Securing Global Nuclear Stockpiles: The First Line of Defense in Preventing Nuclear Terrorism

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The threat of nuclear terrorism is real.[1] Osama bin Laden has called the acquisition of nuclear weapons or other weapons of mass destruction a "religious duty," and al Qaeda operatives have attempted to buy nuclear material and recruit nuclear expertise. Plutonium and highly enriched uranium (HEU), the essential ingredients of nuclear weapons, are beyond the capabilities of terrorists to produce—but with enough of these materials in hand, some particularly well-organized groups could have the potential to make at least a crude nuclear bomb. One study by the now-defunct congressional Office of Technology Assessment summarized the threat: "A small group of people, none of whom have ever had access to the classified literature, could possibly design and build a crude nuclear explosive device... . Only modest machine-shop facilities that could be contracted for without arousing suspicion would be

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required."[2] Indeed, even before the revelations from Afghanistan, U.S. intelligence concluded that "fabrication of at least a 'crude' nuclear device was within al Qaeda's capabilities, if it could obtain fissile material."[3] President Obama has described nuclear terrorism as "the most immediate and extreme threat to global security," and he has pledged to lead "a new international effort to secure all vulnerable nuclear material around the world within four years."[4]

This article surveys the programs that the United States has put in place to secure nuclear weapons and materials in order to prevent groups like al Qaeda from carrying out their nuclear threats, and provides a set of recommendations for expanding, accelerating, and improving these efforts to meet President Obama's ambitious four-year objective. It also offers brief recommendations for strengthening other elements of a multilayered defense against nuclear terrorism.

NUCLEAR SECURITY: TWO CAUTIONARY TALES

Nuclear weapons or their essential ingredients exist in hundreds of buildings in dozens of countries. Security measures for many of these stocks are excellent—but security for others is appalling, in some cases amounting to no more than a night watchman and a chain-link fence. No specific and binding global standards for how these stockpiles should be secured exist. The amounts required for a bomb are small. The Nagasaki bomb included some six kilograms of plutonium, which would fit easily in a soda can. (A similarly powerful HEU bomb would require three times as much material. For a simpler but less efficient gun-type design, roughly 50 kilograms of HEU would be needed—an amount that would fit easily into two two-liter bottles. The world stockpiles of HEU and separated plutonium are enough to make roughly 200,000 nuclear weapons; a tiny fraction of 1 percent of these stockpiles going missing could cause a global catastrophe. Unfortunately, several incidents have already demonstrated how vulnerable some of these stockpiles actually are.

For example, on February 1, 2006, Russian citizen Oleg Khintsagov was arrested in Tbilisi, Georgia (along with three Georgian accomplices) with 79.5 grams of 89 percent enriched HEU.[5] Available evidence suggests that the material may have come from the Novosibirsk Chemical Concentrate Plant in Russia. And in 2003, an Armenian national was caught at the Armenia-Georgia border with 170 grams of HEU—also apparently pilfered from Novosibirsk. In order to transport the sample from Novosibirsk to Tbilisi, the smugglers needed to pass through a Russia-

Georgia border crossing equipped with U.S.-funded radiation-detection sensors, a feat that was accomplished in part with the assistance of the border guards. The smugglers had been shopping around their "sample" for more than a year—and claiming that there were two to three kilograms more available for sale—by the time they were caught in a sting operation by Georgia's Ministry of Internal Affairs.

Less than two years later, on the night of November 8, 2007, two teams of armed men attacked the Pelindaba nuclear facility in South Africa, where hundreds of kilograms of weapon-grade HEU are stored. One of the teams reportedly fired on the site's security forces, who fled. The other team of four armed men went through a 10,000 volt security fence, disabled the intrusion detectors so that no alarms sounded—possibly using insider knowledge of the security system—then broke into the emergency control center, and shot a worker there in the chest after a brief struggle. The worker at the emergency control center raised an alarm for the first time. These intruders spent 45 minutes inside the secured perimeter without ever being engaged by site security forces, and then disappeared through the same point in the fence by which they had entered. No one on either team of intruders has been caught or identified.[6] The security manager resigned and some of the guards on duty that night were subsequently fired. The South African government has not released important details of its investigation of the attack. Moreover, both before and after the attack, South Africa has refused U.S. offers to remove the HEU at Pelindaba or to help improve security at the facility. Indeed, South Africa has delayed for years in establishing and implementing a specific requirement that the site be able to defend against a defined set of potential attacker capabilities, known as a design basis threat (DBT), as recommended by the International Atomic Energy Agency (IAEA). As of the time of the attack, South African security regulations did not yet include a DBT.[7]

Large uncertainties remain with both of these cases. In the former case, did Khintsagov have the two to three kilograms of HEU that he claimed? And, if so, where is that HEU now? In the latter case, there is no publicly available evidence that the Pelindaba attackers were after the HEU but, if not, what were two armed teams doing at a facility that had seemingly little else of value? Both cases raise very troubling questions about both the supply and demand for weapons-usable nuclear material.

