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Preventing a Nuclear 9/11

Presidential leadership is the key to accelerating progress on securing nuclear weapons and materials.

In their presidential contest, President George W. Bush and Senator John Kerry agreed that the most deadly danger facing the United States is the possibility that terrorists could obtain a nuclear bomb. Fortunately, if effective action is taken now, we have a good chance to prevent such a catastrophe from ever occurring.

Currently, however, the scope and pace of the U.S. and world response simply do not match the urgency of the threat. As the new presidential term begins, much of the work of securing the world's nuclear stockpiles so that they cannot fall into terrorist hands remains unfinished. Scores of nuclear terrorist opportunities lie in wait in countries all around the world—sites that have enough nuclear material for a bomb and are demonstrably not adequately defended against the threats that terrorists and criminals have already shown they can mount. These insecure caches also represent opportunities for hostile states, because stolen nuclear material could cut years off the time needed to obtain their first bomb.

Separated plutonium and highly enriched uranium (HEU), the essential ingredients of nuclear weapons, are too difficult for terrorist groups to produce themselves. If the world's stockpiles of these materials and of nuclear weapons themselves could be effectively secured, nuclear terrorism could be reliably prevented, and hostile states could be blocked from taking advantage of this potential shortcut to the bomb. With effective action now, the danger could be substantially reduced during President Bush's second term. Success would require sustained presidential leadership to overcome the myriad political and bureaucratic obstacles to progress, but it would not require enormous investment or the development of technologies not already in hand. President Bush thus has an historic opportunity to leave, as a lasting legacy, a world in which nuclear terrorism is no longer a principal threat to world security.

An attack using an actual nuclear explosive—either a stolen weapon that terrorists had succeeded in acquiring and detonating or a bomb they made themselves from stolen nuclear material—would be among the most difficult types of attack for terrorists to accomplish. Despite a number of claims, there is no

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credible evidence that any terrorist group has succeeded in getting a nuclear bomb or the materials needed to make one. Nevertheless, the warning signs are clear.

• First, by word and deed, al Qaeda and the global movement it has spawned have made it clear that they want nuclear weapons. Osama bin Laden has called acquiring nuclear weapons a "religious duty." Al Qaeda operatives have repeatedly attempted to obtain nuclear material and recruit nuclear expertise. Two senior Pakistani nuclear weapons scientists met with bin Laden at length and discussed nuclear weapons. Documents recovered in Afghanistan reveal a significant nuclear research effort.

• Second, if terrorists could obtain the HEU or plutonium that are the essential ingredients of a nuclear bomb, making a bomb might well be within the capabilities of a sophisticated group. 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 required."

• Third, hundreds of tons of nuclear material in dozens of countries around the world today remain dangerously vulnerable to theft. There are no binding global nuclear security standards, and nuclear security around the world varies from excellent to appalling. Many of the more than 130 civilian research reactors using HEU fuel, which are found in some 40 countries, on every inhabited continent, have no more security than a night watchman and a chain-link fence. Most of the nuclear facilities in the world, including many in the United States, would not be able to provide a reliable defense against attacks as large as terrorists have already proved they can mount, such as the four coordinated, independent teams of four to five suicidal terrorists each that struck on September 11, 2001, or the 40 terrorists armed with automatic weapons and explosives who seized a crowded Moscow theater in October 2002. Theft of the essential ingredients of nuclear weapons is not a hypothetical worry, it is a current reality: The International Atomic Energy Agency (IAEA) has documented 18 cases of theft involving weapons-usable plutonium or HEU.

• Fourth, if terrorists could steal, buy, or make a nuclear bomb, there is little confidence that the government could stop them from smuggling it into the United States. After all, thousands of tons of illegal drugs and hundreds of thousands of illegal immigrants cross U.S. borders every year, despite massive efforts to stop them. The essential ingredients of a nuclear bomb can fit easily into a briefcase, and the weak radiation these materials emit can be made quite difficult to detect with the use of modest amounts of shielding.

• Fifth, such a crude terrorist bomb would potentially be capable of incinerating the heart of any city. A bomb with the explosive power of 10,000 tons of TNT (smaller than the Hiroshima bomb), if set off in midtown Manhattan on a typical workday, could kill half a million people and cause more than $1 trillion in direct economic damage. Devastating economic aftershocks would reverberate throughout the world.

