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WHY THE UNITED STATES SHOULD REMAIN ENGAGED ON NUCLEAR POWER: GEOPOLITICAL AND NATIONAL SECURITY CONSIDERATIONS

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Preface

Nuclear energy has shown much promise and faced considerable challenges since its origins in the mid-20th century. While the United States drove the early charge for safe nuclear power around the globe, its leadership has waned in recent decades. US reactors now under construction—following no orders for such plants in the United States for several decades—have gone well over planned budgets and schedules. And while the United States was once the leading international supplier of reactors, other countries have since stepped forward to fill that role.

Columbia University's Center on Global Energy Policy, as part of its wider work on nuclear energy, is examining the impact of potential American disengagement from nuclear power's development and where opportunities exist to step back in and shape its future. The program also will assess the US nuclear waste management program and efforts to collaborate with other countries on advanced reactor development as well as options for improvement on both fronts.

This effort includes a two-part commentary on some of the benefits the United States might derive from increasing its engagement on nuclear power. The first in the series explored the important role nuclear energy can play in lowering air pollution and greenhouse gas emissions to avoid the worst potential outcomes of climate change. The second part of the series, this piece, examines the geopolitical and national security implications of the United States and its traditional allies effectively ceding the international nuclear energy marketplace to the Chinese and Russians.

The nuclear program's ultimate goal is to inform readers—policy makers, industry leaders, academics, and others—with objective, research-based analysis. It will strive in the months and years ahead to contribute constructively to a necessary dialogue on the future of nuclear power.

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Introduction

Nuclear power in the United States is facing substantial headwinds. However, the urgency and scale of addressing climate change argues for a strong push on all low-carbon technologies, including nuclear energy, as discussed in the first part of this commentary series.[1] Meanwhile, Russia and China have increased the size of their domestic nuclear programs, as well as their export ambitions.[2] As this piece discusses, there are geopolitical implications associated with the United States effectively ceding the international nuclear energy marketplace to these countries. In combination with the potential missed economic opportunities (i.e., a possible $1.5 trillion market),[3] as well as a preference to be the energy technology supplier of choice around the world (or perhaps a preference for countries not to be dependent on Russia and China),[4] there are additional considerations related to US national security.

The purpose of this commentary is not to assess the successes and failures of the global nonproliferation regime or the effectiveness of various US nonproliferation efforts,[5] or to propose new nonproliferation strategies.[6] Rather, the intention is to review the unique role the United States has played in helping erect the global nonproliferation regime and discuss the major elements of the regime that are relevant today for nuclear energy cooperation between the United States and other countries. From there, the commentary examines some of the national security implications associated with potential US disengagement as a nuclear supplier that should be considered by American decision makers as they approach policy making for US nuclear energy and nonproliferation programs.

The Role of the United States in the Creation of the IAEA and the NPT

A global worry after World War II was the spread and potential use of nuclear weapons. A mere four years after the first US nuclear weapons test in 1945, the Soviet Union had tested its first nuclear weapon. The UK followed in 1952 with its own nuclear test. Believing that nuclear secrecy was no longer a credible strategy, and concerned that many countries would launch their own programs and successfully develop nuclear weapons, President Dwight Eisenhower launched an ambitious strategic initiative.

In a 1953 speech to the United Nations, he described the risks of nuclear weapons and elaborated on how those risks could be limited. Notably, he proposed the creation of an international body to monitor nuclear activities. In addition to this global inspection and control regime and a focus on diminishing nuclear weapons stockpiles, Eisenhower proposed that "[e]xperts would be mobilized to apply atomic energy to the needs of agriculture, medicine and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world."[7]

The speech (dubbed "Atoms for Peace") led to the creation of the International Atomic Energy Agency (IAEA) in 1957 and later to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The NPT was opened for signature in 1968, and can be seen as the legal embodiment of the international bargain that Eisenhower had pointed toward in the Atoms for Peace speech. The NPT still serves as the bedrock of the nuclear nonproliferation regime today, and includes several key provisions within its 11 articles:

- Article I obligated nuclear weapon states (NWS) not to transfer nuclear weapons to other countries and not to assist non-nuclear weapon states (NNWS) in acquiring nuclear weapons.
- Article II contained a pledge that NNWS would not develop nuclear weapons. (NNWS were defined in Article IX of the treaty to be states that had not tested a nuclear weapon before 1967.)
- Article III provided that nuclear material (source and special fissionable) in each NNWS would be subject to inspections by the IAEA to verify that it had not been diverted from peaceful purposes. It also contained an export control duty that nations not supply nuclear material or especially designed or prepared equipment to an NNWS' nuclear program unless IAEA safeguards were applied.
- Article IV stated each nation's right to use nuclear energy for peaceful purposes.
- Article VI committed the NWS to negotiations on nuclear weapons disarmament.[8]