These two cases highlight the continuing dangers of nuclear theft in Russia and at research reactors fueled with HEU, such as the one at Pelindaba. Based on the limited data publicly available about the effec-

tiveness of security arrangements for nuclear facilities and transport routes around the world, the kinds of adversary capabilities these security measures must protect against, and the quality and quantity of nuclear materials at different locations, Russian and Pakistani facilities, together with HEU-fueled research reactors, pose the highest risks of nuclear theft.[8]

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Russia still has the world's largest stocks of nuclear weapons and weapons-usable nuclear materials, stored in the world's largest number of buildings and bunkers. The egregious weaknesses of security systems in the 1990s—gaping holes in fences, no detectors to sound the alarm if someone was carrying plutonium out in a briefcase—have, in general, been fixed, but crucial weaknesses remain. And the threats these facilities must protect against—not only possible large-scale terrorist attacks, but also widespread insider corruption and theft—are substantial. In 2008, for example, a colonel from the Ministry of Interior troops that guard Russia's nuclear sites was reportedly arrested for soliciting thousands of dollars in bribes to overlook violations of security rules in the closed nuclear city of Snezhinsk. Earlier, the chief of security at Seversk, a huge plutonium and HEU processing facility, described a stunning array of weaknesses in his site's guard forces, from guards patrolling with no ammunition in their guns to widespread corruption; he described the guards as "the most dangerous internal adversaries."[9]

By contrast, Pakistan has a small nuclear stockpile, in a small number of locations. Pakistan's stockpile is believed to be heavily guarded, but it faces immense threats, from possible attacks by huge numbers of well-armed extremists to insiders with extremist sympathies. At least two Pakistani nuclear weapon scientists sat down with Osama bin Laden to discuss nuclear weapons, and while General Pervez Musharraf was president, active Pakistani military officers in league with al Qaeda were involved with at least two nearly successful attempts to assassinate him. If the people guarding the president cannot be trusted, how much confidence can one have in the people guarding the nuclear weapons?

Finally, there are an estimated 130 research reactors around the world that still use HEU as their fuel, and many of these have only the most minimal security measures in place. (Ironically, the security measures at Pelindaba are much more extensive than those in place for most HEU-fueled research reactors around the world.) Many of these facilities do not have enough material for a bomb at one site, but some do; and the

1998 embassy bombings as well as the 9/11 attacks are painful reminders of terrorists' ability to strike in more than one place at the same time.

The IAEA has documented 18 cases of theft or loss of plutonium or HEU. A key question is: how many other cases may have occurred without being detected? It is sobering to note that nearly all of the stolen HEU and plutonium that has been seized over the years had never been missed when it was originally stolen.

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Making either plutonium or HEU for a bomb is well beyond the plausible capabilities of any known terrorist group. If nuclear weapons and their essential ingredients can be kept out of terrorist hands, nuclear terrorism can be prevented. Theft and transfer to terrorists is by far the most likely pathway by which terrorists would get such material. Hence, by removing nuclear weapons and weapons-usable nuclear materials entirely from as many sites as possible worldwide and ensuring highly effective security for all the remaining locations where these stocks exist, the danger of nuclear terrorism can be reduced to a fraction of its current level.

U.S.-FUNDED EFFORTS TO SECURE NUCLEAR WARHEADS AND MATERIALS

Congress launched the Nunn-Lugar initiative in FY 1992 by authorizing the Department of Defense (DOD) to shift up to US$400 million from other programs to pay for programs to dismantle and control the former Soviet Union's weapons of mass destruction, subject to certain restrictions and certification requirements. Over time, programs pursuing similar goals have been added at the Department of Energy (DOE) and the Department of State (DOS), leading the total cooperative threat reduction budget to climb to roughly $1.4 billion per year.[10] In addition, more than 20 other countries are now contributing to threat reduction programs through the $20 billion Global Partnership Against the Spread of Weapons and Materials of Mass Destruction, the IAEA Office of Nuclear Security, and other efforts—though all funds from other countries, combined, that are specifically targeted on nuclear security improvements are measured in tens of millions of dollars, not hundreds of millions. (The IAEA Office of Nuclear Security, for example, typically spends less than $20 million per

year, and simply does not have the resources to provide assistance for actually implementing nuclear security upgrades.)

The following programs are the principal U.S.-funded efforts specifically focused on securing and consolidating nuclear stockpiles.

Material Protection, Control and Accounting (MPC&A)

Established in 1992 and the recipient of the largest overall share of threat reduction funding, the MPC&A program in DOE's National Nuclear Security Administration (NNSA), which is now formally known as International Material Protection and Cooperation, assists Russia and other states of the former Soviet Union to improve material control and accounting measures and install physical protection upgrades; it assists Russia in developing and maintaining a nationwide MPC&A infrastructure; and it helps Russia consolidate HEU and plutonium into fewer buildings and convert this material to non-weapons-usable forms. The MPC&A program has also been funding classified work to improve security for Pakistan's nuclear stockpile, along with a broad dialogue on security and accounting for nuclear material with civilian agencies in China. The Obama administration has requested $280 million in FY 2010 funding for MPC&A and the program has received a total of $3.25 billion in funding since its inception.[11]

Global Threat Reduction Initiative (GTRI)

Launched in 2004, NNSA's GTRI incorporated and expanded on several pre-existing programs to address threats posed by HEU-fueled research reactors and radiological sources worldwide. The program is divided into three subprograms: conversion of HEU-fueled research reactors to low-enriched uranium (LEU) fuel that cannot be used to make a nuclear bomb; removing HEU from research reactors and other sites that no longer need it (along with removals of radiological materials and, potentially, plutonium); and assistance for improving security for both research reactors and radiological materials.[12] The Obama administration has requested $354 million in FY 2010 funding for GTRI and the program has received a total of $811 million in funding since its inception.