The most vulnerable facilities

Which facilities around the world pose the most urgent dangers? The risk posed by each facility where potential nuclear bomb materials exist depends on four factors: the quantity of material, specifically whether there is enough at the facility for a bomb; the quality of the material, particularly how difficult it would be for potential recipients to turn it into a nuclear bomb; the effectiveness of the security and accounting arrangements at the site; and the level of threat at that site. A security system that would be sufficient in Canada, for example, might not be in Pakistan. Applying this framework to the limited information publicly available, three primary sources of concern emerge: Russia, HEU-fueled research reactors, and Pakistan.

Russia has the world's largest stockpiles of nuclear weapons and weapons-usable nuclear materials, with huge quantities of high-quality materials (or nuclear weapons themselves) dispersed in hundreds of buildings and bunkers at scores of sites. Security for these stockpiles has improved from poor to medium during the past 15 years. The economy has stabilized, nuclear scientists and workers are being paid a living wage (and on time), and glaring holes in fences have largely been fixed. But tight budgets and a widespread complacency about the threat, which also prevails at nuclear facilities in countries around the

world, including the United States, continues to lead to problems ranging from broken intrusion detectors to employees propping open security doors for convenience and guards patrolling with no ammunition in their guns (to avoid accidental firing incidents).

Meanwhile, the threat to these facilities is frighteningly high. Russian officials confirm that terrorist teams have actually carried out reconnaissance at Russian nuclear warhead storage sites (whose very locations are secret). The Russian state newspaper reports that the 41 heavily armed terrorists who seized a theater in Moscow in October 2002 considered seizing the Kurchatov Institute, a Moscow site with enough HEU for dozens of bombs. In 2003, a Russian criminal case revealed that a Russian businessman had been offering $750,000 for stolen weapons-grade plutonium for sale to a foreign client and had made contact with residents of the closed nuclear city of Sarov, Russia's equivalent of Los Alamos, to try to close a deal. Corruption and theft, often involving insider conspiracies, continue to plague Russia on a massive scale. And al Qaeda has deep ties to the Chechen terrorists, who have demonstrated their ability to strike in force, without warning or mercy.

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Next on the list of vulnerable facilities are the world's generally poorly guarded HEU-fueled research reactors. There is little hope of providing effective security at many of these facilities, both because of indefensible locations (for example, on university campuses) and lack of sufficient revenue to pay the cost. Scores of these facilities have enough HEU for a bomb on site, particularly if one includes irradiated fuel elements (which are small and easy to handle, still contain HEU, and in most cases are not radioactive enough to be a serious problem for determined terrorists attempting to steal them).

Pakistan has a relatively small and heavily guarded nuclear stockpile. But the threats facing that stockpile are terrifyingly high, both from the armed remnants of al Qaeda still operating in the country and from insiders in Pakistan's nuclear establishment who are sympathetic to extreme Islamic causes. The fact that A. Q. Khan, revered in Pakistan as the father of the Pakistani bomb, was willing and able to build a global black-market network selling uranium enrichment centrifuge technologies and actual nuclear bomb designs highlights the insider danger. And the possibility that one of those bomb designs might have fallen into terrorist hands emphasizes the urgency of making sure that terrorists cannot get the ingredients to make that recipe.

Progress in reducing the threat

Offensive action against terrorist groups and defensive steps such as nuclear material detection at borders have their place in dealing with the nuclear terrorist threat, but because nuclear materials and the activities needed to turn them into a bomb may be difficult to detect, both are weak reeds to rely on. The greatest leverage in reducing this threat is in preventing nuclear material from leaving the sites where it is supposed to be in the first place, because once it is out the door, the difficulty of finding and recovering it increases enormously.

The United States, other countries, and the IAEA have a wide range of efforts under way to secure, monitor, and reduce stockpiles of nuclear weapons and materials in the former Soviet Union and around the world. These efforts have had real, demonstrable successes, representing an excellent investment in U.S. and world security. Enough material for thousands of nuclear weapons has been permanently destroyed. Indeed, half of the nuclear-generated electricity in the United States now comes from blended-down HEU from dismantled Russian nuclear weapons. Security for scores of vulnerable nuclear sites has been demonstrably improved. At least temporary civilian employment has been provided for thousands of nuclear weapons scientists and workers who might otherwise have been driven by desperation to seek to sell their knowledge or the materials to which they had access. But in virtually every aspect of these efforts, much more remains to be done.