The NPT is best viewed as a bargain between the "haves" (the NWS, which were the United States, Soviet Union, UK, France, and China) and the "have nots" (the NNWS). NWS such as the United States wanted a legally binding commitment by the NNWS not to develop nuclear weapons, and also wanted international inspections on nuclear activities in the NNWS territories to verify that nuclear material was not being diverted to military purposes. The IAEA, for example, would carry out its verification mission in NNWS using a set of technical measures (known as "safeguards") to verify that nuclear facilities were not misused and nuclear material was not diverted from peaceful uses. NNWS, on the other hand, wanted their right to peaceful nuclear energy purposes enshrined in the treaty (and to receive assistance in this regard, as described below) and also for the NWS to commit to nuclear weapons disarmament.

Again, the purpose of this commentary is not to analyze the successes and failures of the Atoms for Peace/NPT bargain, as others have done.[9] As one expert noted, the important observation is that because of US initiative, "In the nonproliferation realm, Atoms for Peace laid the framework for the [IAEA] and the [NPT]—the cornerstones of the international nuclear nonproliferation regime."[10] The IAEA's two objectives are to prevent proliferation and support peaceful nuclear energy use. The civil nuclear energy component of the NPT—Article IV—was an integral part of how the treaty was negotiated and why it was indefinitely extended. As Ambassador Thomas Graham, Jr. reflected,[11] "Article IV was absolutely essential to the negotiation and conclusion of the NPT in 1968… Likewise, Article IV was central to the indefinite extension of the NPT in 1995." In 1995, for example, over two dozen NPT parties had either built nuclear power plants or were seriously considering a nuclear power program. Most nations party to the NPT also had an interest in using nuclear power for purposes other than energy generation, such as in medicine or agriculture.

Development of nuclear energy programs in other countries must necessarily be seen through the lens of the NPT and Article IV as every nation in the world except five (India, Pakistan, Israel, North Korea, and South Sudan) is a member of the treaty. It is the right of every NNWS under

the NPT to pursue peaceful nuclear energy if they choose to do so, so long as they abide by the nonproliferation obligations set out in the NPT. The treaty does not compel states party to the NPT to pursue nuclear energy programs, nor does it mean that nations such as the United States are obligated to supply nuclear reactors or materials to each and every country that is party to the treaty. However, the treaty does speak to obligations to cooperate, especially in NNWS and the developing areas of the world. Article IV.2 stated that all of the parties to the treaty would facilitate the "fullest possible exchange" of equipment, materials and scientific and technological information applied to peaceful uses of nuclear energy. Moreover, it stated that countries such as the United States "shall also co-operate… together with other States… to the further development of peaceful nuclear energy purposes." The NPT explicitly identified NNWS and "developing areas of the world" to benefit from this cooperation.

In 1963, President Kennedy expressed concern that in the 1970s the United States might have to face a world in which "15 or 20 or 25 nations" have nuclear weapons.[12] This scenario never came to pass, and Atoms for Peace, the IAEA, and the NPT deserve some credit in preventing this development. As of August 2020, the number of countries possessing nuclear weapons stood at nine.[13]

Nuclear Export Controls, Cooperation Agreements, and US Leadership

Following Eisenhower's Atoms for Peace speech, the United States carried out programs to accelerate commercial nuclear power development for domestic energy supply. These programs created the civil nuclear energy capabilities that were then offered to other countries as part of the Atoms for Peace/NPT bargain. For example, the US government used cost-sharing arrangements with private companies and other mechanisms to demonstrate different reactor technologies in the 1950s and 1960s as part of the Power Reactor Demonstration Program.[14] These initial public-private partnerships provided the early investment that demonstrated commercial nuclear power technologies and ultimately led to the current fleet of almost 100 commercial reactors in the United States, as well as exports to other countries.

However, the supply of peaceful nuclear energy assistance to other countries was not without controversy, nor was it without incidents that inadvertently contributed to nuclear weapons programs. After the NPT entered into force in 1970, it soon became apparent that additional measures were needed to limit the risk of proliferation.

