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Nuclear proliferation: history and lessons

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Introduction

In the last hundred years, life expectancy has doubled and many deadly illnesses have been eradicated. The world would be a better place to live had these and other astonishing scientific discoveries not been devalued by nuclear weapons – an invention that could destroy life on earth. Fredrick Soddy, who together with Ernest Rutherford discovered in 1901 that radioactivity involved the release of energy, described an atomic future in which humanity could “transform a desert continent, thaw the frozen poles, and make the whole Earth one smiling Garden of Eden.”¹ Although the poles are indeed thawing, the earth hardly looks like paradise.

Today, nine states have nuclear weapons and are estimated to be collectively spending approximately one hundred billion dollars on their nuclear programs.² Citizens of these countries are paying a heavy price in taxes - and sometimes also in sanctions - and many have sacrificed opportunities for economic and educational development to build and maintain weapons that could destroy their lives. Another forty or more states have the technological capacity to acquire nuclear weapons if they wish.

Under the Obama administration, a number of important landmarks were achieved. The 2010 US Nuclear Posture Review reduced the role of nuclear weapons in US policy. Washington signed a long-awaited strategic weapons reduction treaty (New START) with Russia. Two Nuclear Security Summits were held, and a third one is on the way. But larger issues remain unresolved: the Comprehensive Test Ban Treaty (CTBT) is no closer to ratification. The Fissile Material Cutoff Treaty (FMCT) negotiations reached an impasse. Even as the United States and Russia are reducing their nuclear arsenals, nuclear powers outside the Non-Proliferation Treaty (NPT) are building their own; a new nuclear arms race - between India and Pakistan - is a possibility. These developments are occurring in an increasingly uncertain international environment – with the Israeli-Palestinian conflict ongoing, the “war on terrorism” unfinished, and the Middle East destabilized by anti-regime protests in the Arab states.

Lessons from nuclear proliferation history

Fear and pride motivated states to build the bomb

¹ Richard E. Sclove, “From Alchemy to Atomic War: Frederick Soddy’s ‘Technology Assessment’ of Atomic Energy, 1900-1915,” *Science, Technology, & Human Values*, Vol. 14 No. 2 (Spring, 1989), pp. 163-194: 170.

² Global Zero, “World spending on nuclear weapons surpasses \$1 trillion per decade” (2011), <http://www.globalzero.org/en/page/cost-of-nukes>. Accessed July 27, 2012.

Few would openly dispute that nuclear weapons are extremely dangerous, that building a nuclear arsenal is costly, or that proliferation should be prevented, or at least minimized. But even though nearly everyone condemns the atomic bomb, moral considerations have failed to stop states from seeking nuclear weapons.

Examining proliferation history, one comes across decisions made in fear, on one hand, and pride, on the other.³ In 1939, fearing that Hitler's Germany would acquire the atomic bomb first, the United States launched a secret nuclear program in cooperation with the United Kingdom. To catch up with the United States after the bomb's destructive power was demonstrated in Hiroshima and Nagasaki, the increasingly isolated Soviet Union launched a full-speed secret nuclear weapons program. The US and Soviet hydrogen bomb tests in 1952 and 1954, respectively, led the British government to launch an effort to develop its own thermonuclear weapons. Having suffered a crushing political defeat by a former colony (Egypt) in the Suez Crisis, and feeling rebuked by its nuclear-armed ally (the United States), France decided to reinforce its global status by obtaining an independent nuclear deterrent in the 1950s.

China's nuclear program originated under threat from the Western arsenals. Its fear was not without grounds: Washington contemplated bombing Beijing to prevent it from developing its own nuclear arsenal.⁴ India's nuclear ambitions, in turn, were spurred by the fear of China's program, and its first nuclear test was also timed to boost its status vis-à-vis Pakistan. Pakistan's nuclear weapons were meant to counter India's: Ali Bhutto, who established the Pakistani nuclear program in 1972, remarked that his people would "eat grass" to keep up.⁵

Israel hoped its nuclear arsenal would deter its many enemies in the Middle East. Iran claims that it is threatened by Israel and the United States. North Korea invokes the danger emanating from South Korea (which indeed enriched uranium to levels near weapons grade but then stopped⁶), as well as from the United States and the West in general. Furthermore, it can be argued that the nuclear ambitions of North Korea and Iran were generated at least in part by the "lessons" they learned by observing the U.S.-led invasion of Iraq: namely, that possessing nuclear weapons might protect them from a similar fate. Similarly, the five nuclear members of the Security Council use fear of other states acquiring nuclear weapons to justify dragging their

³ Jacques Hymans provides an excellent research and analysis of proliferants' intentions by examining four nuclear proliferation cases in his book. Jacques Hymans, *Psychology of Nuclear Proliferation: Identity, Emotions and Foreign Policy*. Cambridge University Press (2006).

