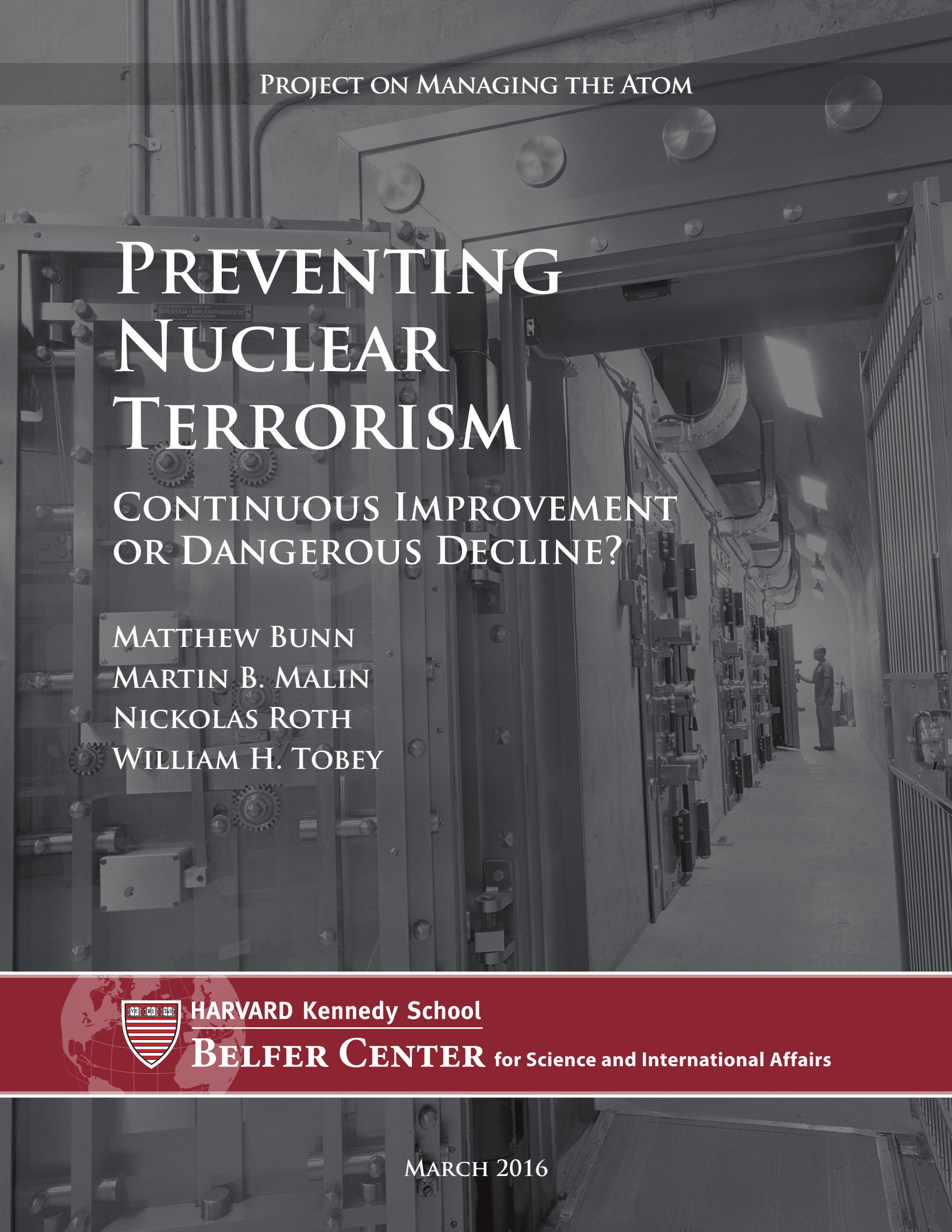

Project on Managing the Atom

Preventing Nuclear Terrorism

Continuous Improvement or Dangerous Decline?

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Project on Managing the Atom
Report

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The "Tunnel Vault" nuclear materials storage facility at Technical Area 41, Los Alamos National Laboratory, as seen in October, 1964. (Los Alamos Archive).