By the end of fiscal year (FY) 2004, the Department of Energy (DOE) estimates that at least the first

round of U.S.-sponsored "rapid upgrades"—for example, bricking over windows and installing nuclear material detectors at doors—had been completed for some 46 percent of the estimated 600 tons of HEU and separated plutonium in the former Soviet Union. Within that total, more complete "comprehensive upgrades" had been completed for roughly 26 percent of the material. On the other hand, comprehensive upgrades have been completed for some 70 percent of the sites where these materials exist, but most of the nuclear material is at the 30 percent of the sites where these upgrades have not yet been completed. Under an accelerated plan developed after the 9/11 terrorist attacks, DOE hopes to complete comprehensive upgrades for all of this material by the end of 2008, but achieving that objective will require a dramatic acceleration of the current pace of progress. During FY 2004, the amount of material covered by either rapid or comprehensive upgrades increased by only a few percent.

The obstacles to progress are more political and bureaucratic than budgetary. Disagreements over exempting U.S. assistance from taxes, over liability in the event of a nuclear accident in the course of a cooperative project, over contracting procedures, and over access to sensitive nuclear sites have slowed progress, in some cases for years at a time. The Bush administration, for example, allowed two important threat reduction agreements with Russia to expire rather than compromise on the liability language on which it was insisting, which would require Russia to accept 100 percent of the liability even if an accident was caused by intentional sabotage by U.S. personnel. That dispute has now delayed efforts to destroy thousands of bombs worth of excess plutonium by more than two years. Similarly, because of disputes over who would pay roughly $50 million in installation costs—and, if the United States paid, how much access U.S. personnel would get—dozens of sets of equipment for a "quick fix" of security at Russian nuclear warhead storage sites that were delivered more than four years ago are still sitting in warehouses uninstalled.

The access issue has been particularly problematic. To confirm that taxpayer money is being spent appropriately, the United States, in most of these programs, has been demanding that Russia give U.S. personnel direct access to the sites where the work is being done. But these sites are some of Russia's most secret nuclear facilities, and Russia has resisted U.S. demands. In some cases, the Russian secrecy is clearly excessive; the danger to Russia from terrorists obtaining these stockpiles is far greater than the danger to Russia from Americans learning a few more secrets. In other cases, the U.S. demands are unreasonable. After all, the United States would not allow Russian experts to visit its comparable facilities. The issue has only become more difficult to address as Russia's security services have grown more omnipresent since President Putin's rise to power. As Russia's economy has improved and its government has strengthened, Russia has become a tougher partner, more willing to take firm positions and stick to them, even at the risk of blocking key assistance programs. Fortunately, there is growing recognition on both sides of the need for some compromise on the access problem, and DOE and Russia's Federal Agency for Atomic Energy have recently completed a promising pilot project to demonstrate approaches to confirming that U.S. funds are spent appropriately without compromising nuclear secrets.

The story is much the same for other parts of the broad effort to reduce the nuclear terrorist danger in Russia. For the locations where actual nuclear warheads are stored, initial rapid or quick-fix upgrades appear to have been installed for roughly half the bunkers where these warheads exist (a calculation complicated by the fact that neither government has ever released complete data on how many of these facilities there are). In addition, after breakthroughs on access to at least some of these sites, some comprehensive upgrades are being completed, although the vast majority remain to be done. A number of European countries have contributed to improving security and accounting for nuclear material at particular facilities in the former Soviet Union, as have Japan and Australia, but these efforts are dwarfed by the U.S. program already described. The 225 tons of HEU destroyed so far under the U.S.-Russian HEU Purchase Agreement represents roughly one-fifth of the HEU stockpile that Russia had when the effort began.