⁴ Cited in Gordon H. Chang, "JFK, China, and the Bomb," *The Journal of American History*, Vol. 74, No. 4 (Mar. 1988), pp. 1287-1310: 1287.

⁵ William Epstein, "Why states go- and don't go- nuclear," *Annals of the American Academy of Political and Social Science*, Vol. 430, *Nuclear Proliferation: Prospects, Problems, and Proposals* (Mar. 1977), pp. 16-28: 19.

⁶ "The official position is that "it was a one-time experiment conducted without government authorization and it was geared toward the country's nuclear energy program". Ironically, "without the authorization or knowledge of the government" was also an explanation offered by Pakistan in explaining the rogue activities of Dr A. Q. Khan in the realm of global nuclear proliferation." Ehsan Ahrari, "Nuclear genie out of S Korean bottle," *Asia Times*, Sep. 8, 2004. <http://www.atimes.com/atimes/Korea/FI08Dg05.html>. Accessed July 5, 2009.

feet on nuclear disarmament stipulated by Article VI of the NPT.

Nuclear weapons have always been a status symbol as well. The leaders of France and the UK launched the nuclear weapons program primarily in quest for national grandeur. Charles de Gaulle greeted the first French nuclear test with words “Hurray for France! From this morning she is stronger and prouder!”⁷ A Bharatiya Janata Party spokesman expressed similar feelings about the Indian bomb: “Nuclear weapons will give us prestige, power, standing. An Indian will talk straight and walk straight when we have the bomb.”⁸ Pakistan prided on being the first Muslim state to build the bomb. As William Epstein notes, because of their nuclear weapons capability, the United Kingdom and France, who have fallen behind Japan and Germany in economic strength, are still regarded as great powers, and China and India are also treated as having achieved great power status.⁹

Since it divides the world into nuclear “haves” and “have-nots,” the non-proliferation regime increases the pride and envy of the nuclear “have-nots.” Many countries explain their decisions to go nuclear by the need to overcome nuclear apartheid, racism, or discrimination on religious grounds.¹⁰ The reluctance of the nuclear powers to further reduce their own arsenals has raised the apparent value of nuclear weapons and has increased other states’ desire to nuclearize.

Status concerns can also contribute to nuclear disarmament

Currently there is a strong stigma against using nuclear weapons, but very little against acquiring them.¹¹ Although being caught violating the NPT may lead to international isolation, those states that succeeded in developing nuclear weapons have been respected or at least feared.

Even so, more countries have abandoned their nuclear ambitions than have chosen to build and retain nuclear arsenals. Nuclear programs were dismantled by states that no longer faced existential threats and that saw a chance to improve their international status by adhering to the non-proliferation regime. For example, the three post-Soviet states – Ukraine, Belarus, Kazakhstan – gave up the arsenals inherited from the Soviet Union in order to obtain Western recognition as independent states and join international institutions.¹² South Africa gave up its nuclear program because accession to the NPT was seen as a chance to end international isolation at the time when the security threats that led to building the weapons dissipated.¹³ These experiences suggest that if keeping a nuclear arsenal becomes a political liability and

⁷ Marcel Duval and Dominique Mongin, *Histoire des forces nucleaires francaises depuis 1945* (Paris: Presses Universitaires de France, 1993), p. 46.

⁸ George Perkovich, “Nuclear Proliferation,” *Foreign Policy*, No. 112 (fall 1998), pp. 12-23: 16.

⁹ Epstein, 21.

¹⁰ For example, India, South Africa, Argentina, Iran, and Brazil. Perkovich, 21.

¹¹ Nina Tannenwald, *The Nuclear Taboo: The United States and the Non-Use of Nuclear Weapons Since 1945*. New York: Cambridge University Press (2007).

¹² Zaitseva, pp. 27-30.

¹³ J. W. de Villiers, Roger Jardine and Mitchell Reiss. “Why South Africa Gave up the Bomb,” *Foreign Affairs* (Nov./Dec. 1993).

undermines rather than raises international status, proliferation will stop or at least be limited to states that face existential threats.