Perhaps the most consequential instance of proliferation during that period involved Canadian and US nuclear energy assistance to India. In the 1950s, Canada had agreed to assist India with construction of a research reactor and the United States agreed to supply the facility with heavy water for its operation. The agreement, however, predated the existence of the IAEA and the NPT and the facility began operations without international safeguards applied to it. Safeguards were never applied to the reactor at a later time, and India never joined the NPT. India's government had provided assurances to both Canada and the United States that their assistance with the research reactor would be used only for peaceful purposes. In 1974, India used plutonium that had been separated from the research reactor's used fuel at a reprocessing facility and detonated a nuclear explosive device, claiming it was a "peaceful nuclear explosion." The use of nuclear material from a research reactor that had been

provided for peaceful purposes—and more generally the problem of what to do with countries that did not join the NPT (less than half of the nations that exist today were party to the NPT in 1974[15])—prompted a flurry of efforts to strengthen the nonproliferation architecture.

While the United States and other likeminded countries could not compel countries such as India to join the NPT and foreswear nuclear weapons, they could erect higher export control standards to guard against another such episode in the future and continue to press more countries to join the NPT. In the same year as India's test, the United States and a small group of countries (Canada, France, Japan, the Soviet Union, the United Kingdom, and West Germany) met to agree on a multilateral set of export control guidelines for the supply of nuclear material, equipment, and technology. The organization, now known as the Nuclear Suppliers Group (NSG), published its first set of export control guidelines in 1978 that contained, among other conditions, new restrictions on the export of enrichment, reprocessing, and heavy water technologies. The NSG published a "Trigger List" of nuclear items (so-called because the export of these items would trigger the need for IAEA safeguards) and guidelines that described the conditions that must be satisfied for the supply of items on the Trigger List to other countries. In 1992, the NSG also published a "Dual Use List" of controlled items with both nuclear and non-nuclear applications and a separate set of guidelines describing the conditions of supply for their export.[16] Today, the NSG is the premiere multilateral nuclear export control forum: it provides a minimum set of export control standards that all of the major suppliers are to abide by in order to prevent a "race to the bottom" on nonproliferation commitments.

The US Congress played an important role in strengthening export controls and nuclear cooperation with other countries in the wake of the India test. The 1978 Nuclear Non-Proliferation Act (NNPA) required future nuclear cooperation agreements with NNWS to include "full-scope" IAEA safeguards. That is, a NNWS would have to accept IAEA safeguards on all of the nuclear materials within its territory, not solely on individual projects involving US collaboration. This was a direct response to the India case—where some facilities had been under IAEA safeguards and some had not—to prevent in particular non-NPT countries from exploiting the same loophole in the future. The United States and other countries pushed for all of the major suppliers to commit to this condition of supply as part of the NSG guidelines, and in 1992, the NSG announced agreement on this policy objective.[17]

Similarly, there are other instances where the United States has unilaterally strengthened its own export controls and then subsequently worked to raise the multilateral commitments of the major suppliers by pressing for adoption in the NSG. For example, in the 1980s and early 1990s, as part of the export licensing process for nuclear energy technologies, the United States began to consistently request formal government-to-government assurances from recipient countries of peaceful use of the technology and/or to put conditions on the retransfer of the technology to subsequent countries. This went beyond what was required by the NSG at the time,[18] and the United States and other countries worked to negotiate these practices into multilateral export controls. In 1995, the NSG made the technology associated with Trigger List items subject to much the same conditions as the Trigger List items themselves. This meant that countries adhering to the NSG guidelines would also have to obtain government-to-government assurances regarding peaceful uses and retransfers of

all listed nuclear energy technologies. This did not prevent supplier nations from requesting stronger nonproliferation commitments as part of these exports, however, and to this day, the assurances that the United States requests from recipient countries regarding the retransfer of certain nuclear energy technologies are stronger than what is required by the NSG.[19]

As a third example, albeit one that is broader than just nuclear export control, the US government launched the Enhanced Proliferation Control Initiative (EPCI) during the George H.W. Bush Administration in 1990. Implemented under 15 CFR Part 744 of the Export Administration Regulations, the controls are based on the end-use or end-user of an item (known as "catch-all" controls) and can thus require US companies to obtain a license to export items even if those items are not explicitly listed in any US export control regulations. Rather, if the applicant knows (or has reasons to believe) or is informed by the US government that the item poses an unacceptable risk of diversion to nuclear, missile, chemical, or biological proliferation activities, a license is required for its export. The US government maintains a list of foreign entities that it has designated as end-users of concern (e.g., some of these entities are involved in nuclear weapons activities in China, India, Pakistan, or Russia). As one Japanese trade advisor described, "The EPCI started as a unilateral control, but with US leadership, allied countries later incorporated the catch-all controls in their export control systems."[20] In 2004, the United States and other nations negotiated a catch-all export control provision into the NSG Dual Use list.[21]

These three examples are by no means an exhaustive list, but they illustrate where US leadership has in part led to strengthened multilateral conditions of supply for nuclear exports.

