Chapter 4

NPT'S Naval Nuclear Propulsion Loophole

Jeffrey M. Kaplow

Nuclear-powered submarines have long been exclusively the province of the established nuclear weapons states. But this small club is poised to expand. India is finally conducting sea trials of its long-delayed indigenous nuclear submarine, Brazil recently opened the shipyard that it hopes will construct five nuclear submarines over the next ten years, and Argentina and Iran also have expressed interest in deploying nuclear subs in the future.[1]

Beyond the concern this raises about the possibility of a new naval arms race, a number of analysts have pointed to the potential proliferation risk associated with nuclear submarines.[2] The Nuclear Non-

---

1. Rajat Pandit, "India's First Indigenous Nuclear Submarine Gears up for Maiden Sea Trials," *Times of India,* December 15, 2014, available from timesofindia.indiatimes.com/india/Indias-first-indigenous-nuclear-submarine-gears-up-for-maiden-sea-trials/articleshow/45517702.cms; Robin Yapp, "Argentina Developing Nuclear-Powered Submarine," *Telegraph* (London), August 2, 2011, available from www.telegraph.co.uk/news/worldnews/southamerica/argentina/8677600/Argentina-developing-nuclear-powered-submarine.html; Olli Heinonen, "Nuclear Submarine Program Surfaces in Iran," *Power & Policy* (blog), July 23, 2012, available from http://belfercenter.hks.harvard.edu/publication/22207/nuclear_submarine_program_surfaces_in_iran.html; and "Brazil's Rousseff Inaugurates Nuclear Sub Shipyard," *AFP*, December 12, 2014, available from news.yahoo.com/brazils-rousseff-inaugurates-nuclear-sub-shipyard-224338823.html.

2. See, for example, James Clay Moltz, "Closing the NPT Loophole on Exports of Naval Propulsion Reactors," *Nonproliferation Review,* Vol. 6, No. 1, Fall

proliferation Treaty (NPT) allows states to exempt nuclear material from international safeguards for use in nuclear submarines. The nuclear fuel that powers naval reactors is also useful in weapons work, and the nonproliferation community has long worried that exempted material could be diverted to a nuclear weapons program without the knowledge of inspectors. Naval nuclear propulsion, then, may represent a dangerous loophole in the NPT.[3]

The naval nuclear propulsion loophole, however, could function as a kind of canary in the coal mine: Any attempt by a proliferant state to take nuclear material out of safeguards for a nuclear submarine program—at least in the present international security environment—may be seen as a significant step toward the development of nuclear weapons. This feature of the naval propulsion loophole makes it a less desirable pathway to a weapon for potential proliferants. States with nuclear weapons aspirations probably would prefer an approach that would not be as quickly discovered, such as the use of covert facilities or the acquisition of sensitive nuclear materials from other states.

The alerting power of the naval nuclear propulsion loophole today, however, is partly a function of its novelty. No state has yet taken advantage of the ability to exempt material for use in military naval reactors, and only the P-5 nuclear weapons states currently deploy nuclear submarines. If the exercise of the naval propulsion exemp-

---

1998, pp. 108–114; Chunyan Ma and Frank von Hippel, "Ending the Production of Highly Enriched Uranium for Naval Reactors," *Nonproliferation Review*, Vol. 8, No. 1, Spring 2001, pp. 86–101; Greg Thielmann and Serena Kelleher-Vergantini, "The Naval Nuclear Reactor Threat to the NPT," *Threat Assessment Brief,* Arms Control Association, July 24, 2013, available from www.armscontrol.org/files/TAB_Naval_Nuclear_Reactor_Threat_to_the_NPT_2013.pdf; and John M. Lamb, "Roiling the Arms Control Waters," *Bulletin of the Atomic Scientists,* Vol. 43, No. 8, October 1987, pp. 17–19.

3. Naval nuclear propulsion is the use of a nuclear reactor to power a naval vessel. While most naval reactors power submarines, both the United States and Russia have produced nuclear-powered surface ships, and Russia still operates a fleet of nuclear icebreakers.

tion comes to be seen as acceptable or normal, or if more states begin deploying nuclear submarines, then the loophole could become much more dangerous. An Iranian exemption of nuclear material for a supposed submarine effort, for example, would set off fewer alarm bells if its rivals also were pursuing nuclear-powered subs. And so the international community is right to attempt to dissuade states from removing nuclear material from safeguards for naval propulsion, and to pursue other avenues for closing or limiting the loophole.

This chapter proceeds in three parts. First, I discuss the origins of the naval nuclear propulsion loophole in more detail and point to several ways in which it differs from other NPT loopholes. Next, I survey the handful of states that have expressed interest in nuclear submarines, highlighting the nonproliferation implications of their naval propulsion programs. Finally, I describe several policy options for narrowing the loophole or for closing it altogether.

The Origins and Consequences of the Naval Nuclear Propulsion Loophole

The naval nuclear propulsion loophole differs from other gaps in the nuclear nonproliferation regime in several ways, with important implications for how the loophole is perceived by the international community and in how, ultimately, it can be filled. First, the safeguards exemption for naval reactors is a sin of omission—it is not made explicit in the NPT. This means that the exemption is actually somewhat broader than is commonly realized, and also that debate about the loophole cannot be resolved by reference to treaty text. Second, this gap in the treaty was no accident; it was quite explicitly designed into the NPT to smooth the path for state ratification and to respond to the objections of allies. Third, the potential danger of the loophole was recognized at the time the agreement was drafted. The United States and others calculated that the benefit to nuclear nonproliferation goals in winning the NPT ad-

herence of key states outweighed the future risk that the loophole would be used to evade international safeguards. So far, at least, this calculation seems to have been correct. Finally, the declaration requirements associated with this loophole make it highly alerting.

A Sin of Omission

There are two broad categories of loopholes in international agreements. Perhaps the most common type of loophole is invoked by the text of the treaty itself, or comes about as a result of disagreements about the correct interpretation of treaty language. The withdrawal clause of the NPT, laid out in Article X, is a loophole of this type. Similarly, some argue that the nuclear weapons states' reluctance to disarm is a kind of loophole resulting from a particular interpretation of their requirements under Article VI.[4]

Another type of loophole is created when the text of an international agreement fails to explicitly address some possible state action. Loopholes formed in this way do not necessarily imply that the drafters of the treaty did not consider the issue—such loopholes may be intentional or not. No treaty is exhaustive, and states must make decisions about what issues to cover explicitly in the text of an agreement.