Civilian and military uses of nuclear energy are too close for comfort

There is an inseparable link between civilian and military uses of nuclear energy. Most of the countries presenting proliferation challenges today got a foot in the door of the nuclear club by developing civilian nuclear programs with the assistance of a nuclear weapon state. In 1953 the United States introduced the Atoms for Peace program to share peaceful nuclear technology with states that renounced nuclear weapons. Its positive contribution notwithstanding, this program accelerated the global spread of nuclear weapons technology as the United States and the Soviet Union provided research reactors in order to establish strategic ties with developing countries.¹⁴ The United States signed more than 40 such nuclear cooperation agreements, including treaties with apartheid South Africa and India (both of which later built nuclear weapons).¹⁵ The Soviet Union assisted China and North Korea (both nuclear powers today). Iran and Iraq also used the Atoms for Peace program and their NPT membership to receive technology useful for developing nuclear weapons.¹⁶

About 31 countries currently use nuclear reactors for electricity production, and more than 60 countries have expressed an interest in acquiring them.¹⁷ The number of states developing or expanding nuclear power capacity is growing. Most do not intend to build nuclear weapons. However, the spread of civilian nuclear capabilities expands the potential for proliferation by significantly reducing the number of additional steps needed to build a bomb. The rise in demand for nuclear technology occurs at the time when the nuclear industry is incentivized to lobby for “denuclearization” of its activities - such as uranium trade - in order to obtain freedom from national and international oversight and earn higher profit.¹⁸ The fewer activities are considered nuclear, the fewer restrictions on the industry, and the more likely that a sale of sensitive technology will be approved or that purchases on the uranium market will go unmonitored. These incentives to commercialize nuclear materials and equipment and sell them with little oversight, combined with the increasing complexity of transactions in nuclear trade, increase the probability that in the long run leaders of some of new nuclear-capable states will succeed in acquiring the bomb.

Proliferation hinges on political decisions that more and more states are able to make

¹⁴ Zia Mian & Alexander Glaser, “A frightening nuclear legacy,” *Bulletin of the Atomic Scientists*, Vol. 64 No. 4 (Sep./Oct. 2008), pp. 42-47: 42.

¹⁵ Leonard Weiss, “Atoms for Peace,” *Bulletin of the Atomic Scientists*, Vol. 59 No. 6 (Nov./Dec. 2003), pp. 34-44.

¹⁶ Weiss, 44.

¹⁷ IAEA, “International Status and Prospects of Nuclear Power”. Board of Governors General Conference, GOV/INF/2010/12-GC (54)/INF/5, (Sep. 2, 2011),

<http://www.iaea.org/Publications/Booklets/NuclearPower/np10.pdf>. Accessed July 28, 2012.

¹⁸ Gabrielle Hecht, “An elemental force: Uranium production in Africa, and what it means to be nuclear”, *Bulletin of the Atomic Scientists*, Vol. 68 No. 2, pp. 22–33.

While virtually every state is guided by security and status considerations, only a few ended up building the “ultimate weapon.” In the end, the acquisition of nuclear weapons is a political choice. It is a political choice whether to adhere to the NPT and comply with the IAEA safeguards. It is political reverberations that a violator of international non-proliferation norms faces. Finally, it is changing internal political realities rather than external pressures or moral considerations that explain why the states that eventually rolled back their nuclear programs did so. Realizing this is important if we are to come up with adequate measures to curb proliferation.

Structuring political incentives correctly is increasingly relevant today when most technologically advanced nonnuclear weapon states with civilian nuclear capabilities can quickly assemble and deploy full-fledged nuclear arsenals if they choose to do so.¹⁹ This was acknowledged by Mohamed El-Baradei, the outgoing director general of the International Atomic Energy Agency (IAEA), who predicted that the next wave of proliferation would involve “virtual nuclear weapon states” – those that can produce plutonium or highly enriched uranium and possess the know-how to make warheads, but stop just short of assembling a weapon, thereby remaining technically compliant with the NPT.²⁰

The case of Japan is instructive in this regard. While Japan has not actually developed or manufactured nuclear weapons, its advanced technological infrastructure can likely overcome this limitation within a few months. Japan’s long-standing plutonium program, its geopolitical position, and its geostrategic vulnerability to an attack from North Korea make it feasible that the country will consider an independent deterrent.