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nical, safety, and legal issues that need to be addressed before the WIPP alternative could be implemented.[149] Russia has completed its MOX plant and brought the BN-800 online, but the fate of the U.S.-Russian plutonium disposition agreement and whether the BN-800 will run on former weapons plutonium or reactor plutonium remain uncertain.[150]

Strengthening Security Culture and Combating Complacency

As discussed below, strong security cultures, in which all security-relevant staff take the issue seriously and are always looking for vulnerabilities to be fixed and ways to make improvements—are essential to nuclear security excellence. The foundation of a strong security culture is belief in the threat—never "forgetting to be afraid."[151]

Initiatives such as the nuclear security summits and GICNT have done a great deal to build international consensus that the threat of nuclear terrorism is real, and that nuclear security is a critical element of efforts to address the threat. Nevertheless, in many quarters, complacency remains.

Progress in combating complacency and strengthening security culture is extraordinarily hard to assess. But that is no excuse for not focusing on the issue, given its crucial importance to nuclear security success. Indicators that could be used to assess progress in these areas include:

- The fraction of the world's locations with nuclear weapons, separated plutonium, or HEU that are managed by organizations with targeted programs in place to strengthen their security culture, and assess their progress in doing so.
- The degree of improvement such programs are achieving in attitudes and behavior of staff, as measured in surveys and self-assessments.
- The degree to which national policymakers involved in nuclear security decisions express belief in the threat and the need for action to improve nuclear security—and the degree to which they back that up by allocating resources and approving stringent nuclear security requirements.

149 Oak Ridge National Laboratory, *Final Report of the Plutonium Disposition Red Team* (Oak Ridge, TN: Oak Ridge National Laboratory, August 13, 2015), http://www.ucsusa.org/sites/default/files/attach/2015/08/final-pu-disposition-red-team-report.pdf (accessed March 6, 2016).

150 "Russia Launches Commercial MOX Fuel Fabrication Facility," *International Panel on Fissile Materials,* September 28, 2015, http://fissilematerials.org/blog/2015/09/russia_launches_commercia.html (accessed January 16, 2016).

151 James Reason, *Managing the Risks of Organizational Accidents* (Aldershot, U.K.: Ashgate, 1997), p. 195.

International nuclear terrorism exercises can provide officials with a visceral sense of the dangers of nuclear terrorism and magnitude of the stakes involved. Many such exercises have already been conducted. Most prominently, perhaps, the 2014 nuclear security summit included the leaders participating in a "scenario-based discussion"—in essence, a simulation of a nuclear terrorism event—and a similar activity is planned for the 2016 summit.[152] In January 2016, the DOE and the government of the Netherlands co-hosted a minister-level nuclear terrorism exercise known as Apex Gold, working through how each of the participating countries and organizations might be able to contribute in an unfolding nuclear terrorism emergency.[153] The Nuclear Threat Initiative has sponsored an exercise in Russia featuring former senior U.S. and Russian officials, and a similar event in China (both of which led the participants to recommend that currently serving officials take part in similar joint exercises), and Harvard has sponsored smaller-scale exercises in its executive program for U.S. and Russian generals.[154] In addition, a series of exercises focused on particular pieces of the problem have been conducted as part of the GICNT, and others have occurred in U.S. cooperation with particular countries.

Officials and nuclear managers in many countries, however, still tend to dismiss the threat of nuclear terrorism. Many have little awareness of the specifics of past terrorist nuclear ambitions and activities or of real incidents of nuclear theft and sabotage. That tendency is likely to grow as time goes by since the last nuclear security summit and the most recent major revelations about terrorist nuclear activity expand. Focused efforts are needed to address complacency and build international understanding of the threat.

A number of programs around the world have been targeted on strengthening nuclear security culture in recent years. The nuclear security summit process strongly endorsed the concept, with the 2014 summit communiqué calling on all operators to take steps to establish effective nuclear security culture.[155] The U.S. government sponsored an extensive nuclear security culture program in Russia, which, as noted earlier, contributed to Rosatom requiring each of its major facilities to have a security culture improvement program

152 Laura S. Holgate, "Preparing the Leaders' Path to the 2016 Nuclear Security Summit," *White House Blog,* August 5, 2015, https://www.whitehouse.gov/blog/2015/08/05/preparing-leaders-path-2016-nuclear-security-summit (accessed February 11, 2016).

