems should remain a point of contention to ensure any created treaties will remain unbroken. The significance of protecting nuclear

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infrastructure in conflict zones is exacerbated with the recent threats of war, and the IAEA is urged to examine solutions that balance national sovereignty, international law, and humanitarian protection.

Timeline

September 24, 1798 — Uranium is discovered by Martin Heinrich Klaproth, a German chemist, sparking the start of nuclear science.[143]

December 1938 — At the Kaiser Wilhelm Institute for Chemistry, Otto Hahn and his colleague Fritz Strassmann record the first nuclear fission reaction by colliding uranium atoms, the core concept of nuclear technology.[144]

August 6, 1945 — The United States detonates an atomic bomb over Hiroshima, marking the first use of nuclear technology in warfare. This creates lasting global concern about the militarization of nuclear infrastructure.[145]

December 20, 1951 — The Experimental Breeder Reactor-I (EBR-I) in Idaho becomes the first nuclear reactor to generate usable electricity, resulting in a rise of nuclear power plants across the globe.[146]

February 1977 — More than 30,000 people gathered in West Germany to protest and disrupt the construction of a planned nuclear power plant site, influencing early European safeguarding frameworks.[147]

September 30, 1980 — Iran executes Operation Scorch Sword, a surprise airstrike on the eighth day of the Iran-Iraq war, on Iraq's Osirak reactor to delay the progress of Iraq's nuclear program while damaging its surroundings.[148] This is one of the first direct attacks on a nuclear facility.

June 7, 1981 — One year after Iran's previously noted attempt, Israel secretly executes Operation Opera, fully destroying Iraq's Osirak nuclear reactor and removing the geopolitically hazardous nuclear infrastructure.[149]

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December 31, 1988 — India and Pakistan sign the *Agreement on the Prohibition of Attacks Against Nuclear Installations and Facilities*, the only current treaty that abolishes nuclear strikes.[150] This agreement remains effective in the two countries.

June 17, 1994 — The IAEA adopts the Convention on Nuclear Safety (CNS), the first legally binding international agreement which improves the safety of nuclear power plants.[151]

July 15, 2006 — Launched by President George W. Bush and President Vladimir Putin, the Global Initiative to Combat Nuclear Terrorism (GICNT) is created in order to enhance the protection of existing nuclear infrastructure.[152]

September 6, 2007 — Israel conducts Operation Outside the Box, air-bombing a suspected nuclear reactor that is under construction in Syria's Deir ez-Zor region.[153]

March 11, 2011 — The Fukushima Daiichi disaster resets global nuclear safety strategies and demonstrates the vulnerability of nuclear infrastructures that are not properly managed.[154] This unexpected incident helped emphasize the need for higher-profile security and safeguarding measures, especially pertaining to unguarded facilities.

July 14, 2015 — The Joint Comprehensive Plan of Action is finalized and established between the veto-holding members of the UNSC, Germany, and Iran in order to restrict Iran's nuclear program to peaceful purposes.[155]

March 3–4, 2022 — During the Russo-Ukrainian War, the Russian military fires shells and ignites a fire at the Zaporizhzhia Nuclear Power Plant.[156] The following day, Russia occupies the Zaporizhzhia NPP, which becomes the first forceful seizure of an operational nuclear power plant during an active conflict.[157] The IAEA was unable to prevent military occupation due to aggressive action from armed forces.

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April 17, 2024 — The IAEA and Ukraine sign a new framework to maintain a permanent IAEA presence at all five Ukrainian nuclear sites to mitigate and prevent the Russian forces from inflicting damage on Ukrainian facilities.[158]

June 13, 2025 — Israel launches surprise airstrikes on Iran's Natanz, Fordow, and Isfahan nuclear facilities. This kills no less than 935 people, becoming one of the most devastating attacks on nuclear property in history.[159]

June 22, 2025 — The United States executes Operation Midnight Hammer, bombing Iran's three main nuclear sites, Natanz, Fordow, and Isfahan.[160] The operation results in a cease-fire agreement and ends the Iran-Israel war.

Historical Analysis

Nuclear infrastructure is a broad concept covering many different forms of atomic technology. Ranging from power plants to research reactors, atomic energy and its surrounding concepts have evolved since the start of the nuclear age.[161] With the concept of nuclear energy rising in popularity amongst many nations, its historical insufficiencies in terms of protection are a topic that must be urgently addressed in order to resolve its upcoming developments.[162]

The first major investment in nuclear infrastructure, the Chicago Pile-1, was built at the University of Chicago on December 2, 1942,[163] becoming the world's first self-sustaining artificial nuclear reactor.[164] However, in 1954, concerns arose regarding the spread of dangerous fissile material through the U.S. and Soviet nuclear programs[165, 166] While the protection of nuclear infrastructure was declared within Woodrow Wilson's "Atoms for Peace" speech in 1953,[167] 4 years elapsed before the creation of the IAEA to ensure and promote safe usage of nuclear facilities.[168]

In 1981, Operation Scorch Sword and Operation Opera were commenced by the Iranian and Israeli governments respectively, becoming the joint-first successful direct attack on a foreign nuclear facility, specifically those of

[158] "Nuclear Safety, Security and Safeguards in Ukraine," IAEA, March 5, 2024, https://www.iaea.org/topics/response/nuclear-safety-security-and-safeguards-in-ukraine.
[159] Al Jazeera, "Iran Demands Accountability for Israel and US after 'War of Aggression,'" Al Jazeera, July 6, 2025, https://www.aljazeera.com/news/2025/7/6/iran-demands-accountability-for-israel-and-us-after-war-of-aggression.
[160] Roque, Ashley, "Operation Midnight Hammer: How the US Conducted Surprise Strikes on Iran," Breaking Defense, June 24, 2025, https://breakingdefense.com/2025/06/operation-midnight-hammer-how-the-us-conducted-surprise-strikes-on-iran.
[161] "Nuclear Reactors, Materials, and Waste Sector," Nuclear Reactors, Materials, and Waste Sector | Cybersecurity and Infrastructure Security Agency CISA, Accessed July 13, 2025, https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/critical-infrastructure-sectors/nuclear-reactors-materials-and-waste-sector.
[162] "World Energy Needs and Nuclear Power," World Nuclear Association, Accessed July 13, 2025, https://world-nuclear.org/information-library/current-and-future-generation/world-energy-needs-and-nuclear-power.
[163] Ibid.
[164] Ibid.
[165] "Nuclear Power and Nuclear Activism," Omeka RSS, Accessed July 13, 2025, https://michiganintheworld.history.lsa.umich.edu/environmentalism/exhibits/show/main_exhibit/1970s_activism/nuclear-power-and-nuclear-acti.
[166] Ibid.
[167] "Atoms for Peace Speech," IAEA, July 16, 2014, https://www.iaea.org/about/history/atoms-for-peace-speech.
[168] "History," IAEA, June 8, 2016, https://www.iaea.org/about/overview/history.