The safeguards exemption for naval nuclear propulsion is of this latter type: It is a sin of omission. The NPT simply does not address the military uses of nuclear technology beyond nuclear weapons. It was left, then, to the International Atomic Energy Agency (IAEA) to create rules about how to safeguard enriched uranium intended for use in military naval reactors. Recognizing that international

4. See, for example, David A. Koplow, "Parsing Good Faith: Has the United States Violated Article VI of the Nuclear Non-Proliferation Treaty?" *Wisconsin Law Review,* Vol. 301, March/April 1993, pp. 301–394. Of course, others disagree. See Christopher A. Ford, "Debating Disarmament: Interpreting Article VI of the Treaty on the Non-Proliferation of Nuclear Weapons," *Nonproliferation Review*, Vol. 14, No. 3, November 2007, pp. 401–428.

inspections of military facilities would be a non-starter, the IAEA relies instead on state declarations. When exempting nuclear materials from safeguards for non-explosive military use, states must declare the activity and the amount of material employed, provide assurances that the material will not be used for nuclear weapons, and agree to reinstate safeguards on the material when its use for military purposes concludes.[5] The IAEA, however, does not attempt to verify these declarations, and so states may see this exemption as a convenient way to divert nuclear material for use in a covert weapons program.

The distinction between gaps in a treaty and more explicit loopholes is important for three reasons. First, when loopholes are not addressed in an international agreement, no amount of legal wrangling over the treaty text will settle the issue. Justification for explicit loopholes often comes down to a debate over the original intent of the treaty language, or over the broader context of particular treaty clauses.[6] This kind of argument is largely avoided when loopholes are simply not covered by the treaty. When non-nuclear weapons states within the NPT have announced their interest in nuclear submarines, for example, the public debate has centered on the nonproliferation or other consequences of that behavior, rather than its legality. That is, taking advantage of the naval propulsion exemption may be unwise, but it is not illegal.

Second, there may be a broader consensus about the existence of a loophole when it is not addressed by the treaty at all. In the case of the naval nuclear propulsion loophole, however, the broad agree-

5. International Atomic Energy Agency, *INFCIRC/153 (Corrected): The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*, Vienna: International Atomic Energy Agency, 1972.

6. The Vienna Convention on the Law of Treaties allows the negotiating history of an international agreement to clarify state obligations. Arguments relying on the intent of treaty drafters are routinely made outside of the courts, as well. See, for example, Ford, "Debating Disarmament."

ment that a loophole exists has not yet led to a concerted attempt at filling the gap in the treaty. This lack of action—in the face of many proposals—may stem from the perception that the loophole does not at this time constitute a significant threat to nonproliferation goals.

Finally, loopholes created by omission are often much broader than those resulting from explicit treaty text. With no treaty language to constrain them, states can take advantage of entire issue areas in which to act without fear of legal transgression. Because it is created by a gap in the treaty, the naval nuclear propulsion loophole is in fact quite a bit broader than it first appears. In contemporary policy debates, the NPT's failure to address non-explosive military uses of nuclear technology is most relevant to naval nuclear propulsion, but there are potentially a number of other applications that qualify for the exemption. Material to power nuclear reactors for military spacecraft might be exempted: Both the United States and Soviet Union had long-running space nuclear propulsion programs, and other countries, such as China and France, investigated the technology.[7] The exemption also would apply to material destined for military reactors intended for radiation testing or to power a military base. The United States, for example, ran a long-standing program to develop small nuclear power reactors for military installations.[8] While the United States was aware of these broader uses for the military exemption, it preferred to keep the focus on naval reactors. For example, a now-declassified State Department cable cautioned the U.S. Embassy in Tokyo in 1976 that the exemption had only

7. On space nuclear propulsion efforts in the civilian sphere, see A. Stanculescu, et al., *The Role of Nuclear Power and Nuclear Propulsion in the Peaceful Exploration of Space*, Vienna: International Atomic Energy Agency, 2005.

8. See Lawrence H. Suid, *The Army's Nuclear Power Program: The Evolution of a Support Agency*, Westport, CT: Greenwood Press, 1990. Although the Army Nuclear Power Program concluded in the late 1970s, analysts continue to discuss the possibility of powering military bases with nuclear reactors. See Marcus King, LaVar Huntzinger, and Thoi Nguyen, *Feasibility of Nuclear Power on U.S. Military Installations*, Arlington, VA: CNA Corporation, March 2011.

been publicly linked to naval nuclear propulsion. It instructed that other possible applications should not be volunteered to Japanese government officials, but could be acknowledged if asked.[9]

A Loophole by Design

The NPT's failure to address military non-explosive uses of nuclear technology was not an accident. Early drafts of the treaty included language that would have required non-nuclear weapons states to put all of their nuclear activities under safeguards, eliminating the possibility of exempting nuclear material from safeguards for any reason.[10] By the time the NPT opened for signature in 1968, Article III limited safeguards for non-nuclear weapons states to "all source or special fissionable material in all *peaceful* nuclear activities," (emphasis added) thus excluding military non-explosive uses such as naval propulsion.[11]

Naval nuclear propulsion ultimately was left out of the NPT because of the complex dynamics of multilateral treaty negotiations. Two factors in particular influenced the decision to allow the military exemption. First, the United States recognized that the NPT would only be effective to the extent that it received widespread international adherence, and so Washington was focused on win-

9. U.S. Department of State, "State Department Cable 040620 to Embassy Tokyo," February 20, 1976, Confidential, Central Foreign Policy Files, Record Group 59, National Archives at College Park, MD, Retrieved from the Access to Archival Databases, available from www.archives.gov.

10. U.S. Department of State, Draft Position Paper, "Non-Proliferation of Nuclear Weapons," August 14, 1964, Secret Noforn, Document 44, *Foreign Relations of the United States*, *1964-1968*, Volume XI, Arms Control and Disarmament, available from history.state.gov/historicaldocuments/frus1964-68v11/d44 and U.S. Arms Control and Disarmament Agency, Draft Position Paper, "Safeguards on Peaceful Nuclear Activities," December 22, 1965, Confidential.

11. *Treaty on the Non-Proliferation of Nuclear Weapons*, July 1, 1968, entered into force on March 5, 1970, 21 U.S.T. 483, 729 UNT.S. 161.

ning the approval of key allies for the proposed treaty. Italy and the Netherlands, however, hoped to pursue nuclear-powered naval vessels in the future, while the United Kingdom worried that treaty language would complicate the import of naval reactors from the United States.[12] By leaving a gap in the treaty, the NPT's drafters helped to allay the concerns of these important allies.[13] Even the requirement that nonweapons states place their *peaceful* nuclear activities under IAEA safeguards was something of a victory; U.S. allies had insisted on removing language calling for mandatory safeguards from early drafts of the NPT.[14]

Second, the NPT drew criticism from some quarters for putting in place a two-tiered system, in which the five recognized nuclear

12. Moltz, p. 109; David Fischer, *History of the International Atomic Energy Agency: The First Forty Years*, Vienna: International Atomic Energy Agency, 1997, p. 272, available from www-pub.iaea.org/mtcd/publications/pdf/pub1032_web.pdf; and U.S. Arms Control and Disarmament Agency, Draft Position Paper, "Safeguards on Peaceful Nuclear Activities." A potential concern might have been the effect of NPT safeguards provisions on plans for a NATO multilateral force—this was a major issue in the NPT negotiations as a whole—but by this time the possibility of multilateral nuclear submarines had been taken off the table. See Wilfrid L. Kohl, "Nuclear Sharing in Nato and the Multilateral Force," *Political Science Quarterly*, Vol. 80, No. 1, March 1965, pp. 94–95.