153 "Apex Gold Discussion Fosters International Cooperation in Run-Up to 2016 Nuclear Security Summit" (Washington, D.C.: National Nuclear Security Administration, February 1, 2016), http://nnsa.energy.gov/blog/apex-gold-discussion-fosters-international-cooperation-run-2016-nuclear-security-summit (accessed March 6, 2016).

154 See *Black Dawn: A Scenario Based Exercise* (Washington, D.C.: Nuclear Threat Initiative and Center for Strategic and International Studies, May 3, 2004), http://csis.org/files/media/csis/pubs/040503_blackdawn.pdf (accessed February 19, 2016).

155 "The Hague Nuclear Security Summit Communiqué," U.S. Department of State, March 25, 2014, http://www.state.gov/documents/organization/237002.pdf (accessed February 10, 2016).

5. Formidable Obstacles to Nuclear Security Progress

In 2009, when President Obama declared the goal of securing all vulnerable weapons-usable nuclear material worldwide in four years, the objective appeared achievable. The essential ingredients of nuclear weapons existed in only a few dozen countries, at only a few hundred sites. The cost of providing effective security or eliminating material from sites where it was no longer needed was very small by comparison to what countries routinely pay to strengthen their military security. Yet, although the world has made major progress since the 1990s in reducing the danger of nuclear theft, it remains a long way from the goal of having effective, continuously improving security for all nuclear weapons and weapons-usable nuclear material. What makes continued progress on strengthening security for nuclear weapons, materials, and facilities so difficult?

A large part of the reason for the recent slowing of progress described in this report is that the low-hanging fruit is already plucked: the readily achievable actions have already been taken. Making further gains in nuclear security will require overcoming cognitive biases that help to foster a sense of complacency, formidable political disputes, organizational weaknesses, and technical problems and costs. Secrecy poses an additional barrier, and bolsters each of the other obstacles. To make further progress, governments will need to fashion policies that help to break down each of these barriers.

Complacency and Other Psychological Barriers

Complacency is the enemy of action. Unless policymakers believe that nuclear terrorism is a real and serious threat to their own countries' security, and that improvements in the aspects of nuclear security they control can significantly reduce the risk, they are unlikely to take the actions needed to address the threat. Although the era of nuclear security summits has helped to elevate concern about nuclear terrorism to the highest level of attention in capitals around the world, complacency about the threat of nuclear terrorism continues to impede progress. The attitude that current measures are sufficient and no action is needed to sustain or strengthen nuclear security is common at every level of decision-making on nuclear security in countries around the world, including, to some extent, in the United States. This complacency takes many forms and is often expressed in the following beliefs.

- *Terrorists could never pull off building a nuclear bomb.* Many policymakers continue to believe, as Anatoliy Kotelnikov, then in charge of security for Russia's nuclear complex, put it in 2002, that it would be "absolutely impossible" for terrorists to make a nuclear bomb even if they got the needed nuclear material.[178]

- *Terrorists could never get their hands on our stuff.* Others believe that existing nuclear security measures are adequate and that there is little chance of terrorists getting enough weapons-usable nuclear material to construct a bomb. Or they believe that while there may be vulnerabilities elsewhere, the security measures in their country or facility are more than sufficient. For example, at the first nuclear security summit, Russia emphasized that none of its material fell into the category of "vulnerable" weapons-usable nuclear material, so the issue was really about other countries.[179] Security managers at many nuclear facilities will argue that their existing security measures are sufficient by pointing out that there have been no thefts or attacks in decades of operation—ignoring the reality that the threats are evolving, and that a single theft could lead to disaster.

- *Nuclear terrorism is not our problem.* In many countries, policymakers and nuclear managers believe that even if terrorists could manage to steal weapons-usable material and construct an improvised nuclear device, its use would take place half a world away—in the United States, or perhaps Russia—and would have little effect on life in their country. The reality, by contrast (as described in the threat section of this report), is that an act of nuclear terrorism anywhere would have reverberating economic and political effects around the world, posing substantial risks to countries far from the city attacked.

