



DIGITAL ACCESS TO SCHOLARSHIP AT HARVARD

Strengthening Global Approaches to Nuclear Security

The Harvard community has made this article openly available.
[Please share](#) how this access benefits you. Your story matters.

Citation	Bunn, Matthew. 2013. Strengthening Global Approaches to Nuclear Security. Proceedings of the International Conference on Nuclear Security: Enhancing Global Efforts, International Atomic Energy Agency (IAEA).
Accessed	February 19, 2015 1:08:08 PM EST
Citable Link	http://nrs.harvard.edu/urn-3:HUL.InstRepos:10869386
Terms of Use	This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA

(Article begins on next page)

Strengthening Global Approaches To Nuclear Security

M. Bunn
Belfer Center for Science and International Affairs
John F. Kennedy School of Government
Harvard University
Cambridge, MA, 02138 USA

Abstract. Despite substantial progress in improving nuclear security in recent years, there is more to be done. The threats of nuclear theft and terrorism remain very real. This paper recommends learning from the much stronger national and international efforts in nuclear safety, and in particular taking steps to build international understanding of the threat; establish effective performance objectives; assure performance; train and certify needed personnel; build security culture and exchange best practices; reduce the number of sites that need to be protected; and strengthen the international framework and continue the dialogue once leaders are no longer meeting regularly at the summit level.

1. Introduction

The international community has made substantial progress in improving nuclear security since leaders at the first nuclear security summit in 2010 agreed on the goal of securing all vulnerable nuclear material around the globe in four years. Several countries have eliminated all the weapons-usable nuclear material on their soil; others have eliminated particular stocks; many have ratified key nuclear security treaties and conventions; and some have strengthened their nuclear security requirements and policies, or are in the process of doing so.

But there is more to be done. Nuclear and radiological terrorism remain genuine threats, and there remain weapons-usable nuclear materials, major nuclear facilities, and dangerous radiological materials that are not effectively protected against the full spectrum of plausible adversary threats. Policymakers should not conclude that at the end of the four-year effort agreed to in 2010, the mission will be complete. Nuclear security, like nuclear safety, requires a focus on continual improvement and striving for excellence that stretches decades into the future.¹

In thinking through how to build a stronger global nuclear security effort, we can learn from the experience of nuclear safety, where both national and international efforts are much more developed than they are for nuclear security. We need to be careful with the analogy, as there are both important similarities and important differences between safety – which protects against random, accidental events – and security, which protects against intelligent adversaries consciously looking for ways to overcome the defenses. And at Fukushima, we saw that the stronger global safety regime was nonetheless not strong enough to prevent a massive natural disaster from causing a devastating accident.

2. Building Understanding of the Threat

Complacency is the enemy of effective action. Many policymakers and nuclear managers in many countries doubt that nuclear terrorism is a serious risk and believe that their existing nuclear security measures are adequate.

In safety, everyone knows that equipment breaks and people make mistakes. It is more difficult to convince people that it is plausible that terrorists would attack a nuclear facility or that thieves might try to steal nuclear material from their site. Yet there are roughly 20 real incidents in which stolen plutonium or highly enriched uranium has been seized from smugglers; multiple incidents in which

¹ This paper draws in part on ideas presented in [1,2].

terrorists sought or acquired radiological material for use in a “dirty bomb”; and multiple incidents in which adversaries considered or implemented attacks on nuclear reactors.²

The following steps could help build international understanding of the threat:

- **Shared analyses of incidents and lessons learned.** In the world of nuclear safety, when an incident occurs, the plant performs a root cause analysis and develops lessons learned to prevent similar incidents from occurring again. These incident reports and lessons learned are then shared with other reactor operators through organizations such as the World Association of Nuclear Operators (WANO) and national groups such as the U.S. Institute of Nuclear Power Operations (INPO). These organizations can then assess trends among the incidents. INPO not only distributes lessons learned to U.S. reactor operators, it inspects to assess how well reactor operators are implementing the lessons learned [4]. Nothing remotely resembling this approach exists in the security world. It is time to begin such an effort – assessing security-related incidents in depth, exploring lessons learned, and distributing as much of this information among nuclear security operators as necessary secrecy will allow. Non-nuclear incidents that reveal types of tactics against which nuclear materials and facilities should also be included. Information about incidents and how to protect against them could be a major driver of nuclear security improvement, as it has been in safety; in a recent survey of nuclear security experts in 18 countries with weapons-usable nuclear material, incidents were cited far more often than any other factor as a dominant or very important driver of countries’ recent changes in nuclear security policies [5]. States could begin with internal assessments of events within their territory, and then provide as much information as can reasonably be exchanged to an international collection of information.
- **Threat reports and briefings.** States that believe they have information on the nuclear terrorist threat should prepare reports and briefings that can be distributed to other states. The United States, in particular, should prepare a detailed report on what it knows about how easy or difficult it would be for a sophisticated terrorist group to make a crude nuclear bomb; al Qaeda’s effort to get nuclear bombs (which reported directly to Ayman al-Zawahiri and got as far as carrying out crude explosive tests in the Afghan desert) and those of other terrorist groups such as the Japanese terror cult Aum Shinrikyo; the potential for terrorists to be able to get plutonium or highly enriched uranium (HEU) from nuclear thieves and smugglers; and other elements of the nuclear terrorist threat.³ Different versions should be prepared for public distribution and for confidential exchange among states.
- **Discussions among intelligence agencies.** Most states rely on their intelligence agencies to provide information on the threats their countries face. Hence a series of discussions among intelligence agencies to share information on the nuclear terrorist threat would be very valuable.⁴ Such discussions could also lead to expanded intelligence cooperation to deal with nuclear smuggling and nuclear terrorist activities.
- **Nuclear terrorism exercises.** Building on the exercise program that has begun in the Global Initiative to Combat Nuclear Terrorism, the United States and other leading countries should organize a series of exercises with senior policymakers from key states, exploring scenarios of nuclear theft and terrorist detonation of a nuclear bomb. Participating in a realistic exercise can reach officials emotionally in a way that briefings and policy memos cannot. A program of such exercises should become a central element of the Global Initiative.
- **Realistic testing of security performance.** Realistic tests, in which groups pretending to be adversaries attempt to find ways to defeat the security at a site, are a key means of finding vulnerabilities and convincing policymakers that improvements are needed. In the U.S. experience, many security systems that looked good on paper failed to provide effective protection

² See, for example, the incidents included in [3].

³ For recent non-government assessments of the threat of nuclear terrorism, see [6,7].

⁴ The head of the U.S. Department of Energy’s intelligence office undertook a small number of such discussions during President Bush’s second term, but this effort should be renewed, expanded, and deepened.

in the face of determined and intelligent adversaries looking for their weak points. The International Atomic Energy Agency (IAEA) now recommends that states conduct such force-on-force exercises, but only a minority of states do so regularly or realistically [8]. The United States and other countries should work with states around the world to implement programs to conduct such realistic tests.

3. Establishing Effective Performance Objectives and Measures to Meet Them

A focus on performance – achieving a very low risk of accident, rather than just following a set of safety rules – has been a critical element in the nuclear safety progress of recent decades. Nuclear security should move in the same direction. A performance-based approach is far more complex in the case of security, however, because adversaries adapt to the defensive measures, choosing to strike at the weakest point as best they can, in a way that earthquakes and human errors do not.

Nevertheless, effective performance against realistic threats is what needs to be achieved. Countries should establish and sustain security measures that will protect nuclear weapons, weapons-usable material, and major nuclear facilities against the full spectrum of adversaries their intelligence agencies judge to be credible threats – including both outsiders and insiders. Prescriptive rules will still be needed – as they are in safety – but they should increasingly be supplemented with performance-based approaches. As with safety, strong, independent regulators with the resources, expertise, and culture to do their jobs effectively are essential to achieving effective and sustainable security, and should be a focus of international nuclear security cooperation.