Nuclear Weapons Security

DOD has two efforts focused on improving security for nuclear warheads in Russia: one focused on upgrading security and accounting for

nuclear warheads in storage, and the other focused on ensuring that they are transported securely. Established in 1994, DOD's Nuclear Weapons Storage Security program has helped Russia install comprehensive security upgrades for 24 nuclear warhead sites in Russia, and it is now working to ensure that appropriate training and maintenance infrastructures are put in place to sustain the improved security measures. (NNSA's MPC&A program funded the upgrades at another 73 nuclear warhead sites.) The program has also helped finance an Automated Inventory Control and Management System (AICMS), to provide real-time computerized accounting of which warheads are where, and assistance to strengthen Russia's program to screen and monitor personnel with access to nuclear weapons.

DOD's Nuclear Weapons Transportation Security (NWTS) program has helped Russia buy and maintain specialized railcars and trucks for nuclear weapons shipments, and it is also financing dozens of train shipments every year, taking nuclear weapons to dismantlement sites or secure centralized storage locations.

The Obama administration has requested $15 million for Storage Security and $46 million for NWTS in FY 2010 funding. Storage Security has received a total of $799 million and NWTS has received a total of $273 million in funding since FY 1994.

It is important to note that the United States has never paid for the actual dismantlement of nuclear weapons in Russia. The ongoing HEU Purchase Agreement, under which Russia blends HEU from weapons to LEU and sells the LEU to the United States, gives Russia a financial incentive to dismantle weapons and destroy HEU, and DOD's Nuclear Weapons Transportation Security program helps transport warheads to dismantlement sites, but neither of these involve direct support for the actual dismantlement of nuclear weapons. The HEU Purchase Agreement is implemented commercially, and does not require U.S. government financing (except for the associated transparency measures).

In addition, several other efforts focus on one aspect or another of improving security for nuclear material around the world. Experts in the State Department and the NNSA work with the IAEA to strengthen international recommendations on security for nuclear material and help states implement international agreements such as the amended Convention on the Physical Protection of Nuclear Materials and Facilities and UN Security Council Resolution 1540 (which, among many other provisions, legally requires every country with nuclear weapons or weapons-usable materials to provide "appropriate effective" security and accounting for them). The Nuclear Regulatory Commission (NRC) limits exports of

HEU and plutonium to facilities that have a clear need that cannot be met by other types of nuclear material, and which will provide adequate physical protection for them, and NNSA experts visit countries to ensure that they have adequate physical protection in place, as required by the Atomic Energy Act. Officials from DOE, DOS, and elsewhere work to convince foreign countries to strengthen their regulations and practices for securing and accounting for nuclear materials. (Such discussions contributed to Japan's recent decision to strengthen its nuclear security rules, for example.) The Global Initiative to Combat Nuclear Terrorism, launched in 2006, provides a forum where these issues can be discussed with a wide range of states, though to date it has not focused primarily on improving nuclear material security.

ASSESSING PROGRESS

The aforementioned cooperative programs have drastically reduced the risks posed by some of the world's highest-risk nuclear stockpiles, providing a benefit for U.S. and world security far beyond their cost—and demonstrating what can be done to address these threats. But in many areas, the progress is clearly insufficient to meet President Obama's goal of securing all vulnerable nuclear stockpiles worldwide within four years.

As already noted, the progress in Russia and the former Soviet Union—the original focus of Nunn-Lugar efforts—has been particularly substantial, though major issues remain. Security upgrades for most nuclear warhead sites and nuclear material buildings in Russia were completed by the end of 2008, as part of the work plan agreed upon after the Bush-Putin nuclear security accord at the 2005 Bratislava summit. Security upgrades had been installed for the small number of sites in the non-Russian states of the former Soviet Union years ago, though further upgrades were continuing in Belarus as of the spring of 2009. In Russia, work continues at a few sites where cooperation was agreed to after the initial Bratislava work plan, and there are some nuclear warhead and nuclear material sites that either Russia has refused to open for cooperative work, or for which the United States has declined to provide assistance.

With the agreed upgrades nearing completion, the most important policy questions now focus on more intangible, difficult-to-measure factors: Are sufficient security measures being put in place, given the scope of the outsider and insider threats in Russia? Will effective security be sustained over time, after U.S. assistance phases out? Will security cultures at all of these sites be strong enough to ensure that the equipment will actually be

used in a way that provides effective security, and that guards will not turn off intrusion detectors or prop open security doors? NNSA, DOD, and their Russian counterparts are working to lay out plans for sustaining security measures at each site, and programs to strengthen the security culture, but both remain major challenges.