Cognitive and organizational biases inevitably contribute to these complacent attitudes. Like everyone else, nuclear guards, security managers, regulators, and policymakers are subject to such biases.[180] Because the probability of nuclear theft or successful sabotage in most nuclear facilities is small—indeed, most people who work to secure nuclear materials and facilities will go through an entire career without witnessing a single serious security incident—it is easy for both guards and managers to convince themselves that

178 Aleksandr Khinshteyn, "Secret Materials," trans. BBC Monitoring Service, "Russian Central TV," November 29, 2002.

179 Office of the Russian President, "Statement of the Russian Federation on Nuclear Security," April 13, 2010, http://news.kremlin.ru/ref_notes/520 (accessed July 6, 2015).

180 For a discussion of some of the biases of government decision-making, see Bryan D. Jones and Frank R. Baumgartner, *The Politics of Attention: How Government Prioritizes Problems* (Chicago: University of Chicago Press, 2005). For a summary of some of the findings of behavioral economics concerning broader biases in human judgment, see Daniel Kahneman, *Thinking, Fast and Slow* (New York: Farrar, Straus, and Giroux, 2011). For a discussion of how these biases affect nuclear security, see Matthew Bunn, *Guardians at the Gates of Hell* (forthcoming, MIT Press).

the risk is completely negligible. Several well-known cognitive limitations are hard-wired into human decision making, which makes sustaining and strengthening nuclear security an uphill and counterintuitive battle. Key biases include status quo bias (the tendency of people and organizations to continue with past decisions and arrangements until evidence that change is needed becomes overwhelming); the availability heuristic (the tendency to discount the chance of something happening that has not happened in recent memory or cannot be called readily to mind); optimism bias (the tendency to believe that your risk of suffering a negative event is much less than it actually is); affect bias (the tendency to think that a person or institution liked for one reason has other positive characteristics as well, such as assuming that a facility providing one's job is also safe and secure); confirmation bias (the tendency to seek out and give weight to evidence confirming preexisting beliefs, while ignoring or discounting evidence that would challenge them); and conformity desire (the tendency to believe what others around you believe).

Because of these factors, security anomalies at nuclear facilities are easily discounted when they happen. If a guard expects that all alarms will be false alarms, his or her first instinct when confronted with one is to confirm the expectation. This appears to be what guards did at the Y-12 facility in July 2012, when an 82 year-old nun and two other protesters breached four fences (three of which were equipped with intrusion detectors) and made straight for the building where thousands of bombs' worth of HEU was stored, ultimately spending a substantial period pounding on the wall of the building with sledgehammers, pouring blood on it, and singing protest songs, before finally being accosted by a single guard.

The government's analysis of the incident pointed out a series of problems across the organization.[181] But some of the problems appear to have involved cognitive errors. In part because the new intrusion detection system was causing frequent false alarms, the guards appear to have assumed that the alarms the protesters set off were also false. When heavily armed guards inside the building heard the sounds of the protesters hammering, they assumed it must be a work crew, even though it was before dawn and they had not been told of any scheduled construction—and they did not bother to check. These responses appear to have been driven by complacency and confirmation bias—the guards interpreted what they saw and heard as consistent with what they expected to see and hear.

In addition to these cognitive failures, workers in a security organization may in fact be motivated to "look the other way" rather than report security vulnerabilities or violations.

181 For a detailed account of the incident, see Office of the Inspector General U.S. Department of Energy, "Inquiry Into the Security Breach at the National Nuclear Security Administration's Y-12 National Security Complex," DOE/IG-0868 (Washington, D.C., DOE, August 2012), http://energy.gov/sites/prod/files/IG-0868_0.pdf (accessed January 29, 2016).

- Conducting joint exercises to strengthen coordinated response in the event of a nuclear terrorism or nuclear smuggling event.
- Expanding cooperation against the IS and other terrorists who may combine the capabilities and intent to pose a nuclear threat in the future.[208]

Recommendations for the Next U.S. President

The next U.S. president should:

- Seek to revitalize nuclear security cooperation programs and adapt them to focus on convincing countries to take the actions needed to achieve nuclear security excellence, and helping them to do so.
- Work with Russia to rebuild and reform U.S.-Russian nuclear security cooperation, including being willing to restart U.S.-Russian nuclear energy cooperation as part of a larger nuclear cooperation package that includes nuclear security.