With the inevitable spread of “dual-use” nuclear technologies (weapons and reactors), virtual arsenals are becoming a global phenomenon. Looking into the future, it may no longer be necessary to build actual nuclear weapons to rely on nuclear deterrence. While this may provide incentives for the current nuclear weapons states to reduce their arsenals, a world in which most states deter each other with fully-formed weapons infrastructure instead of the capability to divert dual-use technologies toward building such infrastructure will hardly be safer. The more states have nuclear capabilities, the more complex and unstable the global web of rivalries and corresponding deterrence dyads becomes.²¹

Existing treaties and agencies are a necessary but insufficient proliferation barrier

¹⁹ Joseph F. Pilat, “Virtual Nuclear Weapons,” US Institute for Peace, <http://www.osti.gov/bridge/servlets/purl/615627-yBBEOO/webviewable/615627.pdf>. Accessed July 19, 2009.

²⁰ Julian Borger, “Mohamed ElBaradei warns of new nuclear age,” *Guardian*, May 24, 2009, <http://www.guardian.co.uk/world/2009/may/14/elbaradei-nuclear-weapons-states-un>. Accessed July 19, 2009.

²¹ See Christopher Ford, “Weapons Reconstitution and Strategic Stability”, Remarks at the Oak Ridge National Laboratory, in Oak Ridge, Tennessee (May 17, 2011), http://www.hudson.org/index.cfm?fuseaction=publication_details&id=9056. Accessed July 28, 2012.

Proliferation measures remain a step behind the ever-changing proliferation challenges. First, the existing non-proliferation controls are out of date: the major treaties (NPT, CTBT) reflect exclusively state-centric solutions to the problem and focus on the physical aspects of nuclear weapons.²² Second, the agencies in charge of maintaining nuclear governance, notably the International Atomic Energy Agency (IAEA), are politicized and unable to perform their tasks effectively.

Today's proliferation risks are qualitatively different from those envisioned at the time the NPT was signed and the IAEA established. It is no longer enough to guard against the intentions of a pariah head of state. Nuclear capabilities and responsible leadership do not prevent states from failing. Weak nuclear weapon states present proliferation risks of their own, as the uncovering of A. Q. Khan's proliferation network showed; Dr. Khan was intimately involved in Pakistan's nuclear weapons program, and subsequently found to have sold nuclear "secrets" to other countries. Even in strong states, sophisticated technologies are increasingly transferred into private hands.²³ If espionage and state-to-state transactions were the means of acquiring nuclear materials a few decades ago, the private sector and the nuclear black market can help states seeking nuclear technology today.²⁴ Violations become harder to detect and the new types of violators are immune to deterrence, sanctions, and international condemnation.

Upholding non-proliferation norms is becoming secondary to the economic benefits of globalization, as the recent nuclear cooperation agreements (US-India, France-Pakistan) demonstrate. The global financial crisis may have increased the proliferant opportunities as financially stressed but nuclear-capable states are more likely to sell sensitive technologies to third parties.

Although the malicious software, Stuxnet, was successfully used to stem proliferation by damaging Iran's nuclear facilities,²⁵ the impact was only temporary and advances in cyber space are presenting additional challenges to nuclear deterrence and security. The Internet is open to a wide range of actors and its relative anonymity allows actions free of reputational constraints and with relative impunity. Just between 2009 and 2011, computer attacks by criminal gangs, hackers and other nations on US infrastructure increased 17-fold.²⁶ Technological revolutions

²² See Pilat.

²³ E.g., Michel Berthélemy, "What drives innovation in nuclear reactors technologies? An empirical study based on patent counts", Working Paper 12-ME-01, Interdisciplinary Institute for Innovation (January 2012).

²⁴ See "Nuclear black markets: other countries and networks" (Chapter 2). In *Nuclear Black Markets: Pakistan, A.Q. Khan and the rise of proliferation networks: A net assessment*, International Institute of Strategic Studies, <http://www.iiss.org/publications/strategic-dossiers/nbm/> Accessed July 30, 2012.

²⁵ Nazli Choucri and Daniel Goldsmith, "Lost in cyberspace: Harnessing the Internet, international relations, and global security", *Bulletin of the Atomic Scientists*, Vol. 68 No. 2, pp. 70–77.