There is also a separate set of nonproliferation considerations that involve the consent rights available to the United States *after* materials and equipment have been exported to another country subject to a US nuclear cooperation agreement. The United States negotiates nuclear cooperation agreements with other countries in accordance with the requirements of Section 123 of the Atomic Energy Act of 1954 (AEA), sometimes referred to as "123 agreements." Nuclear cooperation agreements provide the legal framework for bilateral cooperation and the export of US nuclear materials and equipment. 123 agreements also contain specific points of influence that can be used to affect nonproliferation aspects of a recipient country's nuclear energy program after a given export has been licensed.

Subsequent to the 1978 NNPA, nuclear cooperation agreements with NNWS typically contain the nine nonproliferation criteria described in Section 123a of the AEA. These provisions mean that, for example, nuclear material that has been provided by the United States to another nation cannot be enriched or reprocessed without the prior consent of the United States. If the United States supplies either major reactor components or the fuel for a country's nuclear reactors subject to the nuclear cooperation agreement, the spent nuclear fuel produced by the associated reactors cannot be reprocessed to produce separated plutonium without the consent of the United States. US government officials have in the past called the nonproliferation criteria in US nuclear cooperation agreements, "the most stringent in the world."[22] US nuclear cooperation agreements also require cooperating partners to apply adequate physical protection measures to exported nuclear materials. The US government consults on these matters with other states, and even conducts bilateral physical security visits

at foreign locations with nuclear materials subject to 123 agreements, providing an opportunity for the United States to communicate and share best practices for physical security.

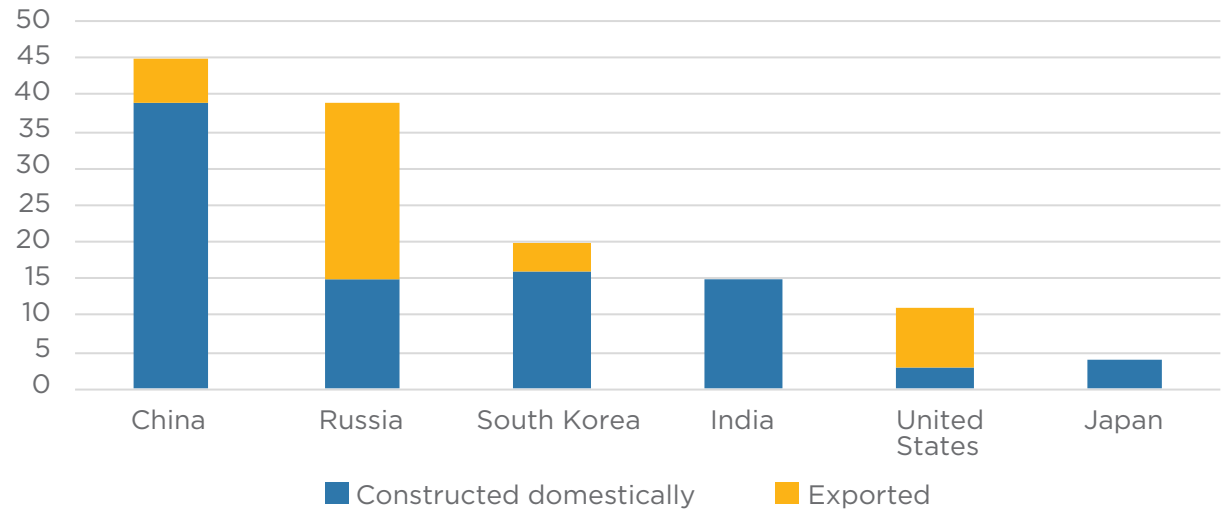
The history of Atoms for Peace and the creation of the IAEA, NPT, and NSG, as well as export control initiatives in more recent decades, are meant to illustrate at least in part the unique and vital role the United States has played in forming, sustaining, and strengthening the global nonproliferation architecture. As the next section discusses, further decline in or a US exit from nuclear power will necessarily mean a reduction in avenues for the United States to exert influence on and shape the nonproliferation regime in future decades.