Iraq.[169] This demonstrated the vulnerable nature of nuclear infrastructure in geopolitical strategies. After this military operation, the United Nations and the IAEA displayed public criticism as Israel continuously ignored all charges, claiming the attack was justified in self-defense purposes.[170] The implied global trust that had been laid down as a foundation by the IAEA was quickly eroding, leading to an expansion of safeguarding measures on nuclear infrastructure. The focus was also shifting toward monitoring and material accounting to better mitigate future issues in conflict zones.[171]

At the start of the 21st century, nuclear energy saw a general decline in usage but was still used by global member states as leverage during geopolitical conflicts. In 2007, Israel illegally bombed a Syrian nuclear facility under what is known as Operation Outside the Box.[172] This operation occurred as fears of Syria possessing new atomic weapons became a threat to Israel, and in an area of high tension caused by the aftermath of the 2006 Lebanon war and the absence of a peace treaty, it was something that could not be ignored. Unexpectedly, President Bashar al-Assad denied the existence of a nuclear reactor; after heavy inspection by the IAEA, it was determined that Israel had destroyed an undeclared nuclear facility.[173] This was not solely detrimental due to a lack of intervention, but also because it proved current IAEA legal frameworks were insufficient. Furthermore, many nations, including Israel, had not signed the Non-Proliferation Treaty (NPT), destroying the mutual trust between member states and opening the door to a crumbling global non-proliferation regime.[174]

The IAEA responded to the issue of vulnerable nuclear infrastructure in conflict zones by passing the 2005 amendment to the 1979 Convention on the Physical Protection of Nuclear Material (CPPNM).[175] As a result of this, in addition to this legally-binding framework covering all atomic facilities, it also expanded to all nuclear materials used for civilian or military purposes.[176] This strengthened the CPPNM and was able to tackle the solution of infrastructural protection to an extent; nonetheless, it still possessed some regulatory gaps such as the exclusion of military activity, and its lack of a compliance system. Ensuing failures were caused by inadequate IAEA regulation, the voluntary nature of some of its treaties, and the delayed ratification and implementation of legislated protections.[177] All in all, the history of nuclear infrastructure in conflict zones reveals a long-term insecurity caused by geopolitical tensions, legal ambiguity, and constant political warfare. This issue remains an urgent global affair and must be addressed in full by the IAEA and its member states.

[169] "Document Friday: When Iran Bombed Iraq's Nuclear Reactor," UNREDACTED.
[170] Schmitt, Michael N, "Israel's Operation Rising Lion and the Right of Self-Defense," Lieber Institute West Point, June 16, 2025, https://lieber.westpoint.edu/israels-operation-rising-lion-right-of-self-defense.
[171] "Additional Protocol," IAEA, June 8, 2016, https://www.iaea.org/topics/additional-protocol.
[172] "Israel Admits Striking Suspected Syrian Nuclear Reactor in 2007," BBC News.
[173] Ibid.
[174] Ibid.
[175] "Convention on the Physical Protection of Nuclear Material (CPPNM) and Its Amendment," IAEA, October 17, 2014, https://www.iaea.org/publications/documents/conventions/convention-physical-protection-nuclear-material-and-its-amendment.
[176] Ibid.
[177] Kateryna, Minkina, "How the IAEA Does (Not) Work: A History of Failures of the 'Peaceful Atom' Defenders," Ukraïner, February 13, 2025, https://www.ukrainer.net/en/iaea.

Past UN/International Involvement

IAEA Support and Assistance Mission to Zaporizhzhia (ISAMZ)

In response to Russia's unlawful occupation of Ukraine's Zaporizhzhia NPP in March of 2022, the IAEA deployed emergency missions and established nuclear safety and security through ISAMZ,[178] signifying the first time the IAEA has kept on-site monitors in an active warzone.[179] Under Director General Rafael Mariano's guidance, the IAEA safety and security team was able to navigate one of the world's most volatile nuclear sites and successfully implement basic safeguarding protocols.[180] On top of that, this mission prevented the complete loss of international oversight at Europe's largest nuclear power plant while simultaneously connecting the world at large with the ZNPP. As the ISAMZ continues, the team stationed in Ukraine constantly provides security risk assessments and issues daily reports to the greater UN body, increasing international awareness.[181]

Unfortunately, even with these actions, the ZNPP is still under Russian occupation.[182] The main shortcoming of the IAEA's support mission lies in the lack of enforcement power, as it cannot prevent military actions or violations of its safety recommendations.[183] As a result, many shelling incidents have occurred post-intervention, indicating Russian forces are ignoring peaceful non-proliferation suggestions.[184] This prevents the agency from holding states accountable for creating nuclear risk, a recurring issue throughout history.[185] While the IAEA has attempted to set up a protection zone around the large nuclear power plant, these actions yet to provide conclusive evidence as Russia has supplanted all prior contingencies, continuing to damage many aspects of the infrastructure even under the pressure of the UN's nuclear watchdog.[186]

The IAEA Nuclear Security Series (NSS)

The IAEA Nuclear Security Series (NSS) is a series of over 40 publications providing structural guidance and detailing nuclear security practices to member states.[187] From nuclear facility regulation to computational and digital security, each publication is unique in its own right. These publications are specifically detailed and helpful for national nuclear regulators interested in safeguarding nuclear infrastructure.[188] Furthermore, these documents form the technical foundation for how nations secure reactor sites, research facilities, and fuel cycle

[178] Madsen, Michael Amdi, and International Atomic Energy Agency, "IAEA Support and Assistance Mission Sets out to Zaporizhzhya Nuclear Power Plant in Ukraine," IAEA, August 31, 2022, https://www.iaea.org/newscenter/news/iaea-support-and-assistance-mission-sets-out-to-zaporizhzhya-nuclear-power-plant-in-ukraine.
[179] "IAEA Head on Preventing a Nuclear Disaster in Ukraine and around the World," CBS News, Accessed July 14, 2025. https://www.cbsnews.com/news/zaporizhzhia-rafael-mariano-grossi-iaea-60-minutes-2022-11-20/.
[180] Ibid.
[181] "IAEA Head on Preventing a Nuclear Disaster in Ukraine and around the World," CBS News.
[182] "Ukraine War Briefing: Power to Zaporizhzhia Plant Cut off as Un Watchdog Warns Nuclear Safety 'Extremely Precarious,'" The Guardian, July 5, 2025, https://www.theguardian.com/world/2025/jul/05/ukraine-war-briefing-power-to-zaporizhzhia-plant-cut-off-as-un-watchdog-warns-nuclear-safety-extremely-precarious.
[183] Digges, Charles, "The IAEA Must Do More to Stand up to Russia's Attacks on Nuclear Power Plants," The Moscow Times, July 14, 2025, https://www.themoscowtimes.com/2024/12/18/the-iaea-must-do-more-to-stand-up-to-russias-attacks-on-nuclear-power-plants-a87393.
[184] Ibid.
[185] Ibid.
[186] Ibid.
[187] "Nuclear Security Series," IAEA, July 7, 2017, https://www.iaea.org/resources/nuclear-security-series.
[188] "Publications Advanced Search," IAEA, Accessed July 14, 2025, https://www.iaea.org/publications/search/type/nuclear-security-series.

infrastructure, becoming the global benchmark for atomic safety.[189] Launched in 2006, its papers have been utilized by over 60 countries to enforce and protect their nuclear facilities.190 For instance, one of the publications, the INFCIRC/225/Rev.5, is a manual providing governments instructions to build resilient security systems capable of withstanding both internal and external threats.[191] Its contents have been referenced in diverse nuclear systems, encouraging a base level of safety standardization.