The specifics of the threat are different in every country – indeed, in some cases they vary by region within a country. But in a world of terrorists with global reach, there is a baseline global level of threat against which *all* countries should protect. It is difficult to argue that there is any country so safe that nuclear weapons or the materials needed to make them – or a nuclear facility whose sabotage could cause a major catastrophe – should not *at least* be protected against a modest group of well-armed and well-trained outsiders (capable of operating as more than one team); a well-placed insider; and both the outsiders and an insider working together, using a broad range of tactics [9]. States should each act to require operators managing such items and facilities to defend against at least such a baseline design basis threat (DBT). Countries facing higher levels of threat should provide more substantial protection.

It would be worthwhile to establish such performance objectives as an international norm. There is little hope, however, that detailed negotiation of a new treaty on nuclear security would succeed in establishing such performance objectives. Informal political commitments made by a group of like-minded states – inviting others to join them, and offering assistance if states would like to meet such performance objectives but need help to do so – could play a major role in reaching the goal.

The United States and Russia, joined by as many other states as are willing, should make such a joint commitment to high standards of nuclear security as a key “gift basket” for the 2014 nuclear security summit. Such a gift basket should include a commitment to require facility operators and transporters to protect nuclear weapons, weapons-usable nuclear materials, and major nuclear facilities against the full range of outsider and insider threats that their intelligence and nuclear agencies judge to be credible – including, at a minimum, the baseline DBT described above. It should also include a range of specific steps to fulfill that objective, from having well-armed, well-trained on-site response forces to putting in place material control and accounting systems adequate to detect either abrupt or protracted thefts and determine roughly where and when the loss occurred.

4. Assuring Performance – Internally and Internationally

As with nuclear safety, in nuclear security states not only need to establish clear performance objectives, they need to develop means to assure themselves (and to assure others) that those objectives are being met. Yet in the case of nuclear security, it is equally important to keep the details

of the security in place for each operation secret. No one wants potential terrorists or thieves to know the details of the security systems they will have to defeat.

Internally, performance assurance should begin with regular self-assessment by the operators, including in-depth vulnerability assessments.⁵ This must then be followed by in-depth inspection by the regulator, focused not just on a checklist of items in place but on a detailed judgment of whether the overall system is providing the required performance. That process requires considerable inspector expertise. Such inspections should include tabletop exercises to explore the operator's security strategies in the face of different threats, and regular force-on-force exercises to test the overall performance of the system in defending against the DBT.

Such measures to convince the country's own government that effective security is in place also provide the basis for assuring other countries (and the public) that security is effective. But extending assurance beyond the national government of the country where a particular nuclear operation is taking place requires further steps.

Independent peer reviews are one critical step that increases both domestic and international confidence in the effectiveness of the measures in place. In the world of safety, such peer reviews are commonplace, organized by both the IAEA and organizations such as WANO and INPO [4]. While IAEA-led reviews occur only when a national government requests one – and many reactors have never had such a review – the industry peer reviews cover all operating power reactors worldwide, since they are a requirement of WANO membership.

Peer reviews in nuclear security are at an earlier stage of development. The most important IAEA-led offerings include the Integrated Nuclear Security Advisory Service (INSServ), which provides a broad overview of a country's nuclear security measures (from border detection to protection of radiological sources) and the International Physical Protection Advisory Service (IPPAS), in which an expert team examines a country's legal infrastructure for physical protection and how it is implemented at a particular site. As of mid-2012, 37 countries had hosted IPPAS missions, though the vast majority of the sites in the world where HEU or separated plutonium are located have never had one and are not likely to in the next decade. (Such reviews have only been applied to civilian stocks, which make up roughly 15 percent of the world's stockpiles of separated plutonium and HEU.) No industry-led peer reviews yet exist, though the World Institute for Nuclear Security (WINS) – a non-government organization founded in part on the WANO model – will soon offer reviews of corporate governance of nuclear security on request.