Rising Competition from China and Russia

As mentioned, the US domestic nuclear energy industry is facing substantial challenges in the US electricity sector. US reactor vendors are also having difficulty competing with other supplier nations to be the vendor of choice for nuclear programs around the world. A 2010 Government Accountability Office report found that the US share of exports of nuclear reactors, major components and equipment, and minor reactor parts fell 36 percent between 1994 and 2008—from an 11 percent share to 7 percent—and the US share of nuclear fuel exports fell from 29 percent to 10 percent in the same period.[23]

As Figure 1 shows, Russia is the leading supplier of nuclear reactors to other countries, and China, with the biggest domestic build in the world, is positioned to play a large role in the future.

Figure 1: Number of nuclear plants under construction and constructed by key countries since 1997



Source: Nuclear Energy Institute, "Nuclear by the Numbers," March 2019.

Given that the Westinghouse AP1000 reactor builds in Georgia and South Carolina have gone very badly,[24] if no US advanced reactor efforts succeed, the United States could be left without a reactor option to offer other countries under its nuclear cooperation agreements. This can only decrease the leverage the United States has to negotiate nonproliferation commitments with other countries in future cooperation agreements. This is especially true today as countries interested in nuclear power do not need to sign agreements with the United States in order to access viable supply chains for reactor programs. It is hard to see why countries would allow America to set conditions on their civil nuclear energy programs—let alone higher ones than NSG standards dictate or that other supplier countries ask for—as part of US 123 agreements if the United States is not able to offer nations anything of value in return.

Under a hypothetical future where US nuclear energy capabilities diminish further, countries that make the sovereign decision to pursue civil nuclear energy programs will still have reactor supplier options—they will just not be US ones. The nonproliferation commitments negotiated by the Chinese and Russians in their supply agreements with recipient states are likely to be weaker than what the United States would have otherwise negotiated as an active participant in the international nuclear energy marketplace. As a recent US National Nuclear Security Administration (NNSA) report noted, the conditions of supply in US nuclear cooperation agreements only apply if US designs are chosen by other countries.[25] In particular, NNSA observed, "Over time, if foreign-designed reactors are consistently chosen over US designs, this would decrease the ability of the United States to influence global supplier norms."

A similar case could be made for nuclear safety and security practices and culture. The United States will have a reduced opportunity to spread its approaches in those critical areas if its presence in the international nuclear energy marketplace is further eroded. Today, the United States must reckon with the reality of other independent reactor suppliers and their ability to fill the void if the United States abdicates its historical role in the international nuclear supplier regime.

Adding to US difficulties, China and Russia make use of financing to support their bids to build their nuclear energy offerings in other countries. The Export-Import Bank of China provides financing to projects abroad, including nuclear reactors. Beijing's "Belt and Road Initiative" involves money for power plant construction as part of an estimated $1.1 trillion for infrastructure.[26] China has been in discussions with Indonesia, Pakistan, Romania, Saudi Arabia, and Turkey on nuclear power plants. Similarly, Russia has offered financing for its reactor supply projects, including the ones in Egypt, Jordan, and Turkey.

As long as the terms of a particular reactor deal meet the conditions of supply found in the multilateral nuclear export supply guidelines from the NSG, the United States has no multilateral commitment or treaty to point to and argue for why a given transaction should not proceed. If a given civil nuclear energy program is supplied by China or Russia, none of the consent rights or points of influence in 123 agreements will exist for the United States. The associated national security consideration is whether the United States is comfortable with China and Russia controlling the supply of nuclear reactors, with the attendant ability to influence global supplier norms. Neither country is likely to be as vigilant in strengthening and adapting supplier standards and nonproliferation commitments in the future.[27]

The United States government has been particularly critical and questioning of China's commitment to nonproliferation in recent decades. The federal government has sanctioned state-owned entities in China for proliferation activities, including sales of dual-use goods to Iran and North Korea. To take perhaps the most prominent example, the United State has sanctioned Li Fangwei, aka "Karl Lee," multiple times and charged him with using a web of front companies to evade US sanctions. The FBI has asserted that Li Fangwei's companies have transferred items to Iran that were controlled by the Nuclear Suppliers Group for reasons of nonproliferation.[28] Government officials have raised the issue of Karl Lee in private with the Chinese government dating back to the Clinton Administration, but without action from Beijing.[29]