Outside of the former Soviet Union, many efforts to improve nuclear security are still in their early stages, and significant gaps remain. The United States and other countries have provided assistance to upgrade security for more than three-quarters of the world's HEU-fueled research reactors whose physical protection did not match IAEA recommendations, but only a small fraction of these have been upgraded to levels designed to defeat demonstrated terrorist and criminal threats. U.S. nuclear security cooperation with Pakistan is underway, but what precisely has been accomplished remains a secret, and grave concerns remain given the immense scale of the insider and outsider threats that exist there. In China, one civilian site with HEU has had extensive security and accounting upgrades, and a broad dialogue is underway regarding a range of further measures, but it remains unclear how much of an effect this dialogue has had on improving security for other Chinese facilities, and cooperation on China's military stockpiles remains stymied. Nuclear security cooperation was not included in the U.S.-India nuclear deal, and India has so far refused any cooperation in this area. Both sustainability and security culture are likely to be serious issues for nuclear security improvements worldwide (as they are in the United States).

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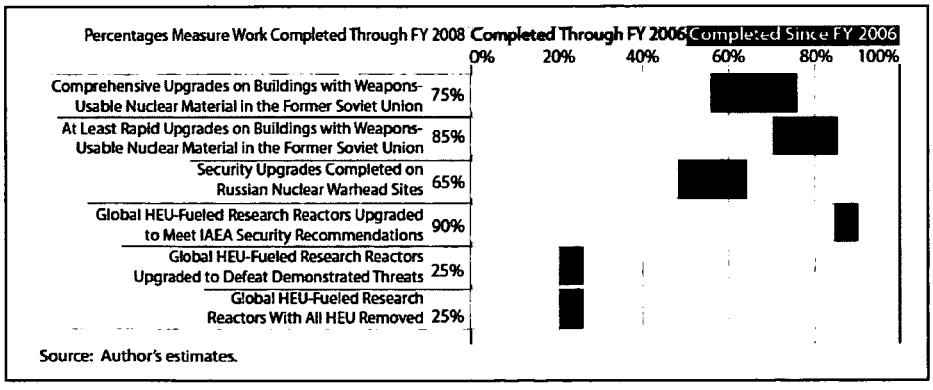
The U.S.-led GTRI has succeeded in accelerating efforts to remove nuclear material from potentially vulnerable sites and to convert research reactors to use low-enriched uranium (LEU) that cannot be used in a bomb as their fuel. GTRI now helps to both convert five to six reactors per year to LEU and to move hundreds of kilograms of HEU each year to secure locations. Moreover, GTRI has expanded the list of reactors it hopes to convert—but a faster and much more comprehensive effort is still needed. Only a small fraction of the HEU-fueled research reactor sites around the world have yet had all their HEU removed. Tons of civilian HEU in many countries are not yet targeted for any removal effort. Even with its expanded scope, the conversion effort will leave roughly 40 percent of the

world's currently operating HEU-fueled reactors uncovered, and as yet there is no parallel effort to convince authorities to shut down unneeded research reactors.

At the same time, there is no global standard for how secure nuclear weapons or the materials needed to make them should be, which would provide a target for President Obama's four-year campaign. There is a convention on physical protection of nuclear materials, but it sets no specific requirements for nuclear security; it requires each party to have a rule specifying how secure nuclear materials should be, but it says nothing about what that rule should say. The IAEA's physical protection recommendations are somewhat more specific, but still quite vague: for a large stock of HEU like the one at Pelindaba, for example, those recommendations call for having a fence with intrusion detectors but say nothing about how difficult to penetrate the fence should be or how difficult to bypass the detectors should be. Fundamentally, none of these documents say anything about the kinds of insider and outsider threats against which nuclear weapons and their essential ingredients should be protected.

Figure 1 provides a summary of several key indicators of the progress of U.S.-funded programs to improve nuclear security, as of the end of FY 2008.[13] As can be seen, the indicators focused on Russia and the former Soviet Union are nearing completion (and have gotten still closer to completion since that time), but only a small fraction of the work covered by the global measures has been completed. Clearly, there is a great deal yet to do if President Obama's four-year objective is to be achieved.

Figure 1: Progress of U.S.-Funded Programs to Secure Nuclear Stockpiles: Percentages of Work Completed through FY 2008. Source: **Bunn, Securing the Bomb 2008, *p.xi.***



EIGHT RECOMMENDATIONS FOR ACCELARATING NUCLEAR SECURITY

Meeting President Obama's four-year goal for securing all vulnerable nuclear material worldwide will not be easy. Overcoming the obstacles posed by complacency about the threat, the secrecy surrounding nuclear stockpiles and their security measures, concerns about national sovereignty and pride, political disputes, and bureaucratic procedures will require sustained leadership from the highest levels, a comprehensive but readily adaptable plan, an effective organizational structure to manage the effort, and adequate resources. President Obama should direct his administration to take eight steps immediately:

First, President Obama and other world leaders should forge a global campaign to lock down every nuclear weapon and every significant stockpile of potential nuclear bomb material worldwide, as rapidly as can possibly be done. It is essential that this effort include *all* the stockpiles that might pose a risk, whether they are military or civilian, and no matter where they are located; the world cannot afford to let stovepipes between programs leave some vulnerable stocks without security upgrades. President Obama should make absolutely clear to countries around the world that this is a U.S. priority and that providing effective security for any nuclear stockpiles they may have is essential to good relations with the United States—just as they have long understood that compliance with arms control and nonproliferation obligations is essential. At the same time, and in order to succeed, such an effort must be based not only on donor-recipient relationships but on real partnerships that integrate ideas and resources from countries where upgrades are taking place in ways that also serve their national interests. The Global Initiative to Combat Nuclear Terrorism provides a useful platform, but must take a modified approach focused on securing all nuclear weapons, plutonium, and HEU to high standards. Much of this global effort can be seen simply as the implementation of UN Security Council Resolution 1540, which legally requires all states to provide "appropriate effective" security and accounting for any nuclear weapons or weapons-usable material they possess. The World Institute of Nuclear Security (WINS) can also play an important role,

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providing an international forum for operators to share and promote the implementation of best security practices.

Second, the Obama administration should take a broader approach to working with other countries to reduce drastically the number of sites where nuclear weapons and their component materials exist, thereby achieving higher security at lower cost. The vast majority of the world's nuclear sites have nothing to do with dispersing nuclear stockpiles to strengthen their survivability and sustain deterrence. The goal should be to remove all nuclear material from the world's most vulnerable sites and to ensure effective security wherever material must remain within four years or less—and to eliminate HEU from all civilian sites worldwide within roughly a decade. The United States should offer new incentives to convince countries and facilities to send back or otherwise eliminate much of the more than 13 tons of U.S.-origin HEU not covered in current GTRI removal plans. The Obama administration, working with other countries and organizations, should establish a new program to provide incentives to shut down unneeded reactors, an approach that may be cheaper and quicker than conversion to LEU, especially for difficult-to-convert reactors. Finally, the United States should launch new efforts to limit the production, use, and stockpiling of weapons-usable separated civilian plutonium—including renewing the nearly completed late-1990s effort to negotiate a 20-year U.S.-Russian moratorium on plutonium separation.

Third, as nuclear security is only as strong as its weakest link, the world urgently needs effective global nuclear security standards. All nuclear weapons and weapons-usable materials should be protected against the kinds of threats terrorists and criminals have shown they can pose—at a bare minimum, against two small teams of well-trained, well-armed attackers, possibly with inside help, as occurred at Pelindaba. One promising approach to forging such global standards is to work with other leading states to develop a common interpretation of the essential elements that must be in place for a nuclear security and accounting system to meet the "appropriate effective" requirement that already exists under UN Security Council Resolution 1540.

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Fourth, President Obama should seek top-level commitments from Russia and other countries to sustain effective nuclear security for the long haul with their own resources. He should also intensify programs to work with countries around the world to build strong security cultures, putting

an end to lax policies that permit staff to prop open security doors for convenience or guards to patrol with no ammunition in their guns.

Fifth, the Obama administration should ensure that it has in place the organizational structure needed to manage and lead efforts to meet the President's four-year objective. President Obama has appointed Gary Samore as the coordinator for nuclear, chemical, and biological nonproliferation, arms control, and counterterrorism: with that sprawling portfolio, Laura Holgate has been appointed to take full-time responsibility for preventing nuclear and biological terrorism. She and Samore must be responsible for conceiving, articulating, and coordinating a comprehensive, prioritized, government-wide strategy to reduce the risk of nuclear terrorism, linking that prioritized strategy to programs and resources, defining agency roles in executing or supporting that strategy, holding agencies accountable for delivering outcomes that achieve the strategy—and keeping this issue on the front burner at the White House every day. A key focus should be to find and fix internal and external obstacles to accelerated and expanded progress. President Obama must also act to ensure that each of the key agencies participating in this effort has the proper organization and leadership needed to succeed. In particular, NNSA is implementing the most crucial efforts to secure nuclear materials around the world; if nuclear terrorism is indeed the most urgent threat to global security, NNSA must be seen as a central national security agency, at the same table with DOS and DOD. Once he has put in place an effective structure for domestic initiatives, President Obama should seek to convince Russia and other key countries to do the same.

Sixth, the President and Congress should act to ensure that lack of money does not slow down or constrain efforts to keep nuclear weapons and the materials needed to make them out of terrorist hands. In particular, as the Obama administration pushes to overcome the obstacles to progress, new opportunities are likely to arise and difficult-to-plan incentives are sometimes required to convince facilities to give up their HEU or convert a research reactor. Hence, Congress should provide an appropriation in the range of $500 million, to be available until expended, that can be spent flexibly on high-priority actions to reduce the risk of nuclear theft as they arise. In addition, funding increases for specific programs would enable current efforts to be accelerated and expanded:

- The Obama administration has requested $280 million for MPC&A in FY 2010 and envisions a steady funding decline through 2014. But because a four-year plan had not been completed when these budgets were prepared, the budgets do not include any funding for

implementing the expanded and accelerated global effort needed to achieve the President's objective. Congress and the White House must act together to provide the additional funds certain to be required.