In a related type of mission, U.S. experts visit countries that have received U.S. nuclear supplies to check that the physical protection of U.S.-origin nuclear materials and facilities is consistent with the recommendations of INFCIRC/225. These visits are required under U.S. law, and take place in many countries. Like IPPAS, these visits review the state's overall rules and procedures for nuclear security, and examine one or more actual sites where U.S.-origin material or facilities exist; sites that are not U.S.-origin are not subject to review. Other nuclear suppliers should begin carrying out similar visits to check that the physical protection requirements in their supply agreements are being fulfilled.

Such direct on-site visits probably provide the highest level of international assurance that is likely to be available in the near term – but they also have other benefits. Independent reviews help the host government be confident that its security measures in place really are effective; often provide useful suggestions for further improving security; and allow participating experts to exchange experience and best practices. Recently, for example, Israel received a visit from a U.S. expert team reviewing security at its civilian nuclear facility at Soreq, which identified both good practices in place and areas for improvement, and both governments have been pleased with the result.

⁵ If operators have limited capability – as might be the case for a small research reactor, for example – it may be possible for operators to contract out these kinds of assessments.

Technical cooperation such as that which has taken place under the Nunn-Lugar initiative also provides a substantial degree of international assurance. U.S.-Russian cooperation, for example, has included a broad range of exchanges about the nuclear security and accounting rules and procedures that are in place, along with actual visits to many nuclear facilities, creating an in-depth understanding of many (though not all) aspects of nuclear security, and a realization of how dramatically security in Russia has improved since the collapse of the Soviet Union. Russian experts have also visited many U.S. facilities, including the facility where U.S. nuclear weapons are assembled and disassembled.

In all of these cases, the information learned on these visits is kept confidential. In the case of IPPAS missions, the IAEA provides the report only to the host government. In the case of U.S. visits, only the host government and the U.S. government receive the results. Host governments can, of course, choose to make all or part of the visit reports public, and some do. The Netherlands, for example, which will host the 2014 nuclear security summit, has had four IPPAS missions in recent years, and has published edited summaries of the results.

The international community should take several steps to strengthen national and international assurances:

- All states with nuclear weapons, HEU, separated plutonium, or major nuclear facilities should implement regular, realistic force-on-force exercises to test operators' ability to protect against the DBT.
- All such states should ensure that they have effective nuclear security and accounting rules and regulations in place, and that their regulators have the independence, resources, expertise, and culture needed to enforce them effectively.
- All such states should regularly publish information about their nuclear security requirements and approaches and the means they use to assure effective performance. All such states should also encourage their operators to publish information on their nuclear security practices, the means they use to assess vulnerabilities, and what they are doing to address any vulnerabilities found. Organizations such as WINS should develop guides to help states and organizations report such information in a common format.
- All such states should regularly publish information on how they test and inspect the nuclear security arrangements in their country; what fraction of nuclear operations received high marks in such tests and inspections; and how they are addressing any issues and vulnerabilities identified. (The United States, for example, publishes detailed information on how its force-on-force exercises are conducted and how many of its facilities did well in these tests; on occasion, it also hosts foreign observers of these exercises.)
- All such states should regularly request IPPAS missions from the IAEA, including reviews of large and sensitive nuclear facilities where these exist. (The United Kingdom took an important step in this direction in hosting an IPPAS mission at the plutonium store at Sellafield, which holds over 100 tons of separated plutonium – by far the most important facility an IPPAS team has ever reviewed. At the next nuclear security summit, the United States and Russia should follow suit, requesting IPPAS missions for the plutonium store at Savannah River and the civilian plutonium store at Mayak.)
- All such states should publish unclassified summaries of the results of such international peer reviews, and the steps they are taking to address them.
- The world nuclear industry should work to establish industry-level peer reviews for nuclear security, comparable to WANO or INPO's reviews of nuclear safety performance, while protecting necessary secrets. These can build on WINS' planned reviews of corporate governance of nuclear security.
- States with particularly sensitive nuclear operations that are not likely to receive IPPAS missions soon, including military nuclear operations, should work together to establish ways to build confidence that they are meeting their nuclear security obligations without compromising

necessary secrecy. One approach, for example, would be to exchange detailed information on the kinds of security tests and assessments they perform – perhaps extending to the level of having the adversary teams that perform such tests train together – and then exchange information on the general results of such exercises.