13. Of course, these states may ultimately have signed the treaty even without the presence of the naval reactor exemption; certainly some had multiple concerns about the NPT even in its final form. Italy, for example, "had been quite difficult" in negotiating the treaty, according to the Director of the U.S. Arms Control and Disarmament Agency. See "Memorandum for the Record of the 548th Meeting of the National Security Council," March 27, 1968, Secret, Document 229, *Foreign Relations of the United States*, *1964-1968*, Volume XI, Arms Control and Disarmament, available from history.state.gov/historicaldocuments/frus1964-68v11/d229. On Italy's stance toward NPT ratification more broadly, see U.S. Department of State, Bureau of Intelligence and Research, "Intelligence Note 605, Italian Parliament Gives Overwhelming Backing to NPT," July 31, 1968, available from www2.gwu.edu/~nsarchiv/nukevault/ebb253/doc31.pdf.

14. "Editorial Note," Document 92, *Foreign Relations of the United States*, *1964–1968*, Volume XI, Arms Control and Disarmament, available from history.state.gov/historicaldocuments/frus1964-68v11/d92.

weapons states would be treated differently than other members. To some extent, this was unavoidable—the fundamental goal of the NPT, after all, was to prevent new countries from joining the select club of nuclear weapons states. But the treaty also created obligations for non-nuclear states that the weapons states did not share; foremost among these was the requirement that states outside the P-5 place their nuclear facilities under international safeguards. The United States tried to cushion the blow by voluntarily offering to implement IAEA safeguards at its civilian facilities, but no nuclear weapons state—including the United States—was willing to go further and allow inspectors to have access to sensitive military installations.[15] In this context, requiring nonweapons states to place non-explosive military activities under safeguards, or prohibiting such activities altogether, might have been seen as one more way in which the nonweapons states were being asked to bear a larger share of the burden under the treaty.

Anticipating a Loophole

Loopholes in international agreements often take countries by surprise; either they are not anticipated by the drafters of the treaty, or changes in technology or circumstances create new opportunities for states to evade the intent of the agreement. The naval nucle-

15. Proposals that would have required weapons states to place all peaceful nuclear activities under safeguards—just as nonweapons states were required to do—were rejected by the Soviet Union. See, for example, U.S. Arms Control and Disarmament Agency, "Memorandum, Director Foster to Secretary of State Rusk," January 11, 1967, Secret Limdis, Document 172, *Foreign Relations of the United States*, *1964-1968*, Volume XI, Arms Control and Disarmament, available from history.state.gov/historicaldocuments/frus1964-68v11/d172. The nuclear weapons states all ultimately implemented voluntary safeguards at civilian nuclear facilities. For background on these agreements, see Adolf von Baeckmann, "IAEA Safeguards in Nuclear-Weapon States: A Review of Objectives, Purposes, and Achievements," *IAEA Bulletin*, Vol. 30, No. 1, March 1988, available from www.iaea.org/sites/default/files/publications/magazines/bulletin/bull30-1/30103552224.pdf.

ar propulsion loophole is different. Not only did the international community intentionally avoid addressing the naval propulsion issue, the risk that states would take advantage of this gap in the treaty was well understood at the time the NPT was being negotiated. A draft U.S. position paper from 1965 was quite explicit: "The U.S. position…is that we do not wish to create a possible loophole whereby a non-nuclear state might claim the right to exempt important nuclear facilities from safeguards, and…perhaps raise suspicions that clandestine nuclear weapons work was being carried out in those facilities."[16] At the same time, however, a spate of nuclear submarine programs seemed quite a long way off in the late 1960s; only the nuclear weapons states seemed likely to deploy naval propulsion reactors for the foreseeable future. That the United States ultimately allowed the loophole into the treaty—knowing its potential consequences—suggests that its benefits were thought to exceed its costs.

A Canary in the Coal Mine

Before taking advantage of the safeguards exemption for naval nuclear propulsion, an NPT member state must make a detailed declaration to the IAEA. This has two important consequences for the loophole. First, it means that actually exercising the loophole can be highly alerting, acting like a canary in the coal mine for nuclear weapons intentions. When a state invokes the naval propulsion exemption, it puts other member states on notice and signals a greater risk of treaty non-compliance or treaty withdrawal in the future. Second, because exempting nuclear material from safeguards is so alerting, it becomes much more costly for states to take advantage of the loophole. Countries using the exemption invite an international response: They may face pressure or threats aimed at reversing their decision, and these consequences may extend well

16. U.S. Arms Control and Disarmament Agency, Draft Position Paper, "Safeguards on Peaceful Nuclear Activities."

outside the bounds of the NPT. States considering taking advantage of the naval propulsion exemption may anticipate an international response and choose other pathways to a bomb. The fact that the loophole is highly alerting, then, may ultimately make it less likely to be invoked in the first place.

This is the silver lining of the naval nuclear propulsion exemption: A country that takes advantage of the exemption is likely to have its nuclear activities subjected to increased scrutiny. Diverting material via the naval propulsion exemption is thus a dangerous way for potential proliferants to kick-start a nuclear weapons program. Other plausible nuclear weapons pathways for NPT member states—a fully covert enrichment program, for example, or acquisition of sensitive nuclear materials from abroad—are probably less alerting, and potentially give other states less time to respond with pressure, sanctions, or attack. Knowing this, proliferant states probably will not choose to divert material under the naval propulsion exemption, opting for less alerting pathways to a bomb, and reducing the danger ultimately posed by the loophole.

The withdrawal clause of the NPT is another loophole of this kind, because it requires a public declaration. Even more than the naval propulsion loophole, it is highly alerting. Any state looking to exit the NPT is basically announcing its intention to pursue nuclear weapons, making withdrawal an unattractive option for proliferants. State leaders seem to agree: While NPT members have engaged in 10 nuclear weapons programs since 1970, only North Korea has opted to withdraw from the treaty, and then only after making substantial progress toward a nuclear weapon.[17]

An important caveat, however, applies to these NPT loopholes:

17. This count of nuclear weapons programs is updated from Dong-Joon Jo and Erik Gartzke, "Determinants of Nuclear Weapons Proliferation," *Journal of Conflict Resolution*, Vol. 51, No. 1, February 1, 2007, pp. 167–194. See also Jeffrey M. Kaplow, "State Compliance and the Track Record of the Nuclear Nonproliferation Regime," working paper of Ph. D. dissertation, University of California, San Diego, 2014, available from dl.jkaplow.net/KaplowCh1.pdf.

They are only alerting so long as they are rarely employed. If several states had recently left the NPT, for example to protest the lack of progress on nuclear disarmament, then the next withdrawal—even by a state with a latent nuclear capability—would be less alarming. Similarly, an Iranian decision today to exempt nuclear material from safeguards for a nuclear submarine effort would set off many alarm bells. The same decision would be a weaker indicator of nuclear weapons ambitions, however, if it followed similar exemptions by others in the region. The exercise of these loopholes serves to legitimize them, ultimately making them less informative about a state's intentions.