While the NSS has been a significant factor in improved nuclear infrastructure protection, many portions of its 43 publications have been recently overlooked and require improvement.[192] As IAEA guidance is legally non-binding, many proposed frameworks have limited scope and ability, leading to many nations not cooperating with the NSS in their own national interests.[193] The absence of a binding treaty or agreement must be rectified in order to eliminate threats towards nuclear infrastructure and general humanity. Another major flaw of the NSS is the IAEA's lack of armed force expertise, resulting in most publications discussing responses against unauthorized non-state actors instead of direct state-level attacks.[194] This was especially evident in Russia's occupation of Ukraine's ZNPP, where IAEA security personnel struggled to deal with the aggressive Russian shelling of their facilities.[195]

Convention on the Physical Protection of Nuclear Material (CPPNM)

The IAEA Convention on the Physical Protection of Nuclear Material (CPPNM) is the sole legally binding international agreement focusing specifically on the physical protection of nuclear materials and facilities.[196] This convention, written in (year), and its amendment, written in 2005, emphasizes security against sabotage, creating a benchmark for nuclear infrastructure protection in conflict zones.[197] The legal basis for issues including facility safety were firmly established by the CPPNM; there was an observed increase in international cooperation and security, especially near unstable borders and vulnerable conflict zones.[198] This vigorous legal framework and convention is also highly promoted by the UNODC as well as the UNGA.[199] Nevertheless, the CPPNM does not issue any operational mandates, instead acting as a regulator and penalizer, resulting in the increased vulnerability of nuclear infrastructures.[200] Moreover, there is no detailed treaty or convention that details real-time emergency

[189] Ibid.
[190] Bolt, Sarah Henry, and International Atomic Energy Agency, "The International Benchmark for Nuclear Security: The IAEA Nuclear Security Series," IAEA, July 18, 2022, https://www.iaea.org/newscenter/news/the-international-benchmark-for-nuclear-security-the-iaea-nuclear-security-series.
[191] "Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)," IAEA, February 1, 2011, https://www.iaea.org/publications/8629/nuclear-security-recommendations-on-physical-protection-of-nuclear-material-and-nuclear-facilities-infcirc225revision-5.
[192] "Nuclear Security Recommendations on Nuclear and Other Radioactive Material," IAEA Publications, 2011, https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1488_web.pdf.
[193] "Establishing a System for Control of Nuclear Material for Nuclear Security Purposes at a Facility during Use, Storage and Movement," IAEA, January 2019, https://www-pub.iaea.org/MTCD/Publications/PDF/P1786_web.pdf.
[194] Fedchenko, Vitaly, "Nuclear Security during Armed Conflict: Lessons from Ukraine," SIPRI, March 16, 2023, https://www.sipri.org/publications/2023/policy-reports/nuclear-security-during-armed-conflict-lessons-ukraine.
[195] Ibid.
[196] Tafili, Vasiliki, "Marking a Milestone: 20th Anniversary of the Amendment to the Convention on Physical Protection of Nuclear Material," IAEA, July 14, 2025. https://www.iaea.org/newscenter/news/marking-a-milestone-20th-anniversary-of-the-amendment-to-the-convention-on-physical-protection-of-nuclear-material.
[197] Ibid.
[198] Tafili, Vasiliki, and Anh Thu Dang, "Strengthening Nuclear Security Worldwide through a/CPPNM and ICSANT," IAEA, December 28, 2023, https://www.iaea.org/newscenter/news/strengthening-nuclear-security-worldwide-through-acppnm-and-icsant.
[199] Ibid.
[200] "Treaties and Conventions," NRC Web, Accessed July 14, 2025, https://www.nrc.gov/about-nrc/ip/treaties-conventions.html.

response, an issue that has become pertinent in recent times.[201] Therefore, while the CPPNM sets a standardized legal foundation for international nuclear infrastructure protection, its many limitations indicate that further action must be taken.

The European Instrument for International Nuclear Safety Cooperation

Originally established in 2007, the European Instrument for International Nuclear Safety Cooperation (INSC) is an EU policy tool used to support non-EU nations in improving nuclear safety and security.[202] In the current cycle, otherwise known as an elected period, of the INSC, which commenced in 2021, 29 nations have received adequate assistance, and an excess of 3000 people have participated in effective training courses advocating for nuclear security.[203] Additionally, INSC centers have served as forums of atomic expertise, providing information on nuclear safety, technology development, and reactor management. It has been specifically active in Ukraine in the past years, as the INSC and the EU have contributed a combined £2 billion to support issues related to Chernobyl recovery efforts and the occupation of ZNPP.204 This funding focused on infrastructure upgrades, emergency preparedness, and regulatory improvements, a change that significantly benefitted Ukraine. All in all, the INSC is an influential regional body that has undergone three iterations of nuclear support, working with the IAEA to provide funding, technical expertise, and political support for infrastructure protection.

Current Situation

Current Nuclear Infrastructure Status

In 2025, there are an estimated 420 nuclear power reactors worldwide, nearing record highs as Japan restarts its production of reactors.[205] The recovery from its Fukushima Daiichi incident has now encouraged Japan, a previously dominant nation in the nuclear field, to resume the usage of nuclear energy. Unfortunately, this leads to higher chances of armed conflict overlapping with civilian nuclear infrastructure, an issue that the IAEA has a lack of experience tackling. Specifically, 6 out of the 30 countries currently operating with nuclear energy are currently experiencing internal or regional tensions or war.[206] The rising risks of sabotage, unlawful occupation, or direct attack on atomic facilities creates an urgent significant humanitarian and environmental threat.[207] Since the first bombing of a nuclear facility in 1980,[208] the IAEA has evolved in its role from peacetime safeguards to direct crisis interventionists, which reflects a broader shift in its mandate toward active engagement in conflict zones.[209] However, recent nuclear attacks have revealed that there are weaknesses and limitations within IAEA