- All states should include detailed information on their nuclear security rules and practices in their UNSCR 1540 reports, to build confidence that their nuclear security, physical protection, and nuclear accounting arrangements really are appropriate and effective as required. Donor states and international organizations should provide assistance to states with limited capacity; indeed, it might be desirable to establish one or more commercial firms that could assist states in preparing these reports. Here, too, WINS could provide guides that would suggest a common format and categories of information that might be included.

The reality is that there are several levels of sensitivity of information related to nuclear security. There is some information states may be willing to make public; other information that cannot be made public but could be shared with the IAEA; other information that states are not willing to share with the IAEA but might be willing to share with a single other state or a small group of states; and, for some states, other information they are not likely to be willing to provide to anyone outside cleared personnel of their own government. The effort to build international assurance in the effectiveness of nuclear security must take this reality into account and seek the maximum assurance practicable at each level of information.

The topic of international assurances is one of the priorities being discussed by the sherpas preparing for the 2014 nuclear security summit. While the final communiqué is unlikely to go beyond a broad endorsement of the idea of assurances, key states should join together to pledge to provide particular types of assurances, as a “gift basket” for the summit.

5. Building Security Culture and Exchanging Best Practices

Achieving effective nuclear security requires a strong security culture in which all staff take security seriously and give it the priority it requires. As one U.S. nuclear security official put it: “good security is 20 percent equipment and 80 percent culture.” Organizational culture is equally critical in nuclear safety, and a vast literature has developed on practices to strengthen safety culture.

The recent intrusion by an 82-year-old nun and two other protesters at the Y-12 nuclear facility in the United States is an example of the vulnerabilities weak security culture can create – even in advanced nuclear states. The incident occurred because the site had tolerated an intrusion detection system sending too many false alarms, cameras that had been broken for months had not been fixed, and guards ignored the alarms the intruders were setting off, thinking them false alarms [10]. While the building storing the HEU is highly secure and there would not have been any serious danger that the intruders could have gotten to the HEU even if they had been adversaries with military-style weapons and training, this nevertheless represented a profound security breakdown.

What can be done to build a security culture where all key staff take security seriously and are always on the lookout for vulnerabilities and ways to fix them? The IAEA and WINS have each published guides to strengthening security culture [11, 12]. The key to a strong security culture is belief in the threat – “never forgetting to be afraid,” as the saying goes. In addition, it is crucial to structure incentives to motivate key staff to take security seriously and invest their time and effort in it [13].

Every state with nuclear weapons, HEU, separated plutonium, or major nuclear facilities should require each of the operators handling these items or managing these facilities to establish a targeted program to assess and improve its nuclear security culture.

At the same time, regular exchanges of best practices – and implementation of these practices after the exchanges – can make a major contribution to nuclear security. Such exchanges can offer insights into how to cope with common problems, efficient ways to achieve particular objectives, and new

approaches that may have been developed elsewhere, while building a community of nuclear security professionals. They can also provide an important element of international assurance, as a detailed description of how an organization handles a particular security issue can do a great deal to build confidence in the competence and professionalism of those managing nuclear security in that country. The United States, Russia, and the United Kingdom have had a successful series of best practice exchanges about various aspects of nuclear security, control, and accounting. WINS has organized dozens of best practice workshops on topics ranging from coping with insider threats to managing guard forces.⁶ In surveys WINS has undertaken, over 95 percent of those responding indicated that they had changed security practices after participating in WINS workshops.

All operators handling nuclear weapons, HEU, or separated plutonium, or managing major nuclear facilities or dangerous radiological sources, should join WINS, participate in its best practice exchanges, and help to support it financially where practicable. States should encourage their operators to participate, and should contribute financially to WINS.