The naval nuclear propulsion exemption also becomes less alerting if a state can make a plausible case that a nuclear submarine program is militarily useful. Nuclear submarines have long represented an attractive military capability, particularly for states concerned with the survivability of a nuclear deterrent, because they can stay underwater for longer and venture further than their conventionally powered counterparts. The benefits of naval reactors, however, are more than matched by their significant cost in development and operation, and lower-cost air-independent propulsion technologies now represent a viable alternative to nuclear propulsion for most states.[18] Few non-nuclear states can make a reasonable claim that a nuclear submarine program is worth the cost, and this hurdle is likely to get even higher over time as alternative technologies become both cheaper and more effective.

A Survey of Nuclear Submarine Programs

Only five states—the United States, Russia, the United Kingdom, France, and China—currently deploy nuclear submarines with

18. Ma and von Hippel, pp. 97–98. On the difficulties that modern, non-nuclear attack submarines pose for U.S. anti-submarine warfare, see John R. Benedict, "The Unraveling and Revitalization of U.S. Navy Antisubmarine Warfare," *Naval War College Review*, Vol. 58, No. 2, Spring 2005, pp. 101–102.

their naval forces. Several other countries have expressed interest in naval nuclear propulsion over the years, however, with potential consequences for global nuclear nonproliferation efforts. In this section, I survey the nuclear submarine landscape beyond the P-5, with an emphasis on the nonproliferation implications of each state's naval nuclear propulsion efforts.

Canada

Canada does not currently have a nuclear submarine program, but it caught many by surprise when it announced in 1987 its intention to add 10–12 nuclear submarines to its naval forces, one piece of a larger strategy to reassert Canadian sovereignty over Arctic territories and improve Canada's deterrent posture.[19] Despite some opposition from Canada's allies, both France and the United Kingdom intended to compete to supply the submarines.[20] Canada's plans were ultimately abandoned—the shifting views of the Canadian public and the end of Cold War made additional military spending unpopular.

The Canada nuclear submarine episode served as a warning about the ease with which a dangerous precedent could be set, even by a state that was strongly supportive of global nonproliferation efforts. Canada would have been the first state to exempt nuclear material from safeguards for military use—the Canadian government even

19. Canada's Defense Minister in 2012 caused some controversy by implying Canadian interest in deploying nuclear submarines, but his comments were quickly walked back. See Laura Payton, "No Nuclear Sub Buy Planned, MacKay Affirms," *CBC News*, October 28, 2011, available from *www.cbc.ca/1.1043181*. On the 1987 defense strategy, see Canada Department of National Defence, *Challenge and Commitment: A Defence Policy for Canada*, Ottawa: Canadian Government Publishing Centre, 1987, pp. 52–53, available from publications.gc.ca/collections/collection_2012/dn-nd/D2-73-1987-eng.pdf.

20. Steve Shallhorn: "Standing up to the United States," *Bulletin of the Atomic Scientists,* Vol.43, No. 8, October 1987, pp. 16–17.

emphasized that it would set a positive example for other states considering exemptions—and this fact drew the attention and criticism of the nuclear nonproliferation community.[21] While Canada itself would not use the exemption to supply a covert nuclear weapons program, its foray into naval nuclear propulsion could have made it easier for others to do so. Removing nuclear material from IAEA safeguards potentially would legitimize the use of nuclear technology for military purposes within the NPT and provide an example for other, less trustworthy states to point to in justifying their actions.

In Canada's case, there was another precedent at play: The first sale of a nuclear submarine to a non-nuclear weapons state. Had the Canadian plan moved forward, it might have increased both the supply-and demand-side risk that additional states would acquire nuclear submarines. On the supply side, the nuclear weapons states had largely held firm in denying the sale of nuclear submarines or naval reactor technology to nonweapons states. This had always been something of an uneasy truce, however, because the nuclear weapons states have significant financial incentives to market such technology abroad. If this barrier were broken and nuclear submarine sales were to become seen as just another arms deal, there could be many additional states in line to acquire naval reactor technology. On the demand side, when new states acquire a nuclear submarine capability, their rivals may feel compelled to follow suit, both to nullify any potential strategic advantage and to satisfy domestic constituencies calling for military parity to be maintained. More broadly, the spread of naval nuclear propulsion may lead states to see nuclear submarines as a sign of international prestige or of status as a major power.

The spread of nuclear submarines indirectly increases the risk of

21. See, for example, Tariq Rauf and Marie-France Desjardins, "Canada's Nuclear Submarine Program: A New Proliferation Concern," *Arms Control Today*, Vol. 18, No. 10, December 1988, pp. 13–18; and William Epstein, "New Stance Tarnishes Canada's Reputation," *Bulletin of the Atomic Scientists*, Vol.43, No. 8, October 1987, pp. 11–12.

nuclear proliferation: More nonweapons states with nuclear submarines means more chances to divert nuclear material using the naval nuclear propulsion exemption. Perhaps more dangerous, however, is the ability of naval reactors to justify the enrichment of uranium at higher levels. Facilities producing fuel for power reactors generally output material enriched to no more than five percent uranium-235 (U-235), but most naval reactors call for at least 20 percent enriched uranium and some use weapons-grade material enriched to over 90 percent.[22] A state with a nuclear submarine may have a built-in excuse to, first, optimize uranium enrichment facilities for the production of material enriched to higher levels and, second, stockpile uranium enriched at those higher levels. The ability to produce higher enriched material dramatically increases a state's nuclear latency and its ability to quickly manufacture a nuclear weapon in a breakout scenario.

India

In 1988, India became the first state outside of the P-5 to operate a nuclear submarine, leasing a Charlie-class submarine from the Soviet Union. That boat was returned in 1991, but in 2012 India added a leased Russian Akula-class nuclear submarine to its fleet. Both deals offered a useful training platform and a source of technology transfer for India's indigenous nuclear submarine effort.[23] The first Indian-built nuclear submarine, the INS Arihant, was unveiled in 2009 and began sea trials in late 2014.[24]

---

22. Ma and von Hippel, p. 91.

23. Moltz, p. 110; and Yogesh Joshi, "Leased Sub Key to India's Naval Modernization," *World Politics Review*, June 1, 2012, available from www.worldpoliticsreview.com/articles/12014/leased-sub-key-to-indias-naval-modernization.

24. Pandit, "India's First Indigenous Nuclear Submarine Gears up for Maiden Sea Trials." The name *Arihant*, reassuringly, is Sanskrit for "destroyer of enemies."