²⁶ "Rise Is Seen in Cyberattacks Targeting U.S. Infrastructure", *The New York Times*, (July 26, 2012), <http://www.nytimes.com/2012/07/27/us/cyberattacks-are-up-national-security-chief-says.html?ref=world>. Accessed July 28, 2012.

have democratized access to nuclear know-how and controlling knowledge is problematic, since it may mean infringing on scientific freedom. Unfortunately, the IAEA system of declarations and inspections aimed at identifying physical aspects of proliferation cannot detect the spread of dangerous nuclear knowledge and expertise.²⁷

Although the intentions of states choosing not to join the NPT are apparent (for example, India from the very beginning decided not to commit to a nonnuclear status), those of the 188 NPT members are less straightforward. Even the five members of the UN Security Council (not coincidentally, all nuclear states) are hardly abiding by the NPT to the letter. Whereas Article VI of the treaty commits nuclear states to “good faith” negotiation toward nuclear disarmament, progress in this regard has been notably slow. Moreover, as the case of North Korean withdrawal from the NPT demonstrates, NPT membership can be easily abrogated. If nuclear proliferation escalates, it will not take long for some parties to give notice of withdrawal. “I am not really thinking of nuclear arms,” said the Shah of Iran in a 1975 interview with *The New York Times*. “But if 20 or 30 ridiculous little countries are going to develop nuclear weapons, then I may have to revise my policies.”²⁸

The current system of nuclear governance also suffers from politicization that results from differing views among the current nuclear weapons states. The decisions of the IAEA board of governors often conflict with decisions taken by the UN Security Council. Members of the Nuclear Suppliers Group have been caught violating their own rules and thus undermining the organization’s credibility.²⁹ The lack of a common approach to nonproliferation and disagreements among the United States, China and Russia stand in the way of resolving pressing nuclear issues with Iran, North Korea, and Syria.³⁰ Additional tensions arise between the advanced nuclear states and the nuclear newcomers, mostly developing states. Many of these are members of the Non-Aligned Movement who resent the biases built into the current nonproliferation regime.

Measures to curb nuclear proliferation

Of the more than 40 states that are technologically capable of producing nuclear weapons, fewer than a quarter have done so. Acquiring nuclear weapons thus remains a deviation rather than the norm. However, it can be argued that one nuclear weapon state is already too many, and, moreover, risks increase with more “fingers on the button.” The current pattern of nuclear

²⁷ Pilat.

²⁸ John B. Oakes, “Shah offers a New Aid Plan for Developing Nations,” *The New York Times*, Sep. 24, 1975.

²⁹ For example, in the last ten years Russia supplied India with more than \$700 million worth of nuclear fuel in violation of the NSG rules (until in 2008 India was granted an exception from the rules). Russia denied violation by citing NSG safety exception, but the Western states disagreed. (See Fred McGoldrick, “The Road Ahead for Export Controls: Challenges for the Nuclear Suppliers Group”, *Arms Control Today*, January/February 2011. Mark Hibbs, “Nuclear energy 2011: A watershed year”, *Bulletin of the Atomic Scientists*, Vol. 68, No. 1, pp. 10–19: 17.)

³⁰ Hibbs.

proliferation will continue, however, unless some decisive measures are taken. Although we cannot completely eliminate fear and pride caused by the structure of the international system, we can certainly decrease their influence on decisionmaking by the following measures.

Supporting the global effort to abolish nuclear weapons

Changing the political decisions of others involves making one's own bold political decisions. It is important to frame and pursue nonproliferation as a global effort for the abolition – not mere reduction – of nuclear weapons. When it comes to nuclear weapons, the difference between zero and a few is enormous. (Indeed, there are cogent theoretical reasons to think that a small, vulnerable arsenal is more destabilizing than a relatively large one, since the latter is less susceptible to a disarming first strike.) As long as nuclear arsenals continue to exist – no matter in whose hands and however many – the incentive to acquire nuclear capabilities remains. Nonproliferation goals can only be achieved if the current nuclear weapon states are unequivocal about moving toward the goal of “Global Zero,” and not just in words, but in deeds.