6. Training and Certification

In nuclear safety, regulators require that people and companies undertaking certain roles have certified competence to do so. Extensive training programs exist that allow participants to achieve the necessary certification if they pass tests demonstrating their knowledge of the needed material. For a company, getting and maintaining a safety “n-stamp” is a major undertaking. Nothing similar yet exists for nuclear security – either for the people or for the equipment.

Nuclear security training is now very much in vogue. An increasing number of countries are establishing nuclear security training and support centers; the IAEA is offering an expanded set of relevant training courses, and seeking to coordinate the work of the national centers; and the IAEA and a group of universities have established a new master’s degree program in nuclear security.

But it is less clear whether all this training will be of the type and quality that is needed; in-depth needs assessments and tailoring of training to those needs are steps that remain to be taken, in most cases.

To help address this issue, WINS is working to establish the WINS Academy, which will certify courses as providing the knowledge needed for competence in particular essential nuclear security roles, beginning with nuclear security managers. All states with nuclear weapons, separated plutonium, HEU, or major nuclear facilities should move over time toward a system in which personnel in key nuclear security roles must be certified as having the expertise needed to fill those roles.

7. Ensuring Sustainability

It is not enough for effective nuclear security to be achieved at one particular moment; nuclear security must be maintained and continually improved for decades to come. Sustaining nuclear security requires both capacity and commitment; assistance programs may focus in one country more on capacity-building and in another more on the difficult task of commitment-building, convincing the state that it is in its interest to take the actions needed to sustain effective security for the long haul.

In particular, states have to put in place the resources, incentives, and organizations needed to sustain nuclear security. Effective regulation is particularly critical, as most nuclear managers will not invest in expensive security measures that bring in no revenue unless a regulatory body tells them they have to do so. Each state with nuclear weapons, HEU, separated plutonium, or major nuclear facilities should put in place a fully effective nuclear security regulatory system and ensure that operators (including those with limited revenue) have the resources to sustain effective nuclear security measures [14, pp. 27-44].

⁶ All of the WINS best practice guides are available to WINS members at <http://www.wins.org>.

The United States and Russia are now nearing the end of the phase of their cooperation that involved installing major upgrades of physical protection, material control, and material accounting systems. At this writing, they are negotiating an accord to provide a revised legal basis for continuing cooperation. In the past, Russia has taken the view that U.S. experts could visit facilities only if that was required for major contracts to be implemented; as upgrades come to an end, U.S. experts may increasingly be excluded from visiting, reducing confidence that the measures put in place are being sustained. To ensure that upgrades are sustained, and the substantial investment that U.S. and Russian taxpayers have made in these systems is not wasted, the United States and Russia should work out a partnership-based approach to continuing cooperation that involves exchanges of best practices, joint development of new approaches, cooperation in improving security in other countries, and ongoing visits by experts from each country to nuclear sites in the other country, providing ongoing assurance.

8. Removing Material From Additional Sites

Stronger nuclear security can be achieved at lower cost if there are fewer places to protect. Every place where nuclear weapons or their essential ingredients exists represents another chance for a security weakness to arise that thieves might exploit. Hence it is highly desirable to eliminate as many sites with nuclear weapons, HEU, or plutonium as possible.

The international community has made considerable progress in this endeavor. Some two dozen countries have eliminated all the weapons-usable nuclear material on their soil (most recently the Czech Republic, in April 2013). Scores of research reactors have converted from using HEU fuel to using low-enriched uranium that cannot be used to make a nuclear bomb, and an even larger number of HEU-fueled reactors that once existed have shut down. The United States and Russia have each reduced the number of sites with nuclear weapons dramatically compared to their peak deployments during the Cold War [15].

But there is a good deal more to be done. Each state with nuclear weapons, HEU, or separated plutonium should:

- Undertake a review of each site where these materials exist, eliminating any state whose continued benefits are outweighed by its costs and risks. The material should then be consolidated at other sites.
- Ensure that its nuclear security regulations are appropriately graded (as recommended in INFIRC/225) so that operators can achieve substantial savings in annual security costs by eliminating plutonium or HEU, even if they continue to have LEU on-site.
- Eliminate any institutional incentives that may exist for operators to maintain HEU or separated plutonium (such as increased research funding for facilities using these materials, for example).