3. Expand Efforts to Strengthen Security Culture and Combat Complacency

To combat the complacency that undermines effective nuclear security, two interrelated sets of actions are needed: steps to strengthen nuclear security culture, and steps to broaden international understanding of the evolving threat and the remaining vulnerabilities that need to be addressed.

A New Nuclear Security Culture Initiative

Most nuclear organizations do not have any focused program to strengthen their nuclear security culture. They should. Countries interested in strengthening nuclear security should join together and commit to working with their operating organizations to take a series of steps to strengthen security culture.

208 For an existing set of recommendations for unilateral, bilateral, and multilateral work from a set of U.S. and Russian experts, see Matthew Bunn Matthew Bunn, Valentin Kuznetsov, Martin B. Malin, Yuri Morozov, Simon Saradzhyan, William H. Tobey, Viktor I. Yesin, and Pavel S. Zolotarev, *Steps to Prevent Nuclear Terrorism: Recommendations Based on the U.S.-Russia Joint Threat Assessment* (Cambridge, MA: Belfer Center for Science and International Affairs, Harvard Kennedy School, and Institute for U.S. and Canadian Studies, September, 2013), http://belfercenter.hks.harvard.edu/files/JTA eng web2.pdf (accessed January 18, 2016), pp. 19–22.

This would begin with the participating countries agreeing on the goal of excellence in nuclear security, with approaches based on the principle of continuous improvement, and on the importance of strong security culture to achieving that objective. Specific steps in such an initiative might include committing to:

- Ensure that all organizations managing high-consequence nuclear materials or facilities have programs in place to (a) assess their security culture, and (b) continuously strengthen it;
- Ensure that these organizations implement security culture recommendations of the IAEA and WINS;
- Ensure that all security-relevant managers and staff at such organizations receive regularly updated information on nuclear security threats, at levels of detail appropriate to their particular roles;
- Ensure that all such organizations establish programs of incentives for strong nuclear security performance (for individuals, teams, and organizations, as appropriate);
- Develop mechanisms for sharing good practices in strengthening security culture among nuclear organizations, and ensure that as many organizations as practical participate in these (including, as appropriate, through the IAEA and WINS); and
- Establish a joint working group charged with discussing progress and lessons learned, and developing additional suggestions for action.

Such an initiative could be one part of the broader nuclear security principles initiative suggested above, or it could be developed independently.[209]

209 For another account of the importance of security culture initiatives and potential actions leaders might take, see Igor Khripunov, "A Culture of Nuclear Security: Focus for the Next Nuclear Security Summit?" *Bulletin of the Atomic Scientists*, June 26, 2015, http://thebulletin.org/culture-security-focus-next-nuclear-security-summit8428 (accessed March 17, 2016).

Protecting Against Nuclear Sabotage

The disaster at the Fukushima Daiichi nuclear power plant in 2011 vividly demonstrated the terror, disruption, and costs that could be caused by a major nuclear accident—which could be caused by purely accidental events or by sabotage.[i] The sabotage of the Doel-4 reactor described in this report is only one of a number of sabotage events over the years, ranging from an insider bringing explosives into a plant and detonating them directly on the reactor's steel pressure vessel to terrorists overwhelming a plant's guards and seizing control of the facility before off-site response forces arrived.[ii] While none of these events released radiation, the danger of a major nuclear sabotage—a "security Fukushima"—is very real.

Preventing and responding to sabotage requires both deterring and delaying adversaries and providing effective safety and emergency response measures for coping with any emergency, whether caused by accident or terrorism. Steps such as ensuring that electric power to nuclear plants can quickly be restored and water can be provided to keep reactor cores and spent fuel stores adequately cooled can help reduce the chance of radioactive releases in any emergency, and steps such as filtered events can reduce the scale of radioactive releases if an emergency nevertheless occurs.[iii] For similar reasons, it would be more difficult for terrorists to cause a major radioactive release by sabotaging a new-generation reactor that relies more on passive systems to achieve safety, such as the AP-1000, than an older-design system more dependent on quick action of pumps and electrical systems; it would be still more difficult to cause a major radioactive release from an even more passive small modular reactor design, with less energy contained in its core to cause overheating.