[201] Ibid.
[202] "Nuclear Safety," European Commission, 2025, https://international-partnerships.ec.europa.eu/policies/climate-environment-and-energy/nuclear-safety_en.
[203] "European Instrument for International Nuclear Safety Cooperation - Performance," European Commission, 2025, https://commission.europa.eu/strategy-and-policy/eu-budget/performance-and-reporting/programme-performance-statements/european-instrument-international-nuclear-safety-cooperation-performance_en.
[204] "EU Announces New €2.3 Billion Agreements Package at the Ukraine Recovery Conference 2025," European Commission, 2025, https://ec.europa.eu/commission/presscorner/detail/en/ip_25_1786.
[205] "Nuclear Power," IEA, Accessed July 22, 2025, https://www.iea.org/energy-system/electricity/nuclear-power.
[206] Ibid.
[207] Rushing, Elizabeth, "Dangerous Forces: The Protection of Nuclear Power Plants in Armed Conflict," Humanitarian Law & Policy Blog.
[208] "Document Friday: When Iran Bombed Iraq's Nuclear Reactor," UNREDACTED.
[209] "The Evolution of the IAEA: Using Nuclear Crises as Windows of Opportunity (or Not)," The Belfer Center for Science and International Affairs, March 14, 2025, https://www.belfercenter.org/publication/evolution-iaea-using-nuclear-crises-windows-opportunity-or-not.

frameworks and regulations such as the CPPNM, wartime documents, or the Nuclear Security Series regarding active conflict zones.[210, 211] Consequently, the urgency to create robust mechanisms for protecting nuclear sites during conflict has become a central issue for the international nuclear community.

Currently, the issue of vulnerable nuclear infrastructures in conflict zones covers a wide range of varying areas, from legal and regulatory challenges to improving IAEA emergency response frameworks.[212] Both the absence of wartime enforcement in the CPPNM and comprehensive legislation that mandates breach of nuclear reactors contribute to the weakening structure of IAEA conventions.[213] Key actors within nuclear infrastructure protection are split into two categories, with aggressive, nuclear concerning nations such as Iran, DPRK, and Russia threatening peace,[214] and safeguarding nations such as the US and NATO advocating for increased protections.[215]

Nuclear Safety and Responsibility

Nuclear power places responsibility on the operating country to ensure safe and ethical usage. Armed conflicts increase the risk of physical damage to reactors, waste storage, and cooling systems, as many current protocols do not cover such scenarios.[216] Additionally, the IAEA currently possesses a limited ability to provide assistance to conflict zones, making the enforcement of nuclear safety a challenging barrier to overcome. For instance, the IAEA's emergency missions are reliant on volunteers, and IAEA Official Grossi's ongoing push for establishing a safe zone remains unresolved.[217] On the other hand, civilian nuclear plants also have the potential to be militarized, threatening nuclear weaponry buildup that is not under IAEA surveillance.[218] Uranium enrichment facilities and nuclear fuel processors can be used to produce weapon grade material, posing increasing risk to neighboring countries and the non-proliferation treaty.[219] Furthermore, these power plants also pose a great humanitarian and environmental risk. Radiation leakage and faulty explosives are destructive to humans, plants, and animals.[220] While present regulations have covered many aspects of this, there is a lack of oversight regarding displacement risks, public safety, and long-term environmental consequences during or after conflicts.[221]

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[210] Alk, Ali, "Nuclear Security during Armed Conflict • Stimson Center," Stimson Center, August 29, 2024, https://www.stimson.org/2022/nuclear-security-during-armed-conflict.
[211] Kecskés, Gábor, "The Protection of Nuclear Installations in Time of Armed Conflict – Old Rules, New Challenges," AKJournals, September 18, 2024, https://akjournals.com/view/journals/2052/64/4/article-p508.xml.
[212] "Emergency Preparedness and Response," IAEA, June 8, 2016, https://www.iaea.org/topics/emergency-preparedness-and-response-epr.
[213] Kecskés, Gábor, "The Protection of Nuclear Installations in Time of Armed Conflict – Old Rules, New Challenges."
[214] "G7 Non-Proliferation Directors Group Statement," GOV.UK, Accessed July 21, 2025, https://www.gov.uk/government/publications/g7-non-proliferation-directors-group-statement-april-2023/g7-non-proliferation-directors-group-statement-17-april-2023.
[215] "Looking Back: The 1978 Nuclear Nonproliferation Act," LOOKING BACK: The 1978 Nuclear Nonproliferation Act | Arms Control Association, Accessed July 21, 2025, https://www.armscontrol.org/act/2008-12/looking-back-1978-nuclear-nonproliferation-act.
[216] Carlson, John, "Prohibition of Military Attacks on Nuclear Facilities," VCDNP, 2022, https://vcdnp.org/wp-content/uploads/2022/09/Attacks-on-nuclear-facilities.pdf.
[217] Dahl, Fredrik, "IAEA Proposal for Ukraine Nuclear Safety and Security Protection Zone Wins Support as Talks Begin on Its Establishment," IAEA, September 28, 2022, https://www.iaea.org/newscenter/news/iaea-proposal-for-ukraine-nuclear-safety-and-security-protection-zone-wins-support-as-talks-begin-on-its-establishment.
[218] "Towards a Safer World," IAEA, October 15, 2003, https://www.iaea.org/newscenter/statements/towards-safer-world.
[219] Ibid.
[220] Rushing, Elizabeth, "Dangerous Forces: The Protection of Nuclear Power Plants in Armed Conflict," Humanitarian Law & Policy Blog.
[221] "How Humanitarian Law Applies to Armed Conflict and Nuclear Power Plants," International Committee of the Red Cross, November 18, 2022.

Case Study: Russia and Ukraine

On March 4th, 2022, Russian forces seized the Zaporizhzhia Nuclear Power Plant during the full-scale invasion of Ukraine, marking the first ever militarization of a civilian nuclear site.[222] As both the largest nuclear power plant in Europe and the supplier of 20 percent of Ukraine's energy, Russian occupation called for international attention.[223] The occupation involved active combat near the facility, multiple instances of shelling in surrounding areas, and periods of complete disconnection from Ukraine's national grid.[224] Specifically, there were at least eight recorded instances of off-site power loss that have occurred since Russia's takeover, which could indicate a high risk of meltdowns due to the threatened reactor-cooling systems.[225] This could possibly result in catastrophic nuclear core meltdown that breaches surrounding environments and damages all living things. Moreover, the armed troops, heavy vehicles, and military equipment all stationed at ZNPP further increase the risk of reactor destruction should the situation escalate.[226] The dire situation in Ukraine exposes the vulnerability of nuclear infrastructures in active conflict zones, emphasizing the current lack of international support and regulatory protection.

As of 2025, all six of Ukraine's reactors still under their jurisdiction have been put in cold shut down mode, meaning they are no longer supplied with fuel rods and do not provide energy.[227] Protection has not ceased, however; IAEA safety and security personnel remain on-site under the IAEA Support and Assistance Mission to Zaporizhzhia.[228] Conversely, Ukrainian staff at the ZNPP are forced to operate the reactor under Russian supervision, a large change that results in the militarization of the once peaceful power plant.[229] In response, IAEA Director General Grossi has made precarious visits to both Kyiv and Moscow to negotiate nuclear safety concerns at ZNPP with the delegations of President Zelensky and President Putin.[230, 231] Furthermore, Grossi continues to press for historically unsuccessful nuclear safety and security protection zones around the ZNPP in diplomatic talks, citing the value of nuclear facility security to the IAEA.[232] While no formal agreement has been reached nor signed, the proposal has been taken into consideration by Ukraine, Russia, and the IAEA.