There are still real opportunities for further consolidation in individual states. Russia, in particular, has the world's largest number of building and bunkers with nuclear weapons, separated plutonium, or HEU; it should announce a major consolidation initiative as one of its commitments for the 2014 nuclear security summit. Similarly, the few non-nuclear-weapon states that still maintain sites with enough HEU for a gun-type bomb at a single site (Belarus, South Africa, and Japan) should overcome the political obstacles each faces and announce initiatives to eliminate these materials. And the United States and Russia should continue to reduce their far larger stocks of HEU, which are still far beyond their real military requirements.

9. Strengthening the International Framework and Continuing the Dialogue

The nuclear security summit process has transformed the global dialogue on nuclear security. Issues that were preciously handled by office directors have been elevated to the level of presidents and prime ministers. This has forced countries to establish interagency cooperation on nuclear security that in many cases was absent before; it has greatly broadened understanding and perception of the

threat (though there is more to do there, as discussed at the outset of this paper); and leaders' desire for deliverables to announce forced through many decisions that might otherwise have languished for years.

But it is clear that the sequence of nuclear security summits every two years is coming to an end – if not in 2014, then in 2016. No single forum will be able to replace it fully. But there will surely be a need for many years to come for some form of continued high-level dialogue on next steps in improving nuclear security.

In particular, there is clearly a need to strengthen the international nuclear security framework, which is a patchwork of treaties with only very vague requirements; voluntary initiatives and recommendations; and often opaque national actions. It has been criticized as “not robust, adaptable, or coherent enough to adequately protect against the intensifying and evolving threats of the 21st century.” [16] Clearly there is a need to bring the 2005 amendment to the physical protection convention into force, and to expand the membership of both that treaty and the nuclear terrorism convention. But more is needed as well. Political initiatives in which groups of like-minded states make specific nuclear security commitments (and develop means to provide assurance that those commitments are being fulfilled) could greatly strengthen the existing framework, and likely offer greater promise than near-term attempts to negotiate new treaties. Many of the initiatives discussed in this paper could be included in such joint political commitments.

Several forums might be able to take on parts of the function that the nuclear security summits have played:

- **IAEA Nuclear Security Meetings.** At this conference, the IAEA nuclear security meeting included a ministerial gathering for the first time. The IAEA plans to hold such meetings every four years, to assist in drafting its four-year nuclear security plans. With all member states invited, such IAEA gatherings have considerable political legitimacy. With the combination of ministers and technical experts, these meetings provide an opportunity for both technical dialogue and political decisions – particularly if, in future, the ministerial meeting is structured as a working meeting intended to reach decisions on particular actions (perhaps with some form of Sherpa-like process to prepare).
- **“Friends of Nuclear Security.”** The United States has proposed that interested states work together to develop proposals to strengthen the IAEA’s role and the international nuclear security framework. By allowing proposals to be discussed and developed in what would likely be a group of relatively modest size, this could increase the efficiency of concept development – and those ideas could then be addressed by the full IAEA membership.
- **An expanded Global Initiative.** To date, the Global Initiative to Combat Nuclear Terrorism has focused primarily on aspects of preventing nuclear terrorism other than security for nuclear weapons, weapons-usable materials, and major nuclear facilities. The participants could create an additional element of the Global Initiative focused specifically on improving security for these items and facilities, working out commitments to high standards, exchanging best practices, working with states to help put particular security measures in place, and more. Plenary meetings of the Global Initiative often take place at the Undersecretary level – high enough to bring some political clout, but low enough to focus on specific action.
- **A higher-profile role for the Global Partnership.** Already, the participants in the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction have agreed to extend the initiative through 2022. Every G8 summit typically features national reports on the projects countries are supporting. It may be possible to convince countries to see the annual G8 summits as an occasion for announcing new nuclear security initiatives, as the nuclear security summits have been – and to create a similar environment in which states do not want to come to the summit “empty handed.” Conceivably states who were not G8 participants but who made substantial nuclear security commitments could be invited to take part in an event with the summit leaders on the margins of the main summit.