Possessing the strongest conventional forces in the world, the United States only faces existential danger in a world with nuclear weapons.³¹ Those states that already have nuclear weapons must stop dodging their responsibilities under the NPT, and advance a serious effort to reduce their nuclear stockpiles to zero. Otherwise, their behavior only weakens the treaty they try to use as a proliferation remedy. Article VI of the NPT commits the parties in possession of nuclear arsenals to pursue negotiations “in good faith” to end the nuclear-arms race and to achieve “nuclear disarmament,”³² but the five nuclear weapon states have been slow to fulfill their commitments and continue to put high value on their nuclear arsenals. No wonder the rest of the world cannot be convinced to forgo nuclear weapons! US President Barack Obama promised to seek a world free of nuclear weapons; the United States could lead in this effort by providing political and financial support, as well as by example.

Building confidence in destabilized regions

Since the NPT took effect in 1970, nuclear proliferation has been occurring in conflicted and/or unstable states in the Middle East and Asia. These states’ interest in nuclear weapons has been animated by fear of vulnerability in regional crises. Some experts believe that any government in the unstable Middle East would acquire nuclear arms if it had the capability.³³ Nuclear arms buildup is already underway in South Asia, between India and Pakistan.

Arms races result from escalating political tensions, so that effective disarmament is only possible when political problems are resolved. A concrete example of how reducing tension can

³¹ Robert Nelson, “Three reasons why the US Senate should ratify the test ban treaty,” *Bulletin of the Atomic Scientists*, Vol. 65 No. 2 (Mar./Apr. 2009), pp. 52-58: 53, 54.

³² Nuclear Non-Proliferation Treaty, Article VI,
<http://www.un.org/events/npt2005/npttreaty.html> Accessed July 28, 2012.

³³ “Iran’s Nuclear Ambitions Seen as Adding to Tehran’s Prestige in Region,” *VOA*, Cairo, 06 August 2003.

lead to arms reductions is the START talks and ensuing treaties between the US and Russia at the end of the Cold War. A potentially dangerous nuclear competition between Brazil and Argentina was averted when political relations improved between these long-time South American rivals. By the same token, countering proliferation threats in the long term means trying to resolve the Kashmir issue, which inflames relations between India and Pakistan, achieving a peaceful solution in the Middle East, reducing tensions in the Persian Gulf, addressing antagonism between the two Koreas, and so on. By reducing incentives for conflict, fear and incentives to acquire nuclear weapons capabilities are similarly reduced.

Strengthening the non-proliferation regime

Improving compliance with existing export regulations, negotiating a reasonable cutoff of fissile materials production, ratifying the CTBT,³⁴ and increasing the price paid for NPT violations are four immediate steps to strengthen the current non-proliferation regime. Stricter standards are necessary to ensure that countries obtaining nuclear reactors do not contribute to nuclear weapons proliferation.³⁵ However, in the long-term, the current regime requires larger fixes: nuclear governance needs to become more equitable, with the same rules and restrictions applied to all states, and non-proliferation measures need to address challenges by non-state actors more directly. The latter problem could even become a solution for the former, if the presence of non-state (including cyber) threats compels states to resolve their differences and advances a new level of cooperation between them as equals.

One of the major frustrations with the current non-proliferation regime is its biases. For example, it is easy to understand the Arab states' frustration with Israel's refusal to reduce and eventually eliminate its semi-covert nuclear arsenal (Israel refuses to officially confirm its existence, although it is an "open secret"). Even the months-old guidelines for enrichment and reprocessing transfers by the Nuclear Suppliers Group (NSG) are creating tensions because the recipient states view them as discriminatory. Developing nations outside of the NSG argue that these guidelines are imposed by the advanced states in order to perpetuate the divide between the nuclear "haves" and "have-nots".³⁶ Efforts need to be made to design more equitable rules: and not by expanding proliferation opportunities for the nuclear "have-nots," but by curtailing opportunities for the "haves." New commitments by the nuclear weapons states – for example, no-first-use declarations of the sort recently announced by the Obama Administration – could enhance the credibility of the nonproliferation regime.

Establishing Nuclear-Weapon-Free-Zones (NWFZs)

Elimination of nuclear weapons region by region by means of establishing NWFZs is one of the most effective paths toward global nuclear disarmament.³⁷ NWFZs complement the NPT by

³⁴ Nelson, p. 53.

³⁵ "Confronting nuclear energy's proliferation problem," *Bulletin of the Atomic Scientists*, Vol. 65 No. 2 (Mar./Apr. 2009), pp. 1-3: 3.

³⁶ Steven E. Miller, "Nuclear weapons 2011: Momentum slows, reality returns," *Bulletin of the Atomic Scientists*, Vol. 68 No. 1, pp. 20-28.