General Grossi's actions against international injustice have spotlighted the crisis at ZNPP, with the UN seeking to address the issue with utmost urgency. Consequently, global forces have sent supplemental equipment to

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[222] Al Jazeera, "'Russian Nuclear Terror': Ukraine Atomic Plant Attacked Again."
[223] Walquist, Calla. "Zaporizhzhia Nuclear Power Plant: Everything You Need To Know," The Guardian, March 4, 2022, https://www.theguardian.com/world/2022/mar/04/zaporizhzhia-nuclear-power-plant-everything-you-need-to-know.
[224] "Ukraine War Briefing: Power to Zaporizhzhia Plant Cut off as UN Watchdog Warns Nuclear Safety 'Extremely Precarious,'" The Guardian.
[225] "Two Years of IAEA Continued Presence at the ZNPP," IAEA, Accessed July 22, 2025, https://www.iaea.org/sites/default/files/documents/two-years-of-iaea-continued-presence-at-the-zaporizhzhaya-nuclear-power-plant.pdf.
[226] Dolzikova, Darya, "Dangerous Targets: Civilian Nuclear Infrastructure and the War in Ukraine," RUSI, 2023, https://static.rusi.org/398-SR-Dangerous-Targets-web-final.pdf.
[227] Traceyhonney, "Zaporizhia Switches Unit 4 to Cold Shutdown," Nuclear Engineering International, May 17, 2024, https://www.neimagazine.com/news/zaporizhia-switches-unit-4-to-cold-shutdown-11686918.
[228] "IAEA Head on Preventing a Nuclear Disaster in Ukraine and around the World," CBS News.
[229] "Update 67 – IAEA Director General Statement on Situation in Ukraine," IAEA, May 7, 2024, https://www.iaea.org/newscenter/pressreleases/update-67-iaea-director-general-statement-on-situation-in-ukraine.
[230] "Un Nuclear Watchdog Chief to Visit Moscow as Fears for Ukraine's Nuclear Plants Spike," AP News, February 4, 2025, https://apnews.com/article/russia-ukraine-war-nuclear-watchdog-un-grossi-a6e9fa88a96ec003e47a39e833faf129.
[231] "IAEA Director General's Introductory Statement to the Board of Governors," IAEA, June 9, 2025, https://www.iaea.org/newscenter/statements/iaea-director-generals-introductory-statement-to-the-board-of-governors-9-june-2025.
[232] Dahl, Fredrik, "IAEA Proposal for Ukraine Nuclear Safety and Security Protection Zone Wins Support as Talks Begin on Its Establishment."

support Ukrainian staff personnel.[233] This included over 111 shipments of safety and security equipment to Zaporizhzhia from 30 different donor states and the European Union, demonstrating the international support the IAEA has cultivated since its emergency mission in 2022.[234] Nonetheless, there is still no binding framework as state-dismantling legislation does not exist, and the Russo-Ukrainian war has demonstrated the inability of existing treaties to prevent the militarization of nuclear sites.

Case Study: Iran

In the early 1970s, Iran's nuclear program was established under the Shah, collaborating with the US and the UK in order to reach a set of ambitious atomic energy goals.[235] With this came the construction of Iran's Natanz nuclear facility, completed in 2002 for civilian purposes.[236] Seven years later, another large scale underground uranium enrichment facility known as Fordow was established. It specialized in enriching the purity of minerals for the Tehran government's nuclear program expansion.[237] These two sites are vital to Iranian nuclear capacity as of the second quarter of 2025, and have been significantly renovated with advanced IR-2m, IR-4, and IR-6 models, which bear the ability to manufacture weapons-grade uranium if necessary.[238] This fact was further confirmed by a May 2025 IAEA report, stating the Fordow site can convert 60 percent of its enriched resource holdings into weapons-grade uranium, which grants them the dangerous capability to create atomic bombs in just three weeks.[239] These civilian nuclear sites, with looming militarization threats, are under high regional tension and have experienced multiple sabotage and security concerns in recent months.[240]

On June 12 and 13, Israeli airstrikes struck the surface level Natanz enrichment facility, destroying the Pilot Fuel Enrichment Plant and electrical infrastructure.[241] This direct attack was considered one of the catalysts of the ensuing 12 day Iran-Israel war, and demonstrated how nuclear infrastructure could be leveraged in conflict.[242] Following this operation, President Trump struck additional Iranian nuclear sites on June 22, heavily damaging Fordow with bunker-buster bombs, a move that gained international attraction to the newly re-elected president.[243] While the IAEA has been managing and regularly monitoring Iran's enrichment facilities, the non-stop surveillance camera access at key sites such as Natanz were offline during the event of the attack, and therefore led to gaps in inspection.[244] Moreover, after the US's airstrikes, the IAEA issued urgent press statements

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[233] "IAEA Director General's Introductory Statement to the Board of Governors," IAEA.
[234] "Update 279 – IAEA Director General Statement on Situation in Ukraine," IAEA, March 5, 2025, https://www.iaea.org/newscenter/pressreleases/update-279-iaea-director-general-statement-on-situation-in-ukraine.
[235] "A History of Iran's Nuclear Program," Iran Watch, December 19, 2023, https://www.iranwatch.org/our-publications/weapon-program-background-report/history-irans-nuclear-program.
[236] Ibid.
[237] "Iran's Secretive Nuclear Site and the Bomb That Could Destroy It," CBCnews, June 19, 2025, https://www.cbc.ca/news/world/iran-fordow-fordo-site-bunker-buster-1.7564311.
[238] "U.S.-Iran nuclear negotiations in 2025: A comprehensive analysis," DebugLies, Accessed July 22, 2025, https://debuglies.com/2025/04/21/u-s-iran-nuclear-negotiations-in-2025-a-comprehensive-analysis/.
[239] "Analysis of IAEA IRAN Verification and Monitoring Report," Institute For Science And International Security.
[240] Matamis, Joaquin, "Iran Escalates Nuclear Standoff by Suspending Cooperation with IAEA • Stimson Center," Stimson Center, July 16, 2025, https://www.stimson.org/2025/iran-begins-nuclear-standoff-by-suspending-cooperation-with-iaea/.
[241] "Operation Rising Lion: The First 72 Hours," Royal United Services Institute, June 16, 2025, https://www.rusi.org/explore-our-research/publications/commentary/operation-rising-lion-first-72-hours.
[242] "Iran Demands Accountability for Israel and US after 'War of Aggression,'" Al Jazeera, July 6, 2025, https://www.aljazeera.com/news/2025/7/6/iran-demands-accountability-for-israel-and-us-after-war-of-aggression.
[243] "Iran Updates," Critical Threats, June 2025, https://www.criticalthreats.org/analysis/iran-updates-june-2025.
[244] "Iran Removing 27 Surveillance Cameras from Nuclear Sites, UN Watchdog Says," CBCnews, June 9, 2022, https://www.cbc.ca/news/world/iran-nuclear-uranium-enrichment-united-nations-1.6482593.

limiting access to affected areas, asking the UN to assist in sending proper remediation measures.[245] This led to Director General Grossi addressing the UNSC on June 26th, condemning both the strikes and Iran's obstruction to post-sabotage inspections, a decision that indicates the severity of the situation.[246] Since the IAEA still does not have enforcement power to intervene with nuclear infrastructure attacks by member states, relying solely on reporting and diplomatic pressure can not, on its own, safeguard nuclear property in high-tension zones.