- GTRI, focused on global threats rather than primarily zeroing in on threats in the former Soviet Union, is still expanding. The Obama administration has requested $354 million for FY 2010, and envisions increases to over $1 billion per year by 2014 (beyond President Obama's four-year deadline). If the four-year objective is to be met, a substantial portion of this planned funding beyond FY 2010 must be moved forward and made available immediately. Opportunities that require additional funding include: accelerating the conversion of HEU-fueled research reactors to proliferation-resistant LEU with LEU fuels already available; building a fabrication plant for the higher-density LEU fuels now in development in order to convert additional reactors; accelerating the pace of removing nuclear material from vulnerable sites around the world, including U.S.-origin HEU in many developed countries; providing targeted incentives to convince countries and operators to convert or shut down HEU-fueled research reactors and allow their HEU to be removed. More generally, achieving President Obama's objective will require a consolidation effort that includes a broader set of materials, of facilities, of incentives, and of policy approaches, all of which will cost money.

Seventh, the United States should put its own house in order. While the most urgent security vulnerabilities are largely in other countries, there is more to do to secure U.S. stockpiles as well, and convincing foreign countries to reduce and consolidate their nuclear stockpiles, to put stringent nuclear security measures in place, or to convert their research reactors from HEU to LEU fuel will be far more difficult if the United States is not doing the same at home. Congress should provide funding for DOE to help HEU-fueled research reactors, or research reactors that pose serious sabotage risks, to upgrade security voluntarily. At the same time, Congress should direct the NRC to phase out the exemption from most security rules for HEU that research reactors now enjoy, and provide funding for DOE to help these reactors pay for the costs of effective security. Congress should also insist that NRC bring its

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rules for protecting HEU into line with recent studies, which make clear that the level of radiation considered "self-protecting" in current NRC standards would pose little deterrent to determined terrorists. At the same time, the NRC's requirements for protection of potential nuclear bomb material should be strengthened to bring them roughly in line with DOE's rules for identical material (particularly since the NRC-regulated facilities handling this material are doing so mainly on contract to DOE in any case, so DOE will end up paying most of the costs of security as it does at its own sites). Congress should also provide incentives to convert HEU medical isotope production to LEU, without in any way interfering with supplies, by imposing a roughly 30 percent user fee on all medical isotopes made with HEU. Using the funds to help producers convert to LEU would give producers a strong financial incentive to convert.

Eighth, the Obama administration must launch new efforts to build a sense of urgency about the global danger of nuclear terrorism. The fundamental key to success in all of these efforts will be convincing policymakers and nuclear managers around the world that nuclear terrorism is a real and urgent threat to *their own country's* security, and worthy of a substantial investment of their time and resources to reduce this risk. Today, there is a widespread belief that nuclear terrorism would be nearly impossible for terrorists to accomplish, or is a threat only to the United States; such faulty assumptions must be addressed and corrected. If the Obama administration succeeds in building that sense of urgency, these officials and managers will be more likely to take the actions that are needed; without that sense of urgency, they are unlikely to do so.

The Obama administration should take several steps to build the needed sense of urgency and commitment, including: (a) *joint threat briefings* at upcoming summits and high-level meetings with key countries, where experts from both the United States and the country concerned would outline the very real possibility that terrorists could get nuclear material and make a nuclear bomb; (b) *nuclear terrorism exercises* with policymakers from key states, which can sometimes reach officials emotionally in a way that briefings and policy memos cannot; (c) *fast-paced nuclear security reviews,* in which leaders of key states would pick teams of security experts they trust to conduct fast-paced reviews of nuclear security in their countries (with U.S. advice and technical assistance if desired), assessing whether facilities are adequately protected against a set of clearly defined threats (as the United States did after 9/11, revealing a wide range of vulnerabilities); (d) *realistic testing of nuclear security performance,* in which the United States could help countries conduct realistic tests of their nuclear

security systems' ability to defeat realistic insider or outsider threats; and (e) *preparing shared databases of threats and incidents,* including unclassified information on actual security incidents (both at nuclear sites and at non-nuclear guarded facilities) that offer lessons for policymakers and facility managers to consider in deciding on nuclear security levels and particular threats to defend against.

A MULTILAYERED DEFENSE AGAINST NUCLEAR TERRORISM

Securing nuclear weapons and materials is the most important step to reducing the risk of nuclear terrorism, but it is only one element of the necessary comprehensive strategy. Three other important elements of a multilayered defense are briefly discussed below.