To date, U.S. nuclear security programs have focused almost exclusively on security for materials that might be picked up and moved to the United States for an attack, rather than on helping countries protect against nuclear sabotage, which was seen as more their problem than a U.S. issue. Similarly, CPPNM did not include sabotage until its 2005 amendment, and the 2011 revision to the IAEA's nuclear security recommendations was the first that included specific recommendations for preventing and coping with sabotage. While the nuclear security summits have not focused in detail on sabotage, the 2012 communiqué noted the importance of the

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i For a discussion of both safety and security lessons from Fukushima, see Matthew Bunn and Olli Heinonen, "Preventing the Next Fukushima," *Science*, Vol. 333 (September 16, 2011), pp. 1580–1581.

ii The first of these incidents occurred at the Koeberg plant in 1982. For a useful summary, see Noah Gale Pope and Christopher Hobbs, *Insider Threat Case Studies at Radiological and Nuclear Facilities* (London: King's College and Los Alamos National Laboratory, April 13, 2015), http://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-15-22642 (accessed February 29, 2016).The second incident mentioned occurred at the Atucha Atomic Power Station in Argentina in 1973. For a brief account of that incident (and many others) see Konrad Kellen, "Appendix: Nuclear-Related Terrorist Activities by Political Terrorists," in Paul Leventhal and Yonah Alexander, *Preventing Nuclear Terrorism* (Lexington, MA: Lexington Books, 1987), pp. x–xv. In both of these cases, the reactors were under construction and not yet loaded with fuel, so radioactive releases were not possibilities.

iii International Atomic Energy Agency, *Engineering Safety Aspects of the Protection of Nuclear Power Plants against Sabotage* (Vienna: IAEA, 2007), http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1271_web.pdf (accessed March 6, 2016).

safety-security link, and the 2014 communiqué included preventing sabotage as one of the fundamental nuclear security responsibilities of all states. A strong argument can be made that U.S. nuclear security programs should also begin including an expanded focus on sabotage: while it would not be in any way comparable to a nuclear detonation in a U.S. city, a foreign nuclear reactor sabotage could devastate the countries concerned and the global nuclear industry, seriously undermining any hope of expanding nuclear energy enough to play an important role in mitigating climate change.

There is clearly more to be done in many countries to provide adequate protection against sabotage.[iv] The protections that were in place in Belgium in 2014 were clearly inadequate to prevent a major sabotage—and Belgium (which has since upgraded security to prevent a recurrence) was not alone. Some countries have no armed guards at all at nuclear facilities, relying on offsite response forces some distance away; others have no background checks before allowing employees access to reactor vital areas or nuclear security systems. Experts in many countries unduly downplay the risk: in a recent survey of experts from 18 countries with HEU or plutonium on their soil, most respondents did not consider insider sabotage as a really credible threat, and some similarly downplayed the credibility of outsider sabotage.[v] Most individual country statements at the nuclear security summits do not mention the threat of sabotage or measures taken to address it.[vi]

States should take action to address these vulnerabilities. At a minimum, all nuclear power plants and other nuclear facilities whose sabotage could cause a major catastrophe should be protected against sabotage by a well-placed insider; a modest group of well-armed and well-trained outsiders, capable of operating as more than one team; and both an insider and outsiders working together. Plants in countries facing especially capable terrorist or criminal threats should be defended against even more capable adversaries. And all nuclear power plants should have fully operable and survivable equipment to provide emergency power and water in the event of a major accident or sabotage.

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iv Major international nuclear security instruments reflect this concern. The 2005 amendment to the physical protection convention, for example, broadens its coverage to include sabotage, and the 2011 revision to the IAEA's physical protection recommendations greatly expands their coverage of protection against sabotage. For a discussion of both safety and security lessons from Fukushima, see Matthew Bunn and Olli Heinonen, "Preventing the Next Fukushima."

v Bunn and Harrell, *Threat Perceptions and Drivers of Change,* p. 23.

vi "The Hague Nuclear Security Summit Communiqué," U.S. Department of State.