Possible Solutions and Controversies

IAEA Permanent Field Presence

In the past, the IAEA has utilized safety missions to tackle escalating nuclear emergencies requiring immediate assistance, such as the situation at ZNPP. These efforts employ security personnel, constant surveillance, and international diplomatic efforts.[247] Despite the holistic nature of this strategy, it has, in practice, yielded ineffective results, as the IAEA was unable to stop the Russian occupation and eventual breakdown of the power plant.[248] On the contrary, the transformation of current IAEA security missions into permanent, scalable field presence during conflict would better secure nuclear infrastructure during armed conflict.[249] This solution could include the deployment of trained experts to monitor and report on nuclear facilities in active conflict zones, as well as the creation of a framework for the rapid and sustained deployment of IAEA troops in conflict. The incremental progress made in Ukraine due to a prototype of this solution encourages the effectiveness of establishing a permanent IAEA field presence in similar scenarios.[250]

Many nations, as well as Director General Grossi, have commended and supported the idea of a continuous physical presence at high-tension nuclear infrastructures, calling it a "crucial" mechanism in active conflict zones.[251, 252] Not only will such a system enhance real-time visibility and monitoring, but it will also strongly deter major risks such as militarization and occupation, discouraging direct attacks by leveraging the IAEA's authority. By collaborating with forces such as the IAEA International Physical Protection Advisory Service (IPPAS) and the UNSC, cohorts of safety personnel could be created and sent to high-tension states with their consent to protect unguarded nuclear facilities.[253] With the help of these two well-established programs, IAEA security would be significantly more impactful and effective when dealing with aggressive state actors, which will decrease

[245] Murphy, Francois, "Un Nuclear Watchdog Has Limited Oversight in Iran," Reuters, June 25, 2025, https://www.reuters.com/world/middle-east/limits-un-nuclear-watchdogs-oversight-iran-2025-06-23/.
[246] "IAEA Director General Grossi's Statement to UNSC on Situation in Iran," IAEA, June 22, 2025, https://www.iaea.org/newscenter/statements/iaea-director-general-grossis-statement-to-unsc-on-situation-in-iran-22-june-2025.
[247] "IAEA Head on Preventing a Nuclear Disaster in Ukraine and around the World," CBS News.
[248] "Ukraine War Briefing: Power to Zaporizhzhia Plant Cut off as UN Watchdog Warns Nuclear Safety 'Extremely Precarious,'" The Guardian.
[249] "Joint Statement on Nuclear Safety, Security, and Safeguards in Ukraine IAEA Board of Governors Meeting," IAEA, June 9, 2025, https://www.government.is/diplomatic-missions/embassy-article/2025/06/09/Joint-Statement-on-Nuclear-Safety-Security-and-Safeguards-in-Ukraine-IAEA-Board-of-Governors-Meeting.
[250] "Assistance to Ukraine," IAEA, May 27, 2024, https://www.iaea.org/topics/response/nuclear-safety-security-and-safeguards-in-ukraine/assistance.
[251] "Joint Statement on Nuclear Safety, Security, and Safeguards in Ukraine IAEA Board of Governors Meeting," IAEA.
[252] "Update 97 – IAEA Director General Statement on Situation in Ukraine," IAEA, May 7, 2024, https://www.iaea.org/newscenter/pressreleases/update-97-iaea-director-general-statement-on-situation-in-ukraine.
[253] "International Physical Protection Advisory Service (IPPAS)," IAEA, July 15, 2016, https://www.iaea.org/services/review-missions/international-physical-protection-advisory-service-ippas.

the likelihood of reactor sabotage. Furthermore, the sustained on-site presence could also help in assessing post-conflict damage, increasing the validity of primary-source of conflict reports.[254]

While this solution is straightforward and has been experimented with in the past, the main condition for success lies in the relationship between the IAEA and the impacted state. Without a government permit or national nuclear regulator approval, the IAEA has zero jurisdiction to implement these enforcement strategies in times of conflict.[255] A direct crisis intervention would also raise potential sovereignty concerns from states wary of foreign observers, a barrier that must be overcome through global credibility and proof of concept.[256] Furthermore, this solution would require a buildup of current resources and manpower as IAEA technical capabilities for long-term monitoring have yet to be solidified.[257] This sparks the discussion on how many permanent missions can realistically be sustained indefinitely without the strain of IAEA resources, and also how to effectively ensure that all regions undergoing geopolitical conflicts receive adequate support. Ultimately, while the solution of permanent field presence promises enforced security and a safer nuclear future, its viability depends on securing both political consent and sustainable operational capacity before being implemented globally.

Conflict Safeguarding Protocols

The major issue with current IAEA frameworks is mainly caused by their involuntary and non-binding nature, enabling malicious state actors to attack nuclear infrastructure.[258] This is especially prevalent in conflict zones—an area the IAEA lacks regulation within—which disrupts international authority and raises the risk of nuclear facility sabotage.[259] To counteract this gap in regulation, the IAEA could establish a binding, standardized safeguards framework that countries would adopt in advance for situations of armed conflict, enhancing their protection of nuclear property.[260] The system could include aspects such as, but not limited to, emergency notification systems, remote surveillance, and legislation designed to abolish illegal sabotage or attacks. An obligation for all states to notify IAEA officials in the event of an armed conflict could also be mandated to accelerate this process.