Countering Terrorist Nuclear Plots

President Obama should work with other countries to build an intense international focus on stopping all the elements of a nuclear plot beyond the acquisition of the nuclear material—i.e., the recruiting, fund-raising, equipment purchases, and more that would inevitably be required. The best chances to stop such a plot lie not in exotic new detection technologies but in a broad counter-terrorism effort, ranging from intelligence and other operations targeting high-capability terrorist groups to addressing the anti-American hatred that makes their recruiting and fund-raising easier (and makes it more difficult for other governments to cooperate with the United States). Existing programs focused on redirecting nuclear weapons scientists to civilian work should be reformed to focus on a broader array of threats, including not only top weapons scientists but also workers with access to nuclear material, guards who could help steal nuclear material, and those retired from nuclear facilities but still possessing critical knowledge. The United States is not likely to have either the access or the resources to carry out this expanded mission by itself, so it must work closely with partner nations to convince them to take most of the needed actions themselves.

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The United States should also work with countries around the world to monitor and stop recruitment attempts at key sites, such as physics and nuclear engineering departments in countries with active Islamic extremist communities.

Preventing and Deterring State Transfers of Nuclear Weapons or Materials to Terrorists

Hostile states are highly unlikely to consciously choose to provide nuclear weapons or the materials needed to make them to terrorist groups, for such a step would risk retaliation that would end their power forever. Nevertheless, the risk of such transfers is not zero—and more states with nuclear weapons would mean more sources from which a nuclear bomb might be stolen. President Obama must engage with North Korea and Iran and work with other states to put together an international package of carrots and sticks large enough and credible enough to convince these governments that it is in their national interest to verifiably end their nuclear weapons efforts (and, in North Korea's case, to give up the weapons and materials already produced). The United States should also put in place the best practicable means for identifying the source of any nuclear attack—including not just nuclear forensics but also traditional intelligence means—and announce that the United States will treat any terrorist nuclear attack using material consciously provided by a state as an attack by that state and will respond accordingly. This should include both increased funding for R&D and expanded efforts to build an international database of material characteristics. Policymakers should understand, however, that nuclear material has no DNA that can provide an absolute match; nuclear forensics will complement other sources of information, but it will rarely make clear where material came from by itself.

Interdicting Nuclear Smuggling

While the first and most critical line of defense in controlling nuclear warheads and materials is to prevent them from being stolen in the first place, a multilayered defense is needed to deal with those cases in which the first line fails and nuclear material is stolen. Police, intelligence, customs, and border-control measures to catch and prosecute nuclear thieves and interdict nuclear smuggling represent the critical second line of defense. The United States and other countries have launched a wide range of programs designed to strengthen these back-up defenses. The Second Line

of Defense (SLD) program strengthens the capability of foreign governments to deter, detect, and interdict illicit trafficking in nuclear and other radioactive materials across international borders and through the global maritime shipping system by working collaboratively with foreign partners to equip border crossings, airports, and seaports with radiation-detection and associated communication equipment. The Proliferation Security Initiative (PSI) may also help focus some countries' attention on putting needed border controls and anti-smuggling legislation in place, though it is likely to be much more useful in stopping shipments of large, readily detectable items such as crates of centrifuge components or ballistic missiles than in stopping transfers of nuclear materials that can fit in a suitcase.

Radiation detection should be one part of the overall effort to decrease nuclear smugglers' chances of success. But insisting on scanning every shipping container, as Congress set as the goal for 2012, is not the best approach given that smugglers have many other pathways at their disposal and current scanners would not be able to detect HEU metal with even modest shielding. Due to the limitations of the technology and the myriad routes smugglers might use, radiation detection will always be a limited tool, and it must not be relied upon as the centerpiece of efforts to stop nuclear smuggling. Ultimately, as intelligence and border controls are strengthened, governments will be more likely to catch a terrorist crossing a border than to detect the nuclear material he or she may be carrying.

Preparing for Disaster

Finally, it is essential that the United States be better prepared should—despite its best efforts—a nuclear terrorist attack occur. While some steps have already been taken, a comprehensive plan and approach are needed. This includes the ability to rapidly assess which people are in the greatest danger and then tell them what they can do to protect themselves; better capabilities to communicate to the populace when TV, radio, and cell phones in the affected area may not be functioning properly; better public communication plans for the critical minutes and hours after such an attack; the ability—including making use of the military's capabilities—to treat many thousands of injured people; and more effective plans to keep the

"... it is essential that the United States be better prepared should—despite its best efforts—a nuclear terrorist attack occur."

government and economy functioning while taking all of the necessary steps to prevent another attack. Many of these steps would help respond to any catastrophe, natural or manmade, and would pay off even if such a nuclear attack were never to come to fruition.

CONCLUSION

The United States needs a total system of interlocking efforts to prevent nuclear terrorism. But the single-highest-priority part of that system is to improve security for nuclear stockpiles around the world, with the aim of reducing the chance that nuclear weapons or materials could ever be stolen and fall into terrorist hands. Every subsequent step on the terrorist pathway to the bomb is easier for the terrorists to take and harder for us to stop. With a sensible strategy, adequate resources, and sustained leadership, President Obama's four-year goal to secure the world's nuclear stockpiles can be achieved and the risk can be dramatically reduced.■

ENDNOTES

1 This article draws on analysis and recommendations in Matthew Bunn, *Securing the Bomb 2008* (Cambridge, Mass.: Project on Managing the Atom, Harvard University, and Nuclear Threat Initiative, November 2008), and Matthew Bunn and Andrew Newman, *Preventing Nuclear Terrorism: An Agenda for the Next President* (Cambridge, Mass.: Project on Managing the Atom, Harvard University, and Nuclear Threat Initiative, November 2008) both available at http://www.nti.org/securingthebomb as of 25 May 2009.