More recently, China's supply of nuclear reactors to Pakistan has raised concerns about China's dedication to its nonproliferation commitments. As Pakistan is not party to the NPT and does not have full-scope IAEA safeguards on its nuclear program, NSG Trigger List guidelines should prevent any country that complies with NSG guidelines from supplying power reactors to it. When China joined the NSG in 2004, it reportedly declared some reactor sales to Pakistan as grandfathered under preexisting contracts, but the latest announcements of new Chinese-supplied reactor builds go beyond these declarations, raising questions again about China's nonproliferation credentials.[30] These episodes and others help to explain why some are concerned that China's influence on nuclear supplier norms will grow if current trends in the marketplace continue.

Conclusion

Preserving the NPT—perhaps the world's central security bargain—should be an ongoing objective for the United States. In the years following the treaty's negotiation, the United States used the offer of peaceful nuclear energy assistance as an inducement for countries to join it.[31] Today, all of the nations of the world are party to the NPT with the exception of only five: India, Israel, North Korea, Pakistan, and South Sudan. The United States and other parties to the NPT will need to continue to uphold their end of the bargain. As the official who led the US government effort to indefinitely extend the NPT in 1995 has noted, "The [NPT] is not a gift from the 184 NPT nonnuclear weapon states to the five NPT nuclear weapon states; it is a political and strategic bargain… Article IV must be faithfully implemented."[32]

Past US initiatives have contributed to higher multilateral global export control standards and requirements for full-scope safeguards. But what will the future look like for nations embarking on new nuclear power programs in the coming decades if the US role as a supplier diminishes further? A future absence of US engagement in the nuclear supplier regime will unavoidably result in a reduced set of options for the United States to shape supplier norms and nonproliferation, safety, and security aspects of other countries' civil nuclear energy programs.

In some instances, the approach to nuclear energy engagement with other countries that best serves US interests may be to negotiate nonproliferation commitments in 123 agreements and then supply materials and/or equipment to entangle the associated civil nuclear energy programs in US consent rights.[33] This type of strategy as a whole, however, is only viable if the United States has something of value to export under its cooperation agreements.[34]

The national security implications of further US decline or its exit from international nuclear trade, as discussed in this commentary, deserve serious attention. Trends in the global nuclear energy marketplace and related nonproliferation concerns should be considered alongside other reasons for continued US engagement on nuclear power—including the battle against climate change and air pollution—as federal decision makers craft nuclear policies in the years to come.

Notes

1. Matt Bowen, "Why the United States Should Remain Engaged on Nuclear Power: Climate Change and Air Pollution," Center on Global Energy Policy, June 2020, https://energypolicy.columbia.edu/research/commentary/why-united-states-should-remain-engaged-nuclear-power-climate-change-and-air-pollution.

2. Robert F. Ichord, Jr., "US Nuclear-Power Leadership and the Chinese and Russian Challenge," Atlantic Council Global Energy Center Issue Brief, March 2018, https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/us-nuclear-power-leadership-and-the-chinese-and-russian-challenge/.

3. World Nuclear News, "Future Nuclear Supply Chain Worth Billions, Report Finds," September 14, 2016, https://www.world-nuclear-news.org/NN-Future-nuclear-supply-chain-worth-billions-report-finds-1509167.html.

4. Jane Nakano, "The Changing Geopolitics of Nuclear Energy: A Look at the United States, Russia, and China," Center for Strategic and International Studies, March 2020, https://www.csis.org/analysis/changing-geopolitics-nuclear-energy-look-united-states-russia-and-china.

5. e.g., Nicholas L. Miller, *Stopping the Bomb: The Sources and Effectiveness of US Nonproliferation Policy* (Ithaca, NY: Cornell University Press, 2018).

6. e.g., Daniel Poneman, *Double Jeopardy: Combating Nuclear Terror and Climate Change* (Cambridge, MA: MIT Press, 2019).

7. A transcript of President Eisenhower's speech can be found on the IAEA's website: https://www.iaea.org/about/history/atoms-for-peace-speech.

8. The NPT has 11 articles, but only Articles I, II, III, IV, and VI are discussed briefly (and incompletely) here, as they are the most relevant to the focus of this commentary.