In much of the rest of the world, the cooperative effort to lock down these stockpiles is at an even earlier stage. HEU has been removed from a few sites, and security has been upgraded (modestly in some cases, more substantially in others) at a larger number,

but this still constitutes a small fraction of the total. However, in the spring of 2004, Secretary of Energy Spencer Abraham announced the Global Threat Reduction Initiative (GTRI), with the mission of accelerating removals of nuclear material from vulnerable sites around the world and improving security at sites where such material will remain, along with improving controls over radiological materials that might be used in a "dirty bomb." GTRI, however, is just getting started. Key cooperative efforts with countries such as Pakistan, China, and India are just beginning to get under way. Also, as of the end of fiscal 2004, effective nuclear material detection equipment was up and running at only 1 of the 20 "megaports" that ship most of the millions of containers that arrive in the United States every year and at only a fraction of the legal points of entry into the United States (not to mention the thousands of kilometers of wild borders and coastline).

The first and most crucial step in securing nuclear materials is to put in place an accelerated and strengthened effort with Russia, based on genuine partnership.

In addition to the pace of these efforts, there are two other critical issues that have to be considered: effectiveness and sustainability. Security systems for nuclear weapons and their essential ingredients must be adequate to defeat the scale of threats that exist in the post-9/11 world. Moreover, success in defending against any given threat will require not only good equipment but also effective security personnel, with a strong security culture. Propped-open security doors and guards without ammunition suggest that the culture problem remains a substantial one, not just in Russia but in countries around the world.

Equally, it will do little good to spend billions of dollars installing security equipment if the equipment is broken and unused in five years' time. It is absolutely critical to build in approaches to ensuring that these systems and procedures will be sustained for the long haul and particularly to obtaining high-level government commitment to provide the resources to make that happen.

The United States now spends roughly $1 billion annually on cooperative efforts to dismantle, secure, and prevent the proliferation of weapons of mass destruction in countries around the world. That amounts to less than one-quarter of one percent of the U.S. defense budget. In 2002, the Group of Eight industrialized democracies established the Global Partnership against the Spread of Weapons and Materials of Mass Destruction, with the other participants agreeing to match the U.S. investment. To date, however, the non-U.S. funds have been slow in coming and are largely committed to projects such as dismantling aging submarines that, although important, will have little direct effect on reducing the risk of nuclear terrorism. For now, expanded budgets are less critical than overcoming the underlying political and bureaucratic obstacles to progress. But if those obstacles can be overcome, more money will be needed to implement an accelerated global effort. Though no detailed cost estimate for securing the world's nuclear stockpiles has yet been done, the needed security upgrades could probably be put in place worldwide within a few years for a cost, during that period, of between one-half of one percent and two percent of the U.S. annual defense budget.

A security-first agenda

An accelerated and strengthened effort would have many ingredients, but three are essential: accelerating and strengthening the effort in Russia, where the largest stockpiles of potentially vulnerable nuclear materials still exist; removing the material entirely from the world's most vulnerable sites; and building a fast-paced global coalition to improve security for nuclear materials around the world.

Working with Russia. The first and most crucial step is to put in place an accelerated and strengthened effort with Russia, based on genuine partnership. Between them, Presidents Bush and Putin have the power to overcome the disputes that have been allowed to slow progress in these efforts. President

Bush should use his excellent relationship with President Putin to convince the Russian president of the urgency for action, both for Russia's own security and as a central requirement of a positive relationship with the United States.

The next U.S.-Russian summit should focus on a presidential agreement that would identify securing all stockpiles of nuclear warheads and materials as a top priority for both countries' national security; jointly set a target date of completing comprehensive upgrades within four years (while putting in place a mechanism for quickly identifying and overcoming obstacles as they arise); include an agreed approach regarding access to sensitive sites (including a U.S. offer of reciprocal access to comparable sites in the United States and an arrangement for accomplishing security upgrades at sites too sensitive for either side to be willing to allow access to the other); instruct their governments to ensure that the security upgrades accomplished are designed to provide security in the face of post-9/11 terrorist threats; and put in place the commitments and approaches needed to ensure that once effective security systems are installed, high levels of security will be maintained after international assistance is phased out.