2 U.S. Congress, Office of Technology Assessment, *Nuclear Proliferation and Safeguards* (Washington, D.C.: OTA, 1977 available at http://www.princeton.edu/~ota/disk3/1977/7705/7705.PDF as of 27 March 2008), p.140. OTA reached this conclusion long before the internet made a great deal of relevant information much more widely available.

3 Laurence Silberman and Charles Robb (co-chairs), Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, *Report to the President of the United States* (Washington, D.C.: Government Printing Office, 31 March 2005), p. 276 available at http://www.gpoaccess.gov/wmd/pdf/full_wmd_report.pdf as of 1 June 2009.

4 See The White House, Office of the Press Secretary, *Remarks by President Barack Obama*, Hradcany Square, Prague, Czech Republic, 5 April 2009 available at http://www.whitehouse.gov/the_press_office/Remarks-By-President-Barack-Obama-In-Prague-As-Delivered/ as of 13 May 2009.

5 See Michael Bronner, "100 Grams (And Counting): Notes From the Nuclear Underworld" (Cambridge, Mass: Project on Managing the Atom, Harvard University, June 2008) available at http://belfercenter.ksg.harvard.edu/files/100-Grams-Final-Color.pdf as of 21 May 2009. The material was roughly 100 grams of uranium oxide, containing 79.5 grams of actual uranium. See also Lawrence Scott Sheets, "A Smuggler's Story," *The Atlantic*, April 2008 available at http://www.theatlantic.com/doc/200804/uranium-smuggling as of 21 May 2009.

6 Micah Zenko, "A Nuclear Site is Breached: South African Attack Should Sound Alarms," *Washington Post,* 20 December 2007. See also Rob Adam, "Media Briefing: Security Breach at Necsa on 8 November 2007," Nuclear Energy Corporation of South Africa, 13 November 2007; Graeme Hosken, "Officer Shot as Gunmen Attack Pelindaba," *Pretoria News,* 9 November 2007; Hosken, "Two Gangs of Armed Men Breach Pelindaba Nuclear Facility," *Pretoria News,* 14 November 2007; Joel Avni, Gertrude Makhafola, and Sibongile Mashaba, "Raid on Site Planned," *The Sowetan,* 14 November 2007; and CBS News: 60 Minutes, "Assault on Pelindaba", 21 November 2008 available at http://www.cbsnews.com/video/watch/?id=4624568n&tag=contentMain;contentBody as of 1 June 2009.

7 In the annual report for the period leading up to the break-in, the South African department that oversees the site acknowledged that the goal of "implementation of a revised nuclear security framework" was "0 percent complete", because "Design Basis Threat (DBT) document was not yet established." See Department of Minerals and Energy, Annual Report 2006/2007 (Johannesburg: DME, 2007), p.69.

8 For a more detailed assessment, see Bunn, *Securing the Bomb 2008*, pp.7-10 and 21-44.

9 Report of the Snezhinsk incident is from "An Employee of the Department of Classified Facilities of the MVD Was Arrested in Snezhinsk: What Incriminates the 'Silovic,'" trans. Jane Vayman; reported on available at www.ura.ru as of 29 May 29 2008. The Seversk description is from Igor Goloskokov, "Refomirovanie Voisk MVD Po Okhrane Yadernikh Obektov Rossii (Reforming MVD Troops to Guard Russian Nuclear Facilities)," trans. Foreign Broadcast Information Service, *Yaderny Kontrol* 9 (4) (Winter 2003).

10 See Bunn, *Securing the Bomb 2008, pp.115-127.*

11 Figures for the DOE FY 2010 budget requests are from DOE, National Nuclear Security Administration, *FY 2010 Congressional Budget Request*, Office of Chief Financial Officer, Vol. 1, May 2009 available at http://www.cfo.doe.gov/budget/10budget/Content/Volumes/Volume1.pdf as of 29 May 2009. Data for the DOD requests provided by DOD, 26 May 2009. Figures for the cumulative budget totals are from "Interactive Budget Database," in Nuclear Threat Initiative Research Library: Securing the Bomb (Cambridge, Mass., and Washington, D.C.: Project on Managing the Atom, Harvard University, and Nuclear Threat Initiative, 2009; available at http://www.nti.org/e_research/cnwm/charts/cnm_funding_interactive.asp as of 29 May 2009.

12 National Nuclear Security Administration, Defense Nonproliferation, Office of Global Threat Reduction, http://nnsa.energy.gov/nuclear_nonproliferation/1550.htm

13 For the data and discussion behind this figure, see Bunn, *Securing the Bomb 2008*, pp. 89-113.

14 Recommendations are taken from Bunn and Newman, *Preventing Nuclear Terrorism: An Agenda for the Next President.*