³⁷ "A nuclear-weapon-free zone (NWFZ) is a specified region in which countries commit

preventing the deployment of nuclear weapons in non-nuclear weapon states. Such practice is currently followed by NATO: under NATO's nuclear sharing arrangements, US tactical nuclear weapons are deployed in European states that do not have their own nuclear arsenals.³⁸ NWFZs also foster regional cooperation and help build confidence among countries in the region by increasing transparency and strengthening verification measures.³⁹ Even more importantly, members of a NWFZ can effectively band together to press for greater progress on nuclear disarmament. NWFZs are also a means of preventing nuclear testing in the regions they cover as well as addressing the threat of global nuclear terrorism. Finally, NWFZ members set a strong example to the rest of the international community.

There are currently five NWFZs with a total of 133 states parties: in Latin America and the Caribbean (the Treaty of Tlatelolco, 1967); in the South Pacific (the Treaty of Rarotonga, 1985); in Southeast Asia (the Treaty of Bangkok, 1995), in Africa (the Treaty of Pelindaba, 1996), and in Central Asia (Central Asian Nuclear-Weapon-Free Zone Treaty, 2006).⁴⁰ The 1967 Treaty of Tlatelolco helped pave the way for the NPT itself. The NWFZs have been extraordinary successful not only in ensuring the absence of nuclear weapons in their respective regions, but also in promoting regional openness and cooperation as approaches to state security. However, progress toward the establishment of NWFZ has stalled. States face enormous difficulties in their attempts to establish a NWFZ, as the example of Central Asian and Middle Eastern NWFZ efforts show.

Part of the problem is that not all countries are taking the idea seriously. For example, the US has lacked commitment to a WMD-free zone in the Middle East, which was first proposed by the Arab League more than 15 years ago. At the 2010 NPT Review Conference, certain basic initiatives were undertaken, but fundamental questions -- such as the participation of Israel and Iran -- remain unresolved.⁴¹ Despite difficulties of implementation the concept of NWFZs

themselves not to manufacture, acquire, test, or possess nuclear weapons. [...] Article VII of the nuclear Nonproliferation Treaty (NPT), which entered into force in 1970, affirms the right of countries to establish specified zones free of nuclear weapons. The UN General Assembly reaffirmed that right in 1975 and outlined the criteria for such zones. Within these nuclear-weapon-free zones, countries may use nuclear energy for peaceful purposes." Nuclear-Weapon-Free Zones (NWFZ) At a Glance, Arms Control Association, Fact Sheet, November 2007. <http://www.armscontrol.org/factsheets/nwfz>. Accessed August 3, 2009.

³⁸ In 2009, the German government asked for the withdrawal of the U.S. nuclear weapons from Germany, starting a larger debate on NATO's nuclear posture. See Oliver Meier and Paul Ingram, "The NATO Summit: Recasting the Debate Over U.S. Nuclear Weapons in Europe", *Arms Control Today*, Vol. 42 (May 2012).

³⁹ In 2003, the UN General Assembly adopted a resolution "Nuclear Weapon Free Southern Hemisphere and Adjacent Areas," in which the members of the existing NWFZ pledged to work together to "pursue common goals," and "to explore and implement further ways and means of cooperation among themselves." "Nuclear Weapon Free Southern Hemisphere and Adjacent Areas," UN General Assembly Resolution 58/49, December 8, 2003.

⁴⁰ In addition to NWFZs, treaties ban the deployment of nuclear weapons in Antarctica, Mongolia, on the seabed, and in outer space.

⁴¹ Steven E. Miller, "Nuclear weapons 2011: Momentum slows, reality returns", *Bulletin of the*

seems essential to addressing the crucial nonproliferation challenges on the Korean peninsula and in the Middle East.⁴²

Reducing the risks of the global nuclear power spread

The need to meet growing energy needs and limit carbon dioxide emissions has increased global interest in nuclear power and generates further threats to the nuclear non-proliferation regime. The disaster at the Fukushima Daiichi Nuclear Power Station in Japan in 2011 did not slow the spread of the civilian nuclear technology worldwide, and dozens of new states interested in mastering the atom have since approached the IAEA, despite the fact that Japan itself has moved away from reliance on nuclear energy after its recent, painful experience. Stricter controls on exports of enrichment technology are one measure to discourage states from acquiring nuclear weapon capabilities. Using “multinational enrichment facilities as an alternative to nationally controlled plants” is another.⁴³ Such facilities are cheaper and have been effective thus far.⁴⁴ It is also important to realize that new nuclear power plants are not a safe, long-term solution for a country’s energy needs and that investment in renewable energy offers a safer, more cost-effective and practical alternative.