Increasing Understanding of the Nuclear Terrorism Threat

In addition to the security culture initiative, it is important to take steps particularly focused on increasing international understanding both of the nuclear terrorism threat and the potential vulnerabilities of existing nuclear security systems that require additional action. Important steps could include:

Agreement to Establish a Shared Database of Analyses of Incidents and Lessons Learned. Sharing of incidents, with root cause analyses and lessons learned, is routine, and extremely important, in strengthening nuclear safety. It is time to undertake a similar approach in nuclear security—within the inevitable constraints of necessary secrecy. The United States should work with other states to establish a shared database of security-related incidents. Each incident should be explored in depth, with analyses of the vulnerabilities that adversaries exploited to defeat security systems, and lessons learned (including security measures that could prevent such incidents from occurring at other sites). This would go well beyond the information available in the IAEA's databases, such as the Incident and Trafficking Database (ITDB); with a focus on how the incidents occurred and lessons learned from each one, it is more useful in understanding both the scope of the threat and the measures needed to address it.[210] Non-nuclear incidents that offer important lessons about the types of tactics against which nuclear materials and facilities must be protected should also be included.[211] 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.[212] The United States should kick things off with a detailed description of both the weaknesses that allowed the 2012 intrusion at the Y-12 nuclear complex to occur and the lessons learned and steps that have been taken to prevent similar occurrences in the

210 Even the ITDB information available to participating states offers little assessment of the causes of incidents or lessons learned. The information available to the public is little more than total numbers of incidents of particular kinds. See "IAEA Incident and Trafficking Database: Incidents of nuclear and other radioactive material out of regulatory control 2015 Fact Sheet," *International Atomic Energy Agency*, 2015, http://www-ns.iaea.org/downloads/security/itdb-fact-sheet.pdf (accessed February 19, 2016).

211 For three recent examples of such international incident assessments, seeking to draw lessons learned, see Jarret M. Lafleur, Liston K. Purvis, and Alex W. Roesler, *The Perfect Heist: Recipes From Around the World*, Vol. SAND-2014-1790 (Albuquerque, N.M.: Sandia National Laboratories, April 2014); Bunn and Sagan, *A Worst Practices Guide to Insider Threats: Lessons from Past Mistakes* and Pope and Hobbs, *Insider Threat Case Studies*. In the past, the U.S. government sponsored a nuclear security incidents database maintained by the RAND Corporation, but that effort is no longer being pursued. For examples of the kind of information that was included in the RAND database, see Kellen, "Appendix: Nuclear-Related Terrorist Activities by Political Terrorists."

212 Bunn and Harrell, *Threat Perceptions and Drivers of Change,* pp. 27–28.

future.[213] Participating 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.

Providing Briefings and Reports on the Threat. States that believe they have information on the nuclear terrorist threat should prepare reports and briefings and distribute them to other states. The United States, in particular, should prepare a detailed report on how easy or difficult it would be for a sophisticated terrorist group to make a crude nuclear bomb; past efforts by al Qaeda and other terrorist groups to get nuclear bombs and assessments of plausible future efforts by the IS and others; the potential for terrorists to be able to get plutonium or HEU from nuclear thieves and smugglers; and other elements of the nuclear terrorist threat. Different versions should be prepared for public distribution and for confidential exchange among states, including information that can be shared with non-nuclear-weapon states and more detailed information that could be shared with nuclear weapon states.[214]

Undertaking Discussions Among Intelligence Agencies. National governments get much of their information about the threats they face from their intelligence agencies. It would make sense, therefore, to work to ensure that relevant intelligence agencies are fully informed about nuclear terrorism threats. During the Bush administration, for example, Rolf Mowatt-Larssen, then head of the DOE Office of Intelligence and Counterintelligence, traveled to several capitals for in-depth discussions of the nuclear terrorism threat with intelligence counterparts. In some cases, these discussions appeared to provoke internal discussions between intelligence agencies and nuclear weapons design labs about the ease or difficulty of making a crude nuclear bomb, leading to intelligence agencies having a fuller appreciation of the topic.[215] In addition, in the years right after the 9/11 attacks, when U.S. intelligence encountered particularly alarming information about what were thought to be ongoing terrorist nuclear plots, it shared complete information with every government it thought likely to be able to help—even Iran.[216] The United States and other interested countries should launch a series of discussions among intelligence agencies to

213 While the United States has published several separate documents related to this incident, it has not make public any comprehensive account either of the root causes that led to the incident or the lessons the United States has learned about avoiding such incidents in the future.