Because India is outside the NPT and already possesses nuclear weapons, its development of nuclear submarines does not set a new precedent with respect to the military use of nuclear material under IAEA safeguards. India's nuclear propulsion ambitions do, however, have several indirect consequences for nuclear nonproliferation. First, India's efforts raise the profile of nuclear submarine technology and demonstrate to other states that this capability is attainable. This, in turn, may make nonweapons states within the NPT more likely to seek nuclear submarines of their own. Second, once India has a demonstrated nuclear submarine capability, it becomes a potential supplier of nuclear propulsion technology to other states, with all of the proliferation risks that implies. While onward proliferation is a concern, it is worth noting that India has shown restraint in other aspects of nuclear supply. Finally, Indian nuclear submarines potentially affect the strategic balance with Pakistan, and may prompt Islamabad to intensify its naval efforts. Should Pakistan seek its own nuclear submarine capability, it is likely to turn to China for assistance, further weakening the norm against the supply of naval nuclear propulsion technology and leading to an escalation of what is already a low-level naval arms race in the region.[25]

Brazil

Brazil's nuclear submarine effort dates from the late 1970s, part of the parallel nuclear program run by the nation's military services. The Brazilian navy's contribution to the program included both the development of gas centrifuge uranium enrichment technology and

25. Iskander Rehman, "Drowning Stability: The Perils of Naval Nuclearization and Brinkmanship in the Indian Ocean," *Naval War College Review*, Vol. 65, No. 4, Autumn 2012, pp. 64–88 and Yogesh Joshi and Frank O'Donnell, "India's Submarine Deterrent and Asian Nuclear Proliferation," *Survival*, Vol. 56, No. 4, August/September, 2014, pp. 157–174.

exploration of naval propulsion reactors.[26] The navy's nuclear submarine work persisted at a low level even as most of the military's nuclear efforts were shuttered in the late 1980s and early 1990s; the submarine program was revitalized in 2007 with the announcement of significant funding to build a prototype nuclear propulsion reactor. With new buy-in from the political leadership, progress in the nuclear submarine program has accelerated in recent years. A deal with France will provide assistance with the non-nuclear components of the submarine, and Brazil aims to complete the first of six planned subs by the mid-2020s.[27]

The rationale for a Brazilian nuclear submarine capability has never been completely clear, and still puzzles analysts. At a recent dialogue between Brazilian and U.S. defense experts and officials, the motivation for the submarine program led to some debate even within the Brazilian delegation. A Brazilian defense analyst "argued that Brazil not only lacked a compelling rationale for such submarines, but that the cost accounting for the program was nontransparent. … The discussion revealed that there is little public knowledge of the Brazilian nuclear propulsion program, nor is there clarity on the full costs or rationale for the program."[28] Brazilian military and political leaders have spoken vaguely about Brazil's need to defend its maritime interests and national sovereignty, and more specifically about the defense of offshore oil and gas assets. Of course, the nuclear submarine effort long predates the discovery of those energy resources, and there may be better tools for the job than a naval capability that is generally seen as a way to project power

26. "Memorandum, Information for the President of Brazil, No. 011/85 from the National Security Council, Structure of the Parallel Nuclear Program," February 21, 1985, Wilson Center, History and Public Policy Program Digital Archive, available from digitalarchive.wilsoncenter.org/document/116917.

27. Thielmann and Kelleher-Vergantini, pp. 4-5.

28. Anne L. Clunan and Judith Tulkoff, *Perspectives on Global and Regional Security and Implications of Nuclear and Space Technologies*, Monterey, CA: Naval Postgraduate School, October 2014, p. 20, available from calhoun.nps.edu/handle/10945/43786.

far from a state's borders.[29] Fundamentally, the nuclear submarine program probably has more to do with Brazil's great power aspirations than with any of the stated military needs.[30]

Whatever its intended purpose, Brazil's long-delayed nuclear submarine is notable for its nonproliferation consequences: It is likely to be the first case in which nuclear material is exempted from international safeguards for military use. Like the Canadian flirtation with nuclear submarines described above, a move by Brazil to take advantage of the NPT's naval propulsion exemption would set a precedent for other non-nuclear weapons states, and so risk weakening IAEA safeguards generally. Unlike Canada, however, Brazil has not been a model nonproliferation citizen. It is widely considered to have had an active nuclear weapons program from the late-1970s through the 1980s. It was a late adherent to the NPT, finally joining the treaty in 1998, nearly the last nonweapons state to do so. Negotiations with the IAEA over safeguards procedures at Brazil's enrichment facility, typically managed without fanfare by mid-level officials, made international news because of Brazil's insistence that inspectors not be allowed to actually see the centrifuges operating at the plant.[31] And Brazil remains a high-profile holdout when it comes to the Additional Protocol to its IAEA safeguards agreement, a more stringent set of declaration and inspection requirements for nuclear activities that has been signed by 124 states.

---

29. Sarah Diehl and Eduardo Fujii, "Brazil's Pursuit of a Nuclear Submarine Raises Proliferation Concerns," *WMD Insights*, No. 23, March 2008, pp. 9–18.

30. For a full discussion of Brazil's motivations for seeking nuclear technology generally, including the nuclear submarine effort, see Togzhan Kassenova, *Brazil's Nuclear Kaleidoscope: An Evolving Identity*, Washington, DC: Carnegie Endowment for International Peace, 2014, available from http://carnegieendowment.org/2014/03/12/brazil-s-nuclear-kaleidoscope-evolving-identity-pub-54832.

31. Sharon Squassoni and David Fite, "Brazil as Litmus Test: Resende and Restrictions on Uranium Enrichment," *Arms Control Today*, Vol. 35, No. 8, October 2005, available from legacy.armscontrol.org/act/2005_10/Oct-Brazil.

Given Brazil's controversial nuclear past, a decision to exempt nuclear material from safeguards for a submarine program would draw strong criticism from the nonproliferation community. But here, as in the case of Canada, the concern is less about the risk of Brazil itself diverting material to a nuclear weapons program, and more about the precedent this activity sets for other NPT member states. If Brazil takes advantage of this exemption, it makes it more likely that another state—such as Iran—follows suit, and at the same time makes the actions of that other state less alerting.[32] Once the transfer of material to a nuclear submarine program comes to be seen as acceptable, states may judge that they too can use the exemption without the international community assuming that they are working toward a nuclear weapon.

Iran

Iran is not known to have an active nuclear submarine program, but several high-level Iranian officials have expressed the intent to pursue naval nuclear propulsion, or at least to keep that option open.[33] Iran's interest in nuclear submarines has been met with a combination of alarm and skepticism by the international community. Alarm because an Iranian appeal to a nuclear submarine program seems to validate the worst fears of those concerned about the naval propulsion loophole. Iran, after all, is widely suspected to have harbored nuclear weapons ambitions and has been found to have violated its NPT commitments; the loophole would allow it to simply and legally remove nuclear material from international safeguards. It can take this step—and here the skepticism of the in-

32. The same potential consequences apply to the nuclear submarine ambitions of a state like Argentina. See Yapp, "Argentina Developing Nuclear-Powered Submarine."