- **A new forum.** Finally, interested states could create a new forum, below the summit level but at a high enough level to maintain a high-level impetus for nuclear security. This could take a wide variety of forms, from a continued focus only on nuclear security to various possibilities for a broader focus – for example, a focus on all forms of high-consequence terrorism.

There is a great deal to be done to strengthen nuclear security around the world. But with steps such as those described in this paper, the international community can build the road to a world in which all nuclear materials and facilities are effectively secured against the full spectrum of plausible threats, and all countries are able to have confidence in the effectiveness of the security in place.

REFERENCES

- [1] BUNN, M., HARRELL, E., MALIN, M.B., Progress on Securing Nuclear Weapons and Materials: The Four-Year Effort and Beyond, Project on Managing the Atom, Harvard University, Cambridge, Mass. (2012).
- [2] BUNN, M., Securing the Bomb 2010: Securing All Nuclear Materials in Four Years, Project on Managing the Atom, Harvard University, and Nuclear Threat Initiative, Cambridge, Mass., and Washington, DC (2010).
- [3] Monterey WMD Terrorism Database, James Martin Center for Nonproliferation Studies, Monterey Institute for International Studies, Monterey (no date), <http://wmddb.miiis.edu/>.
- [4] REES, J.V., Hostages of Each Other: The Transformation of Nuclear Safety Since Three Mile Island, University of Chicago Press, Chicago (1996).
- [5] BUNN, M., HARRELL, E., Threat Perceptions and Changes in Nuclear Security Around the World: Results of a Survey, Project on Managing the Atom, Harvard University, Cambridge, Mass. (2013).
- [6] BUNN, M., et al., The U.S.-Russia Joint Threat Assessment of Nuclear Terrorism, Belfer Center for Science and International Affairs, Harvard Kennedy School, and Institute for U.S. and Canadian Studies, Cambridge, Mass. (2011).
- [7] BUNN, M., The Threat of Nuclear Terrorism: What's New? What's True? Project on Managing the Atom, Harvard University, Cambridge, Mass. (2012), http://www.nuclearsummit.org/files/nuclear_terror_threat_dossier_2012.pdf.
- [8] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities, INFCIRC/225/Rev.5, IAEA, Vienna (2011).
- [9] BUNN, M., MASLIN, E.P., All Stocks of Weapons-Usable Nuclear Materials Worldwide Must be Protected Against Global Terrorist Threats. *J. Nucl. Mat. Management*, **39** 2 (2011) 21.
- [10] U.S. DEPARTMENT OF ENERGY, OFFICE OF THE INSPECTOR GENERAL, Inquiry Into the Security Breach at the National Nuclear Security Administration's Y-12 National Security Complex, DOE, Washinton (2012).
- [11] WORLD INSTITUTE FOR NUCLEAR SECURITY, Nuclear Security Culture: A WINS Best Practice Guide for Your Organization, WINS, Vienna (2009).
- [12] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Security Culture: Implementing Guide, Nuclear Security Series No. 7, IAEA, Vienna (2008).
- [13] BUNN, M., "Incentives for Nuclear Security," 46th Annual Meeting of the Institute for Nuclear Materials Management (Proc. Conf. Phoenix, Ariz., 2005), INMM, Northbrook, Ill (2005).
- [14] BUKHARIN, O., BUNN, M., LUONGO, K.N., Renewing the Partnership: Recommendations for Accelerated Action to Secure Nuclear Material in the Former Soviet Union, Russian American Nuclear Security Advisory Council, Washington, D.C (2000).
- [15] BUNN, M., HARRELL, E. Consolidation: Thwarting Nuclear Theft, Project on Managing the Atom, Harvard University, Cambridge, Mass. (2012).
- [16] Responsibility Beyond Rules: Leadership for a Secure Nuclear Future, Nuclear Security Governance Experts Group, Washington (2013).