214 For the briefing provided to the Sherpas for the 2014 Nuclear Security Summit, see William H. Tobey and Pavel S. Zolotarev, "The Nuclear Terrorism Threat," (paper presented at Meeting of the 2014 Nuclear Security Summit Sherpas, hosted by the Thai Ministry of Foreign Affairs Pattaya, Thailand 2014), http://belfercenter.ksg.harvard.edu/publication/23879 (accessed January 12, 2016).

215 Personal communication with Rolf Mowatt-Larssen, January 2016.

216 Mowatt-Larssen, *Al Qaeda WMD Threat*, p. 26.

explore assessments of the nuclear terrorist threat, remaining uncertainties, and priorities for reducing the uncertainties. Such discussions could also lead to expanded intelligence cooperation to deal with nuclear smuggling and nuclear terrorist activities.

Expanding the Use of Realistic Nuclear Security Tests, Including Force-on-Force Exercises. In the U.S. case, embarrassing failures in nuclear security inspections or tests—often followed by Congressional investigations—have driven action to strengthen nuclear security. Nothing is quite so convincing in countering the complacent view that a site's security measures are impregnable as a test in which mock adversaries manage to defeat them. The United States and other interested countries should work to convince as many of the countries with HEU or separated plutonium as possible to carry out regular, realistic tests of both their protection against insider thieves and their protection against outsiders trying to break in. Such exercises should be included in the commitment to stringent nuclear security principles suggested above, and should be a focus of nuclear security technical cooperation programs (which should include allowing experts from other countries to observe such exercises where appropriate). The fifth revision of the IAEA's nuclear security recommendations include a recommendation for force-on-force exercises; the IAEA should develop guidance and advisory services for states on how to conduct such tests, as well as realistic tests of protections against insider threats.

Nuclear Theft and Terrorism Exercises. Participating in a realistic simulation can give officials a "gut" feel for a problem in a way that no amount of reports, memos, and briefings can do. Building on past efforts, the United States and other interested 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. Some exercises might focus on scenarios in which a nuclear theft has occurred and states need to cooperate to find and retrieve the nuclear material. Other scenarios might focus on intelligence that terrorists had nuclear material and were working to build a bomb at an unknown location; responding to a credible terrorist threat to detonate a nuclear bomb; dealing with a situation in which nuclear material or a nuclear bomb is on the road or on the sea and has to be found and intercepted; or coping with the aftermath of a terrorist nuclear detonation. Sabotage and "dirty bomb" scenarios should be the subject of such international exercises as well. These could be organized as part of the GICNT, through bilateral or "minilateral" cooperation among small groups of states, through the IAEA, or through non-government channels such as WINS.

The "Armageddon Test." There is much that is still unknown about the shadowy networks that attempt to smuggle nuclear and radiological materials. Many officials around the world believe terrorists would have little chance of getting nuclear material. An intelligence initiative could shed light on this question. The next U.S. President should direct U.S. intelligence—working in cooperation with agencies in other countries—to establish a small operational team dedicated to understanding and penetrating the world of nuclear theft and smuggling. They would seek to answer the outstanding questions from past cases—where previously confiscated material came from, who stole it and how, what smugglers were involved, whether there were real buyers, how buyers and smugglers connected with one another, and more. They would probe to see who is in the market today. In some cases they might pose as either potential buyers or sellers of nuclear material, although they should do nothing to simulate a demand for material that might make its theft more likely. In other cases, they might offer substantial sums for information leading to the capture of smugglers and the nuclear material in their possession. If they succeeded in making contact with smugglers who had access to weapons-usable material, this would dramatically highlight the continuing threat, and potentially identify particular weak points and smuggling organizations requiring urgent action. If they failed, that would suggest that terrorist operatives would likely fail as well, building confidence that measures to prevent nuclear terrorism are working.[217]

Recommendations for the Next U.S. President

The next U.S. president should:

- Work with other countries to launch an international initiative to strengthen nuclear security culture.
- Work with other countries to establish a shared database of security-related incidents and lessons learned, and to take other steps to build understanding of the threat and key vulnerabilities.

217 William Tobey and Rolf Mowatt-Larssen, "The Armageddon Test: To Prevent Nuclear Terrorism, Follow the Uranium," *Belfer Center for Science and International Affairs,* Harvard University, July 26, 2010, http://live.belfercenter.org/publication/20279/ (accessed January 21, 2016).