33. Heinonen, "Nuclear Submarine Program Surfaces in Iran"; and "Iran Mulls Highly Enriched Uranium," *UPI*, April 17, 2013, available from www.upi.com/Top_News/Special/2013/04/17/Iran-mulls-highly-enriched-uranium/82301366205307/.

ternational community comes in—even if there is no actual nuclear submarine program.

And it gets worse: Even if nuclear material remains under safeguards, a supposed nuclear submarine program gives Iran an excuse to enrich uranium to higher levels, bringing it closer to the nuclear threshold if it should decide to push forward and build a weapon. Iranian officials already seem to be deploying the naval propulsion rationale for higher levels of enrichment. The Director of Iran's nuclear agency told reporters in 2013 that, "[a]t present, we have no enrichment plan for purity levels above 20 percent but when it comes to certain needs, for example, for some ships and submarines, if our researchers need to have a stronger underwater presence, we will have to make small engines which should be fueled by 45-56 percent enriched uranium."[34] Iran's parliament has done its part to support this position, approving a symbolic bill that would require the government to build and fuel nuclear-powered commercial naval vessels.[35] Nuclear material for this kind of non-military naval propulsion would not qualify for exemption from safeguards, but it still provides a useful justification for enrichment beyond 20 percent U-235.

Of course, these statements and parliamentary maneuvers occur in the context of Iran's ongoing standoff with the international community over its nuclear program, and so they may say more about Iran's negotiating strategy than any real-world plans for a nuclear submarine or for higher levels of uranium enrichment. Raising the specter of a nuclear submarine gives Iranian negotiators one more bargaining chip in service of a larger nuclear deal, and it is a bargaining chip that may cost almost nothing for Iran to give away if Iran does not actually intend to pursue a nuclear submarine or take advantage of the naval reactor exemption. This has been the domi-

34. Ibid.

35. Ali Akbar Dareini, "Iran Parliamentarians Call for Nuclear Ships," *Associated Press*, July 15, 2012, available from news.yahoo.com/iran-parliamentarians-call-nuclear-ships-172547792.html.

nant interpretation of Iranian hints about a nuclear submarine—a negotiating ploy and an excuse for enrichment, but nothing more.[36]

Actually exercising the naval propulsion loophole, then—exempting nuclear material and diverting it for weapons purposes—does not seem like the most likely scenario for Iran. But consider, anyway, what would happen if Iran today announced that it was exempting some enriched uranium from safeguards for the purposes of testing a naval nuclear reactor. Beyond the diplomatic protestations that would surely follow, the portion of the international community already skeptical of Iranian motives—the United States, Western Europe, and Israel most of all—would have to at least confront the strong possibility that Iran had taken the decision to pursue nuclear weapons. Talks would be suspended, sanctions would tighten, international tensions would increase, and the risk of military action to stave off Iranian nuclear weapons possession would jump dramatically. If Iran's goal were merely to remove enriched uranium from the watchful eye of the IAEA, then it would certainly succeed. But this small victory would come at a significant cost. While the invocation of a nuclear submarine program might provide enough of a fig leaf for Iran's actions that some states already sympathetic to Iran might defend its "right" to exempt material under the NPT, the rest of the world would have no illusions about Iranian behavior.

Contrast this series of events with a more likely path to an Iranian nuclear weapon: Iran operates a small, undeclared uranium enrichment facility to produce nuclear material beyond the gaze of IAEA inspectors. This would require transferring uranium feed material from Iran's existing enrichment plants or uranium conversion facility, or operating an undeclared uranium conversion facility. Diversions of uranium from declared facilities risk being noticed by inspectors, of course, but small quantities of material might be writ-

36. Fredrik Dahl, "Iran Submarine Plan May Fuel Western Nuclear Worries," *Reuters*, July 5, 2012, available from www.reuters.com/article/2012/07/05/us-iran-nuclear-submarines-idUSBRE8640PC20120705.

ten off under the broad category of "material unaccounted for," and in any case it probably would take the IAEA some time to pin down any discrepancies.[37] The end result may be the same—Iran would have nuclear material outside of safeguards with which to supply a nuclear weapons effort—but this pathway is likely to give Iran more time to actually develop nuclear weapons before the international community takes some action to delay or stop its program.

Iran is the illustrative case for the danger posed by the naval propulsion loophole, but even here it seems unlikely that Iran would actually take this route to a weapon. And if Tehran did choose to exempt nuclear material from safeguards and then divert it for weapons, this would probably be preferable—from the point of view of the international community—to a more covert strategy. Taking advantage of the naval propulsion loophole sounds a very clear alarm, giving the international community more time to bring both diplomatic and military pressure to bear to change Iran's course.

Mitigating the Naval Propulsion Loophole

There have been many proposals in recent years designed to strengthen the NPT and close its various loopholes, and the naval nuclear propulsion exemption has drawn its share of scrutiny. But before discussing policy options for heading off future nuclear submarine programs, we might ask whether closing this loophole is even worth the trouble. While the analysis above suggests that the naval propulsion exemption really does not pose much of a proliferation risk at the moment, the loophole becomes more dangerous once a precedent has been set that legitimizes the non-explosive

37. For a skeptical take on the IAEA's ability to quickly detect safeguards violations, see Henry D. Sokolski, "Assessing the IAEA's Ability To Verify the NPT," and Thomas B. Cochran, "Adequacy of IAEA's Safeguards for Achieving Timely Detection," in Henry D. Sokolski, ed., *Falling Behind: International Scrutiny of the Peaceful Atom*, Carlisle, PA: Strategic Studies Institute, 2008, pp. 3- 49,121-157.

military use of nuclear material. The second state to use the exemption will have an easier time procuring sensitive technology, face less international pressure to change course, and generally set off fewer proliferation alarm bells. It makes sense, then, to try to hold the line and prevent countries from exercising the exemption in the first place or, if a precedent must be set, to try to limit its damage.

Several policy options are available, including voluntary safeguards agreements for naval nuclear reactors, efforts to limit the sale of nuclear submarine technology, a push to transition nuclear submarines to low enriched uranium fuel, and even a separate treaty on fissile material production. Most of these, however, do not really close the naval propulsion loophole; instead, they only reduce the likelihood that the loophole will be exercised, or render the loophole less dangerous if a state chooses to use it.

Safeguarding Naval Nuclear Propulsion

The decision by NPT drafters not to require safeguards on non-explosive military uses of nuclear material was very much a product of its time. States in the mid- to late-1960s were reluctant to allow inspectors access to civilian nuclear facilities, let alone military installations.[38] Safeguards concepts and techniques were not yet well established, and the mandate of the IAEA itself was undergoing a large shift as it prepared for the challenge of acting as the inspections body for the NPT. At the time of the NPT negotiations, IAEA inspections of military naval vessels or military-run reactors would have been seen as a substantial expansion of the agency's statutory authority.