The main advantage of the implementation of conflict-specific safeguarding protocols is that it institutionalizes nuclear safety and security in active war zones.[261] Along with its benefit to both reactors and human lives, these protocols also strengthen the IAEA's mandate and authority, giving this committee and its personnel enforcement power that can help avert future aggressive attacks. To further add on, there have been many instances similar to the situation in Iran where the IAEA responded at a slow pace; establishment of this reliable, legislative-based approach can mitigate all delays in crisis response.[262] This protocol, though more complex and

[254] Vestergaard, Cindy, "Nuclear Annexation: The New Abnormal," Stimson Center, March 3, 2023, https://www.stimson.org/2023/nuclear-annexation-the-new-abnormal/.
[255] "Developing Regulations and Associated Administrative Measures for Nuclear Security," IAEA Nuclear Security Series No. 29-G, 2018, https://www-pub.iaea.org/MTCD/Publications/PDF/P1762_web.pdf.
[256] "Ukraine Condemns IAEA Nuclear Plant Visit via Russian-Occupied Territory," Reuters, 2025, https://www.reuters.com/world/europe/ukraine-condemns-iaea-nuclear-plant-visit-via-russian-occupied-territory-2025-03-02/.
[257] Ferguson, Charles, "Strengthening Nuclear Safeguards," Issues in Science and Technology, July 1, 2022, https://issues.org/ferguson-2.
[258] "Establishing a System for Control of Nuclear Material for Nuclear Security Purposes at a Facility during Use, Storage and Movement," IAEA.
[259] Kecskés, Gábor, "The Protection of Nuclear Installations in Time of Armed Conflict – Old Rules, New Challenges."
[260] "Nuclear Security Conventions," IAEA, June 8, 2016, https://www.iaea.org/topics/nuclear-security-conventions.
[261] "Nuclear Safety, Security and Safeguards in Ukraine," IAEA, March 5, 2024, https://www.iaea.org/topics/response/nuclear-safety-security-and-safeguards-in-ukraine.
[262] "Iran Removing 27 Surveillance Cameras from Nuclear Sites, UN Watchdog Says," CBCnews.

time-consuming to create, could be easily integrated into current IAEA frameworks, including the Comprehensive Safeguards Agreements (CSAs), or serve as an extension of the CPPNM to amend present regulatory standards.[263]

Despite its clear benefits and legal compatibility, the effectiveness of a binding conflict safeguard protocol relies on several critical conditions for effective results and brings many controversies that must be addressed. The creation of an involuntary framework requires formal approval and adoption by the majority of IAEA member states, which would inevitably spark debate from ideologically non-aligned nations, leading to delays in implementation.[264] Aside from consensus, this protocol requires the commitment of member states' political agendas under active conflict, as this ensures that these IAEA agreements will be endorsed and sustained.[265] This is yet another obstacle that must be overcome, as it is not guaranteed that countries would entrust their country's security and sovereignty into the IAEA's jurisdiction.

Nuclear Protection Norms

Promoting a global political norm against targeting nuclear facilities in armed conflict is another feasible solution. Unlike the previous approaches, this solution tactically addresses the root cause of reactor vulnerability. Based on existing humanitarian law,[266] the IAEA could encourage states to issue a declaration of restraints on civilian nuclear property, ensuring that such infrastructure is not used for military purposes. This would place facilities in legal categories similar to cultural heritage sites.[267] Moreover, the IAEA could collaborate with the UN General assembly to generate political pressure and awareness, normalizing the protection of nuclear infrastructure internationally. The standard created by this initiative could then discourage militaries from targeting or occupying nuclear sites, establishing a standard for future binding policies.[268] Furthermore, this solution has many unintended benefits including, but not limited to: environmental preservation; promotion of humanitarian principles; and most importantly, safeguarding the world of future generations. This solution is one that has the potential to significantly affect the future by setting a standard that promotes peace amongst nuclear nations.

Spreading awareness about nuclear infrastructure protection is not an easy task even for large organizations such as the IAEA, and therefore, it needs broad diplomatic support from the UN, as well as major military powers. Long-term success depends on if member states account for this solution in their military planning, as influencing a nation's principles requires a significant amount of persuasion and deliberate reasoning. Controversies can also surface, as some states may view the no-strike norm as an unrealistic standard, arguing that military strategy should take priority over humanitarian restraint.[269] These issues must be addressed by the IAEA before

[263] "Additional Protocol," IAEA, June 8, 2016, https://www.iaea.org/topics/additional-protocol.
[264] Mutluer, Adem, "Safeguards Implementation Report 2023," IAEA, June 18, 2024, https://www.iaea.org/newscenter/news/iaea-performed-over-3000-verification-activities-around-the-world-safeguards-implementation-report-2023.
[265] Marquette, Heather, "Political Will: What It Is, Why It Matters for Extractives and How on Earth Do You Find It?" Columbia Center on Sustainable investment, 2020, https://ccsi.columbia.edu/news/political-will-what-it-why-it-matters-extractives-and-how-earth-do-you-find-it.
[266] Carlson, John, "Prohibition of Military Attacks on Nuclear Facilities."
[267] "How Humanitarian Law Applies to Armed Conflict and Nuclear Power Plants," International Committee of the Red Cross, November 18, 2022, https://www.icrc.org/en/document/how-ihl-applies-to-conflict-nuclear-power-plants.
[268] Kecskés, Gábor, "The Protection of Nuclear Installations in Time of Armed Conflict – Old Rules, New Challenges," AKJournals, September 18, 2024, https://akjournals.com/view/journals/2052/64/4/article-p508.xml.
[269] Dienelt, Anne, "How Are Nuclear Power Plants Protected by Law during War?" Völkerrechtsblog, March 7, 2022, https://voelkerrechtsblog.org/how-are-nuclear-power-plants-protected-by-law-during-war.

establishing this nuclear protection benchmark through member state collaboration and intense diplomatic justification, ensuring the alignment of all countries.

Mutual Trust

Mutual trust is a vital component in enforcing regulatory measures, describing the belief in transparent action and accountability for all member states.[270] In order for any proposed solutions to work to any effect, mutual trust must be established within the IAEA. Within the scope of infrastructure protection, this can be demonstrated through transparency in information exchange; constant notification of nuclear activity; consistent adherence to agreed safety measures; and other reliance mechanisms.[271] These measures reduce the risk of misinformation and build confidence in the safe usage of civilian nuclear power plants, contributing to a more cooperative environment.[272] Mutual trust can be established through a variety of methods, including information sharing agreements, joint statements between member states, and internal IAEA practices. On top of that, embedding mutual trust frameworks into IAEA safety missions and supplemental initiatives will strengthen the joint protection of nuclear facilities. To conclude, mutual trust should be used to strengthen collaboration, monitor implementation, and ensure nuclear security regulations are in effect.

Bloc Positions

Western Powers

This bloc consists of the most nuclear-advanced nations in North America and Europe, including, but not limited to, the United States, Canada, France, the United Kingdom, and Germany.[273] These member states would place nuclear security as their top priority and fully support expanding IAEA authority in high-risk zones, endorsing binding safeguard protocols.[274] In the past, multiple members of this bloc have advocated for a sustained IAEA presence, suggesting solutions resembling permanent field occupancy for faster monitoring and response action.[275] Since the members of this bloc have some of the largest nuclear energy output from their power plants, this solution would likely be promoted to ensure protection of their own infrastructure.[276] As this bloc contains some of the more historically influential members of the IAEA, it could leverage this position and exercise diplomatic pressure on non-cooperative states in order to reach an international consensus on their frameworks, as seen in the past.[277] However, while these nations would support the idea of maintaining a permanent IAEA presence for protection purposes, many of these countries would be against any solutions that weaken national sovereignty or require military enforcement under the IAEA's command. This is due to significant concerns over