9. See *Atoms for Peace: A Future after Fifty Years?* (Joseph F. Pilat, ed.) for various viewpoints on the Atoms for Peace speech and its consequences. For example, in Chapter 2 James Schlesinger (the former US Secretary of Energy, and thus the top manager of the US government's nuclear complex) notes, "Whether through foresight or lack of outside pressure, it worked for an extended period. Recall the pessimism of the 1950s and 1960s President Kennedy who was "haunted by the feeling" that by 1975 there might be fifteen or twenty nuclear powers... On the nonproliferation front, we have done far better than we anticipated at the time," and "[w]hat then are we to conclude a half-century after President Eisenhower's Atoms-for-Peace address? ... Dwight Eisenhower was a supreme

pragmatist. All in all, he would not be entirely satisfied with the results we have achieved, but also he would not be displeased."

10. Joseph F. Pilat, ed., *Atoms for Peace: A Future after Fifty Years?* (Baltimore: Johns Hopkins University Press, 2007), 3.

11. Ambassador Thomas Graham, Jr., email communication with the author on December 24, 2019. Ambassador Graham was involved in the negotiation of every major arms control and nonproliferation agreement from 1970 to 1997. Ambassador Graham's extended quote: "Article IV was absolutely essential to the negotiation and conclusion of the NPT in 1968. Many states were opposed to what was called 'double discrimination,' which would have resulted under the NPT in exclusive P-5 control of peaceful nuclear energy as well as nuclear weapons without Article IV. Such states also viewed the peaceful use of nuclear energy as important to their economies. Likewise, Article IV was central to the indefinite extension of the NPT in 1995. By this time a large number of NPT parties had an actual or potential commitment to nuclear power energy generation. And virtually all NPT parties were using or had an interest in using nuclear power for purposes other than energy generation, such as in medicine or agriculture."

12. John F. Kennedy Presidential Library and Museum, "News Conference 52, March 21, 1963," https://www.jfklibrary.org/archives/other-resources/john-f-kennedy-press-conferences/news-conference-52.

13. Arms Control Association, "Nuclear Weapons: Who Has What at a Glance," July 2019, https://www.armscontrol.org/factsheets/Nuclearweaponswhohaswhat.

14. Electric Power Research Institute, *Government and Industry Roles in the Research, Development, Demonstration, and Deployment of Commercial Nuclear Reactors: Historical Review and Analysis*, EPRI Report No. 3002010478 (Washington, DC: EPRI, 2017).

15. In May 1975, for example, only 91 nations were party to the NPT, and thus were participants to the first review conference (see: https://www.armscontrol.org/factsheets/Timeline-of-the-Treaty-on-the-Non-Proliferation-of-Nuclear-Weapons-NPT); In April 2020, 191 countries have joined the NPT (see: https://www.un.org/disarmament/wmd/nuclear/npt/). As the UN website states, "more countries have ratified the NPT than any other arms limitation and disarmament agreement, a testament to the Treaty's significance" (see https://www.un.org/disarmament/wmd/nuclear/npt/).

16. See the NSG website for the most recent Trigger List and Dual Use List, along with their respective guidelines: https://www.nuclearsuppliersgroup.org/en/.

17. For more discussion on the 1992 agreement to full-scope safeguards as a condition of supply and the creation of the Dual Use List in 1992, see Carlton Thorne's 1997 keynote speech at the first NSG International Seminar on the Role of Export Controls in Nuclear Non-Proliferation. Available at: https://www.nuclearsuppliersgroup.org/en/nsg-documents

18. See Chapter III, page 17, of the 2017 Nuclear Innovation Alliance report, "Part 810 Reform" for discussion.

19. James A. Glasgow, Elina Teplinsky, and Stephen L. Markus, *Nuclear Export Controls: A Comparative Analysis of National Regimes for the Control of Nuclear Materials, Components and Technology*, (Washington, DC: Pillsbury Winthrop Shaw Pittman LLP, 2012).

20. Tamotsu Aoi, *Historical Background of Export Control Development in Selected Countries and Regions* (Tokyo: Mitsui & Co., Ltd., 2016), http://www.cistec.or.jp/english/service/report/1605historical_background_export_control_development.pdf

21. The public statement coming out of the 2004 NSG Plenary in Gothenburg, Sweden, states: "In order to strengthen further the Participating Governments' national export controls, the Plenary decided to adopt, inter alia, the following measures… A 'catch-all' mechanism in the NSG Guidelines, to provide a national legal basis to control the export of nuclear related items that are not on the control lists, when such items are or may be intended for use in connection with a nuclear weapons programme."