Preventing nuclear terrorism

There are approximately 1,440 tons of highly enriched uranium (HEU) in the world today – ready to be stolen by terrorists seeking to build a nuclear weapon. Low-enriched uranium (LEU) can be used in virtually all civilian applications and no technical impediments to the conversion of HEU into LEU remain.⁴⁵ However, about 700 kilograms of HEU continues to be annually used in civilian research reactors, and 40 to 50 kilograms -- in civilian isotope production.⁴⁶ At the same time, many illicit attempts to buy fissile materials have been made.⁴⁷ The risks are growing exponentially with the emergence of every new nuclear state and the weakening of controls in the existing nuclear states.

Atomic Scientists, Vol. 68 No. 1, pp. 20–28.

⁴² Scott Parrish and Jean du Preez, “Nuclear-Weapon-Free Zones: Still a Useful Disarmament and Nonproliferation Tool?” Report for Weapons of Mass Destruction Commission, 2006.

⁴³ James, Goodby and Fred, McGoldrick, “Reducing the risks of nuclear power's global spread,” *Bulletin of the Atomic Scientists*, Vol. 65 No. 3 (May 2009), pp. 40-47: 44.

⁴⁴ Ibid., 46.

⁴⁵ So far, nearly 450 tons of HEU have been converted. Corey Hinderstein, Andrew Newman, and Ole Reistad, “From HEU minimization to elimination: Time to change the vocabulary,” *Bulletin of the Atomic Scientists*, Vol. 68 No. 4, pp. 83–95.

⁴⁶ Ole Reistad and Stykaar Hustveit. “HEU fuel cycle inventories and progress on global minimization”. *Nonproliferation Review*, Vol. 15 No. 2, (2008), pp. 265-287.

⁴⁷ For example, in 2011, Moldovan officials arrested six people for nuclear smuggling. Andrew E. Kramer, “Arrests in Moldova Over Possible Uranium Smuggling”, *The New York Times*, June 29, 2011. Also see Center for Nonproliferation Studies, “Confirmed Proliferation-Significant Incidents of Fissile Material Trafficking in the Newly Independent States (NIS), 1991-2001”, November 30, 2001. <http://cns.miis.edu/reports/traff.htm>. Accessed July 30, 2012.

It is important to continue assisting states that currently lack sufficient financial controls, adequate border security, and up-to-date export controls.⁴⁸ The lessons of cooperative non-proliferation programs in the former Soviet Union suggest that such assistance is most effective when security and developmental goals are combined. Threat reduction programs in post-Soviet states can serve as models to create new, peaceful jobs for North Korea's cadre of nuclear scientists and bomb makers. More than simply removing nuclear material and infrastructure, it is vital to provide the North's nuclear workers with alternative civilian jobs, since they could presumably resume their country's nuclear activities in the future or hire themselves out to help others build nuclear weapons. An approach similar to the Cooperative Threat Reduction (CTR) program between the United States and former Soviet states could be the best way to prevent future clandestine North Korean nuclear activities. The CTR program, established in 1991, has made a positive contribution, helping to destroy excess nuclear, chemical, and biological weapons and to support related non-proliferation objectives in Russia, Kazakhstan, Belarus, and Ukraine.⁴⁹

Conclusion

The hand of “The Doomsday Clock,” maintained since 1947 by the *Bulletin of the Atomic Scientists* to represent the threat of global nuclear war, currently stands at five minutes to midnight. Half-measures will not turn the world back from the brink. Although one state, no matter how powerful, cannot make political decisions on behalf of another, it can contribute to structuring appropriate incentives in the international system and affecting these decisions indirectly. It is up to the nuclear weapon states of today to shape the incentives of other states so as to help create a safer world.

⁴⁸ Brian Finlay and Elizabeth Turpen, “The Next 100 Project: Leveraging National Security Assistance to Meet Developing World Needs,” *Stanley Foundation*, Feb. 2009.

⁴⁹ Jungmin Kang, “Redirecting North Korea's nuclear workers,” *Bulletin of the Atomic Scientists*, Vol. 65 No. 1 (Jan./Feb. 2009), pp. 48-55: 48.