The context for IAEA safeguards has changed significantly since those early days. IAEA inspectors have established on the Agency's behalf a reputation for fairness and discretion. The scope of the IAEA's safeguards work has expanded from merely verifying state

38. "Editorial Note," Document 92.

declarations and performing material accounting at select facilities; the Agency is now widely seen to be responsible for assuring that a member state has no undeclared nuclear activities. In the Iran case, the IAEA has even taken on the task of evaluating possible nuclear weapons-related activities that do not involve sensitive nuclear material.[39] Safeguards technology, too, has evolved, offering new tools for verifying non-diversion even when inspectors visit a site only infrequently.[40]

All of these changes mean that IAEA safeguards for naval reactors—a non-starter as recently as the late 1980s, when Canada was ready to take advantage of the naval propulsion exemption with only bilateral safeguards in place—now represent a reasonable approach to mitigating the proliferation risks of nuclear submarines. To be sure, nuclear submarines pose special challenges for existing safeguards techniques. A major selling point for nuclear propulsion, after all, is that nuclear submarines can venture further from port and stay away longer, and this complicates efforts to verify the non-diversion of material. Naval reactors may also pose technical

39. This last shift is not without some controversy. See, for example, Daniel Joyner, "Iran's Nuclear Program and the Legal Mandate of the IAEA," *JURIST*, November 9, 2011, available from jurist.org/forum/2011/11/dan-joyner-iaea-report.php. For a defense of the legal basis for the IAEA's activities in Iran, see David Albright, Olli Heinonen, and Orde Kittrie, *Understanding the IAEA's Mandate in Iran: Avoiding Misinterpretations*, Washington, DC: Institute for Science and International Security, November 27, 2012, available from isis-online.org/uploads/isis-reports/documents/Misinterpreting_the_IAEA_27Nov2012.pdf.

40. Important advances in safeguards technology include remote monitoring systems, commercial satellite imagery, and environmental sampling. See Mark Schanfein, "International Atomic Energy Unattended Monitoring Systems," in James E. Doyle, ed., *Nuclear Safeguards, Security, and Nonproliferation*, Boston: Elsevier, 2008, pp. 113-134; Kaluba Chitumbo, Stephen W. Robb, and John Hilliard, "Use of Commercial Satellite Imagery in Strengthening IAEA Safeguards," in Bhupendra Jasani and Gotthard Stein, eds., *Commercial Satellite Imagery: A Tactic in Nuclear Weapon Deterrence*, Chichester, UK: Praxis Publishing, 2002, pp. 23–48; and D.L. Donohue, "Strengthening IAEA Safeguards through Environmental Sampling and Analysis," *Journal of Alloys and Compounds*, Vols. 271–273, June 1998, pp. 11–18.

difficulties for verification because of their high burn-up rates and large quantities of fission products.[41] But these hurdles could be overcome sufficiently to at least provide belated notice of the diversion of nuclear material. Such a safeguards approach for naval propulsion has made it onto the IAEA's long-term research and development plan.[42] Fundamentally, naval nuclear propulsion safeguards of any kind would be a substantial improvement over the presumed solution today, which would exempt nuclear material from verification altogether. If implemented, voluntary monitoring of naval nuclear propulsion by the IAEA could go a long way toward mitigating the nonproliferation impact of a nuclear submarine program.

Convincing a state to subject its naval nuclear propulsion work to IAEA verification, however, may be a tough sell. Brazil, in particular, has illustrated its reluctance to take on new safeguards obligations by refusing to sign the Additional Protocol, even in the face of significant international pressure. Brazil may also be particularly sensitive to the risk that inspections would reveal information about military plans or capabilities. Brazil has cited concerns about the protection of proprietary technical information in seeking to limit IAEA inspector access to its centrifuge plant.[43] These concerns would probably be even more pronounced if inspections required that the IAEA gain access to a Brazilian military facility or the nuclear submarine itself.[44]

---

41. Mark E. Abhold, "Irradiated Fuel Measurements," in *Nuclear Safeguards, Security and Nonproliferation: Achieving Security with Technology and Policy*, p. 66.

42. International Atomic Energy Agency, *IAEA Department of Safeguards Long-Term R&D Plan*, 2012-2023, Vienna: International Atomic Energy Agency, January 2013, available from https://www.bnl.gov/ISPO/docs/STR-375-IAEA-Safeguards-Long-Term-Plan.pdf.

43. Squassoni and Fite.

44. On the other hand, Brazil's unique four-party safeguards arrangement (with Argentina, the IAEA, and the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials) could be interpreted as leaving an opening for

While some may resist voluntary monitoring, the international community does have at least one point of leverage in pressuring states to go along: The supply of nuclear submarine technology could be made contingent on this kind of alternative safeguards arrangement. Suppliers may also be in a position to dictate the use of low enriched uranium—less than five percent U-235—which would eliminate the justification for creating an infrastructure to enrich uranium at higher levels. France's deal with Brazil is not known to carry any kind of additional verification requirement, but a safeguards provision could be an important component of future agreements to supply nuclear submarine technology.

Limiting the Supply of Nuclear Submarine Technology

Another approach would seek to cut off the supply of nuclear submarine technology to new aspirant states. Given the small number of potential nuclear submarine supplier states—the P-5 weapons states and India—setting collective limits on the sale of naval nuclear propulsion technology, or stopping it completely, is at least a possibility.[45] Preventing the spread of nuclear submarines makes it harder for would-be proliferants to plausibly claim an exemption from safeguards and has the added bonus, as discussed above, of limiting demand for this capability; states are more likely to seek nuclear submarines when their rivals do the same. An agreement to limit supply might be negotiated within existing multilateral bodies—the Nuclear Suppliers Group is an obvious choice, although it currently excludes India—or it could be the focus of a separate

---

safeguards on nuclear material used in naval reactors. See Thielmann and Kelleher-Vergantini, pp. 6–7.

45. U.S. export controls already limit the participation of U.S. companies in foreign naval propulsion efforts under most circumstances. See Carlton E. Thorne, "Nonproliferation Export Controls," in *Nuclear Safeguards, Security and Nonproliferation: Achieving Security with Technology and Policy*, p. 541.

control regime.[46]

Limits on nuclear submarine technology transfer, however, probably would come too late to affect Brazil's nuclear submarine ambitions, as a supply agreement with France has already been concluded.[47] And restrictions on supply could not stop flagrant abuse of the naval propulsion loophole for nuclear weapons purposes; states could still claim a nuclear submarine program, produce highly enriched uranium, and divert it to a weapons effort. The absence of a known foreign supplier, however, might make the justification of a submarine program less believable, and thus make the exemption of nuclear material more clearly indicative of a nuclear weapons effort.