22. From Section 123: *Civilian Nuclear Cooperation Agreements: Hearing before the Committee on Foreign Relations*, 113th Cong. 579 (2014), statement of Daniel B. Poneman, Deputy Secretary of Energy of the United States: "No government requires more stringent nonproliferation conditions than the United States."

23. Government Accountability Office, *Governmentwide Strategy Could Help Increase Commercial Benefits from US Nuclear Cooperation Agreements with Other Countries* (Washington, DC: GAO, 2010), https://www.gao.gov/assets/320/311924.pdf.

24. Anya Litvak, "Westinghouse sold an unfinished product, then the problems snowballed," *Pittsburgh Post-Gazette*, October 23, 2017, https://www.post-gazette.com/business/powersource/2017/10/23/Westinghouse-sold-an-unfinished-product-then-the-problems-snowballed/stories/201710290008.

25. DOE-NNSA, "International Safeguards, Security, and Regulatory Aspects of US Light Water Small Modular Reactors," 2014.

26. Ichord, "US Nuclear-Power Leadership," 8.

27. See discussion in Nicola de Blasio and Richard Nephew's "The Geopolitics of Nuclear Energy," Center for Global Energy Policy, Columbia SIPA, March 2017, 24: "Some states have prioritized the nonproliferation mission to the extent that they have conditioned future nuclear trade on it. The United States has been at the forefront of this effort, requiring various forms of commitments from nuclear commercial partners to nonproliferation standards… Still this is not a universal sentiment. Russia moved forward with the construction and fueling of the Bushehr Nuclear Power Plant in Iran during the height of international concerns with the Iranian nuclear program. China has maintained a plan to export nuclear power plants to Pakistan, claiming its contract to do so preexisted its NSG obligations…"

28. Federal Bureau of Investigation, "'Karl Lee' Charged in Manhattan Federal Court with Using a Web of Front Companies to Evade US Sanctions," April 29, 2014, https://www.fbi.gov/contact-us/field-offices/newyork/news/press-releases/karl-lee-charged-in-manhattan-federal-court-with-using-a-web-of-front-companies-to-evade-u.s.-sanctions.

29. Jeff Stein, "How China Helped Iran Go Nuclear," *Newsweek*, July 14, 2015.

30. Mark Hibbs, "Moving Forward on China, Pakistan, and the NSG," Armscontrolwonk.org, June 23, 2011, https://www.armscontrolwonk.com/archive/1100228/moving-forward-on-china-pakistan-and-the-nsg/.

31. Rebecca Davis Gibbons, "Supply to Deny: The Benefits of Nuclear Assistance for Nuclear Nonproliferation," *Journal of Global Security Studies* (December 12, 2019).

32. Thomas Graham, *Unending Crisis: National Security Policy After 9/11* (Seattle: University of Washington Press, 2012): 186.

33. See, for example, a letter to Congress from a bipartisan group of nonproliferation experts on US strategy with regard to Saudi Arabia's plans for a civil nuclear energy program: https://www.nuclearinnovationalliance.org/ksa-123-non-proliferation-letter-us-congress. US sanctions have also shown some value in helping to deter proliferation in certain cases. See Nicholas L. Miller, "The Secret Success of Nonproliferation Sanctions," *International Organization* 68, no. 4 (2014): 913–44; Nicholas L. Miller, "Why Nuclear Energy Rarely Leads to Proliferation," *International Security* 42, no. 2 (2017): 40–77. Sanctions can have increased salience if the US supplies another country's nuclear power program. For example, Section 129 of the Atomic Energy Act of 1954, as amended, cuts off nuclear supplies in the event a country detonates a nuclear explosive device or violates its IAEA safeguards agreement. These acts would thus risk stranding a country's multibillion-dollar electricity generating assets if the US is supplying them with parts and fuel, providing some measure of deterrence against a country proliferating.

34. This point is also noted in a 2013 Center for Strategic and International Studies report, "Restoring US Leadership in Nuclear Energy: A National Security Imperative" on pages x–xi: "American leadership was instrumental in shaping the global nuclear nonproliferation regime and nuclear safety norms … . But our nation's ability to promote nonproliferation and other national security objectives through peaceful nuclear cooperation has diminished … . The national security concern is that much of this new interest in nuclear power is coming from countries and regions that may not share America's interests and priorities in the areas of nonproliferation and global security. And our leverage to influence their nuclear programs will be weak at best if US companies cannot offer the technologies, services, and expertise these countries need to operate a successful nuclear program … ."

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