[270] Chami, Ralph, "Trust As a Means of Improving Corporate Governance and Efficiency." IMF eLibrary, 2022, https://www.elibrary.imf.org/.
[271] "Promoting Greater Transparency for Effective Nuclear Security," Nuclear Security Governance Experts Group (NSGEG), February 2013, http://www.nsgeg.org/.
[272] Ibid.
[273] "Top 15 Nuclear Generating Countries," NEI, Accessed July 22, 2025, https://www.nei.org/resources/statistics/top-15-nuclear-generating-countries.
[274] "Statement on Behalf of 26 European Union Member States at the IAEA Board of Governors on Nuclear Safety, Security and Safeguards in Ukraine," EEAS, 2025, https://www.eeas.europa.eu/delegations/vienna-international-organisations/statement-behalf-26-european-union-member-states-iaea-board-governors-nuclear-safety-security-and_en.
[275] "Joint Statement on Nuclear Safety, Security, and Safeguards in Ukraine IAEA Board of Governors Meeting," IAEA.
[276] Carlson, John, "Prohibition of Military Attacks on Nuclear Facilities."
[277] The New Arab Staff & Agencies, "West Plans to Push IAEA Board to Find Iran in Breach of Duties," The New Arab, Accessed July 21, 2025, https://www.newarab.com/news/west-plans-push-iaea-board-find-iran-breach-duties.

losing national regulatory authority in addition to the risk of losing troops during potential UN combat enforcement. All in all, this bloc would be the main supporters of technical aid and would commend IAEA field presence while ensuring the security of national sovereignty.

Conflict-Affected Nations

This bloc contains diverse perspectives, being mainly made up of states in high-tension zones with threatened nuclear infrastructure. This includes countries with ongoing nuclear-related conflicts, such as Ukraine, Iran, and Israel, who all contain facilities currently under geopolitical threat.[278, 279] As these nations face regional tensions at a minimum, the solution of interest would be the IAEA wartime emergency response protocols.[280] The members of this bloc are conscious of potential infringement on sovereignty during conflict, and as a result, will only accept IAEA monitoring if accompanied by broader diplomatic negotiations to ensure proper host-state consent.[281] Conversely, these conflict-affected nations promote post-conflict remediation and support recovery mechanisms by the international community to help repair damaged infrastructure. This bloc hopes to protect nuclear infrastructure through balanced international assistance that respects state sovereignty while simultaneously deploying safeguarding mechanisms.

Emerging Nuclear Nations

This bloc describes the majority of this committee, consisting of a diverse array of developing countries. As the group currently researching, constructing, and deploying their nuclear facilities,[282] this bloc is likely to reach a consensus on infrastructure protection in conflict zones. These nations, such as Argentina, Cuba, Indonesia, and Turkey, agree upon strengthening IAEA capabilities and strongly advocate for flexible frameworks for the varied environments of different member states. To further integrate their programs, emerging nations would also propose enhanced regional cooperation frameworks, built so that each respective area can have access to tailored regulatory policies, similar to the IAEA Regulatory Cooperation Forum.[283] Consequently, the specialized frameworks for each region would increase the effectiveness of infrastructural protection as they are better adapted to their regional policies and geographical demographic. Since members of this bloc have less expertise regarding nuclear facilities, many states would prioritize technical support for safeguarding infrastructures under construction. In summary, this bloc occupies a neutral perspective within the committee and is open to most solutions, specifically favouring region-specific protocols to increase reactor security

Low-Infrastructure Nations

This bloc consists of nations with limited nuclear progress, either due to opposing beliefs or lack of capital. The members of this bloc, including Greece, Austria, and Nigeria, strive to improve nuclear infrastructure protection

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[278] Al Jazeera, "'Russian Nuclear Terror': Ukraine Atomic Plant Attacked Again."
[279] "Operation Rising Lion: The First 72 Hours," Royal United Services Institute.
[280] "Nuclear Safety, Security and Safeguards in Ukraine," IAEA, March 5, 2024, https://www.iaea.org/topics/response/nuclear-safety-security-and-safeguards-in-ukraine.
[281] "Iran President Signs Law Suspending Cooperation with IAEA," Al Jazeera, July 2, 2025, https://www.aljazeera.com/news/2025/7/2/iran-president-signs-law-suspending-cooperation-with-iaea.
[282] "Emerging Nuclear Energy Countries," World Nuclear Association, Accessed July 4, 2025, https://world-nuclear.org/information-library/country-profiles/others/emerging-nuclear-energy-countries.
[283] Li, Weirong, "Regulatory Cooperation Forum Discusses Ways to Further Enhance Nuclear Safety," IAEA, September 9, 2024, https://www.iaea.org/newscenter/news/regulatory-cooperation-forum-discusses-ways-to-further-enhance-nuclear-safety.

for the greater security of the globe.[284] Being largely dependent on external sources for any nuclear-related expansion, nations within this bloc are relatively inexperienced in the field of nuclear science. Furthermore, as some of these countries are ethically opposed to the concept of atomic energy, this bloc favours solutions that prioritize humanitarian protection, hoping to reduce and mitigate any instances of nuclear sabotage or radiation leakage.[285] Due to relatively limited political influence, this bloc endorses the solution of promoting nuclear safety as a norm, and would act morally to encourage the international community to stop nuclear facility attacks.[286] Countries in this bloc also have the potential to become effective and impartial third-party mediators between other blocs, facilitating agreements through balanced discussion. Ultimately, this bloc seeks equitable inclusion in international nuclear safety and security by advocating for humanitarian-focused, protective, and global solutions that address the risk of nuclear facilities in times of conflict.

Discussion Questions

1. To what extent should the protection of nuclear facilities override state sovereignty during armed conflict?
2. How can the IAEA effectively enforce safeguards and ensure compliance in high-tension regions where the government could be skeptical about international intervention?
3. What measures must be established to ensure the safety of IAEA security personnel during nuclear infrastructure protection in international conflicts?
4. How can the IAEA implement its monitoring systems in real-time during active conflicts in areas where access to nuclear facilities is restricted or unsafe?
5. To what extent should the international regulatory framework be flexible to accommodate the diverse member-states across different geopolitical regions?
6. How can the IAEA ensure civilian nuclear facilities are appropriately and safely utilized to prevent potential aggression?
7. What systems could be created to incorporate low-infrastructure nations as possible mediators of nuclear conflict? What role do mediators play, and how are they influential in this overall process?

Additional Resources

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[284] "When the Steam Clears," The Economist, Accessed July 4, 2025, https://www.economist.com/briefing/2011/03/24/when-the-steam-clears.
[285] Nuclear legislation in OECD Countries: Austria (EN), Accessed July 4, 2025, https://www.oecd.org/content/dam/oecd/en/publications/reports/2006/03/nuclear-legislation-in-oecd-countries-austria_g1ghacbf/9789264061583-en.pdf.
[286] "General Assembly Hails International Atomic Energy Agency's Vital Role in Ensuring Global Security, as Delegates Urge Universal Respect for Safeguards | Meetings Coverage and Press Releases," United Nations, 2018, https://press.un.org/en/2018/ga12089.doc.htm.

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