Transitioning to Low Enriched Uranium in Naval Reactors

The presence of a nuclear submarine program provides states with a built-in rationale for producing highly enriched uranium, which leads to greater proliferation risk. If a state opts to take full advantage of the loophole to support a weapons program, diversion of highly enriched uranium brings it that much closer to a nuclear weapon. Even if a state plays by the rules and uses the safeguards exemption only for naval propulsion, an infrastructure able to produce highly enriched uranium contributes to the state's latent nuclear capability and shortens the distance to a weapon should it ever decide to build one. Having highly enriched uranium around also complicates the state's nuclear security task and increases the risk of nuclear smuggling or sale to a third party. More generally, each additional state with highly enriched uranium has the effect of weakening global efforts to limit the production of sensitive nuclear materials. Control efforts, which largely rely on persuasion and bilateral cooperation agreements, can be undermined by the ability

46. Moltz, pp. 111–112.

47. Thielmann and Kelleher-Vergantini, pp. 4–5.

of states to point to others that have substantial enrichment and reprocessing capabilities.[48]

Most nuclear submarines burn highly enriched uranium fuel; uranium enriched to higher levels translates into a smaller reactor, longer operating periods, and less refueling. Modern naval nuclear reactors, however, can reasonably be powered by low enriched uranium. Only the United States and United Kingdom use weapons-grade nuclear material in their nuclear submarines, and China and France already use low enriched uranium to fuel their naval reactors.[49] If nuclear submarine aspirant countries could be convinced to adopt low enriched uranium as the fuel for their naval propulsion systems, this would help to mitigate some of the proliferation risk associated with these programs. There is room for some cautious optimism here. While an Iranian statement referring to "45-56 percent enriched uranium" for naval propulsion has drawn some attention, Brazil plans to use low enriched uranium for its nuclear submarines.[50] States that already field nuclear submarines running on highly enriched fuel—particularly the United States and United Kingdom—could help matters by considering a transition to low enriched uranium fuel for their naval propulsion programs. A recent U.S. Department of Energy report found such a transition would be feasible but uneconomical; this at least leaves the door open to a policy determination that the added expense might be worth it to realize broader nonproliferation goals.[51]

---

48. On the importance of international precedent in efforts to limit the spread of enrichment and reprocessing capabilities, see Jeffrey M. Kaplow and Rebecca Davis Gibbons, *The Days After a Deal with Iran: Implications for the Nuclear Nonproliferation Regime*, RAND Perspectives, Washington, DC: RAND Corporation, 2015, available from www.rand.org/content/dam/rand/pubs/perspectives/PE100/PE135/RAND_PE135.pdf.

49. Ma and von Hippel, p. 91 and Thielmann and Kelleher-Vergantini, p. 2.

50. Thielmann and Kelleher-Vergantini, p. 2 and "Iran Mulls Highly Enriched Uranium."

51. Office of Naval Reactors, *Report on Low Enriched Uranium for Naval Re-*

Closing the Loophole with Legal Obligations

The NPT does have an amendment procedure, laid out in Article VIII of the treaty, but it is not of much practical use. Amendments do not take effect without the ratification of the five nuclear weapons states recognized by the NPT, all the members of the IAEA Board of Governors, and a majority of member states. An addition to the treaty still would not be binding for member states until they themselves ratify the amendment, and so for existing members an amendment would not amount to much more than a voluntary obligation that they could choose to take on. It would make more sense, then, to try to fill the naval propulsion loophole as part of a broader control treaty. There is some precedent for using new treaties to plug loopholes in the NPT: the Comprehensive Nuclear-Test-Ban Treaty largely closes the NPT loophole allowing non-nuclear weapons states to benefit from research into "peaceful nuclear explosions." A peaceful nuclear explosion—for example, using a nuclear blast to excavate a canal—is technically identical to a nuclear weapons test.

The best candidate for an international agreement to fill the naval propulsion loophole is the Fissile Material Cut-off Treaty (FMCT). Existing proposals for the FMCT would stop the production of highly enriched uranium or plutonium for nuclear weapons, but the treaty could be extended in negotiations to cover the production of nuclear material for naval propulsion as well.[52] The FMCT is not on a fast track, however. First taken up for negotiations at the United Nations (UN) Conference on Disarmament in 1995, the treaty has languished in a body that operates by consensus. In recent years, Pakistan has been the primary impediment, blocking negotiations even as it adds to its own stocks of fissile material.[53] Still, there are

---

actor Cores, Report to Congress, Washington, DC: U.S. Department of Energy, January 2014.

52. Ma and von Hippel, p. 87.

53. Peter Crail, "Pakistan's Nuclear Buildup Vexes FMCT Talks," *Arms Con-*

some signs that talks on the FMCT may finally be moving forward, as discussions have shifted to a smaller group within the Conference on Disarmament that excludes Pakistan.[54] Progress on this treaty may bring the international community closer to a real solution for the naval propulsion loophole.

Conclusion

Among the NPT's various shortcomings, the naval propulsion loophole stands out. It was created by a gap in treaty coverage, rather than by explicit language. The NPT's drafters intentionally omitted language on military non-explosive uses of nuclear technology, with the full understanding that it fashioned a loophole that might be exploited by states seeking nuclear weapons. The nuclear submarine exemption probably encouraged key states to join the treaty, however, and requires states to make a declaration before removing nuclear material from safeguards. That the naval propulsion exemption today is highly alerting—if exercised by some states, it probably would be a fairly good indicator of a nuclear weapons program—partly mitigates the proliferation risk of the loophole. Use of the exemption would be more alarming, however, because no state has ever taken advantage of it. Once a precedent is set for exempting material from safeguards, the loophole becomes less costly for states to employ and thus a greater proliferation risk. For this reason, the international community has an incentive to mitigate the proliferation consequences of nuclear submarine programs.

While Iran has drawn attention recently for hinting at nuclear submarine ambitions, Brazil is the real contender for the state most

---

trol Today, Vol. 41, No. 2, March 2011, available from www.armscontrol.org/act/2011_03/Pakistan.

54. Michael Krepon, "Will Pakistan and India Break the Fissile Material Deadlock?" *Arms Control Wonk* (blog), July 31, 2014, available from krepon.armscontrolwonk.com/archive/4217/fmct.

likely to set a dangerous nuclear submarine precedent. The Brazil case is difficult and complex; Brazil has long refused to bow to international pressure on nonproliferation matters, and its nuclear submarine effort has its origins in the military's nuclear weapons program. But Brazil also has no interest in throwing open the door to unsafeguarded nuclear material in states like Iran. The international community—and particularly France, which is supplying Brazil with submarine technology—has an opening to convince Brazil that it should not take advantage of the naval nuclear propulsion exemption. Rather, it should negotiate a supplementary safeguards approach with the IAEA that maintains some level of assurance against non-diversion of nuclear material. A voluntary safeguards agreement, if implemented, would significantly reduce the proliferation impact of Brazil's nuclear submarine effort.

This chapter's analysis of the naval nuclear propulsion loophole speaks to a broader issue with the way we evaluate the effectiveness of international legal constraints. The NPT is in some ways a victim of its own success. As the undisputed lynchpin of the nuclear nonproliferation regime, the NPT is a magnet for criticism, and, indeed, the treaty has a number of significant loopholes. It does not follow, however, as some analysts have suggested, that the NPT's gaps leave it wholly ineffective or even harmful in its own right to nonproliferation goals. Some of the treaty's flaws, to the extent that they encourage additional state adherence and provide information about potential noncompliance, may even be a source of strength.