The single most critical ingredient of success will be changing the prevailing attitude among the nuclear elite in Russia, as well as in most countries around the world, that the nuclear terrorist threat is farfetched and that existing security approaches are adequate. The Beslan tragedy, showing that the terrorists Russia faces can and will strike in force and kill even schoolchildren, has reportedly begun to undermine this complacency, and additional troops were dispatched to guard nuclear facilities after that crisis. But the underlying problem remains. Until President Putin concludes that better security for these stockpiles is an urgent priority for Russia's own security, he is not likely to assign the needed resources to put in place and sustain effective security for all of Russia's nuclear stockpiles or to sweep aside the obstacles to accelerated international cooperation that his agencies have raised. Several steps might help build a sense of urgency among Russia's key decisionmakers:

A fast-paced survey of nuclear security vulnerabilities. President Bush should encourage President Putin to put together a team of Russian experts to conduct an assessment of potential vulnerabilities and recommendations for fixing them at all Russian sites with nuclear weapons or weapons-usable nuclear material. Any thorough review would reveal that many of these facilities are not adequately defended against either large outside attacks or significant insider conspiracies and would give President Putin direct information on the situation, rather than relying on assurances from his nuclear officials. The United States can offer to share its own experience with such fast-paced reviews, which in some cases have led to dramatic and rapid improvements in security, and to help cover the cost of the needed improvements.

• *Nuclear terrorism war games.* War games and similar exercises have been effective in prompting policymakers in a number of countries to think through and face up to urgent challenges. A war game or series of war games for Russia's national security policymakers, focused on nuclear theft and terrorism (following up a similar exercise recently conducted in Europe) could help convince participants that more needs to be done to secure nuclear stockpiles.

• *Joint U.S.-Russian threat briefings.* A series of briefings by Russian and U.S. experts for key Russian policymakers could outline in detail terrorist desire for and efforts to obtain nuclear weapons, as well as the very real possibility that if terrorists obtained the needed nuclear materials, they could make at least a crude nuclear bomb. Similar points should be made in training nuclear security personnel, highlighting the urgency of maintaining high security.

• *National requirements to meet a specified threat.* The United States should encourage Russia to institutionalize regular review of vulnerabilities through national regulations that would require facilities to be able to defeat a specified level of threat, coupled with effective inspection and performance testing (in which "red teams" playing outside attackers or insider thieves attempt to overcome the system) to ensure that this goal is being met.

Ultimately, gaining the needed Russian commitment to this effort and the buy-in of Russian experts crucial to long-term sustainability will require a genuinely partnership-based approach in which Russian experts play key roles, working with foreign partners in the conception, design, and implementation of the entire effort. As part of that partnership, the two countries should jointly lead a global effort to secure nu-

clear stockpiles around the world.

Removing vulnerable bomb material. The only foolproof way to ensure that nuclear material will not be stolen from a particular site is to remove it. What is needed now is a fast-paced effort to remove the weapons-usable nuclear material entirely from the world's most vulnerable sites, particularly HEU-fueled research reactors.

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Accomplishing that objective will require flexibility and creativity, with approaches, including incentives to give up the nuclear material, targeted to the needs of each facility. Most of the world's research reactors are aging and unneeded. The best answer for them is to provide incentives to shut them down. This could include funding for decommissioning and for employing their scientists in productive research after the reactors close. This will take considerable care, as no approach perceived by the world's reactor operators as anti-science or anti-nuclear is likely to succeed. As part of such an effort, the international community should help establish a smaller number of more broadly shared research reactors, which is the same direction that high-energy particle accelerators took long ago.

A substantial number of the research reactors that are still needed and still using HEU could convert to proliferation-resistant low-enriched uranium (LEU) fuels that are already available. They should be given support and incentives to do so, including funding for buying new LEU fuel if necessary, especially in cases in which a reactor would otherwise not buy new LEU fuel because it already has HEU that will last for many years or for the lifetime of the reactor. The remaining research reactors that are still genuinely needed and cannot convert to available LEU fuels without a substantial degradation of their scientific performance should be effectively secured for now and given incentives to convert when development of higher-density LEU fuel is completed. These efforts to shut down or convert HEU-fueled facilities should include the full range of vulnerable facilities with dangerous HEU, including critical assemblies, pulse reactors, isotope production reactors, and nuclear icebreakers. The target should be to remove potential bomb material from the world's most vulnerable sites within four years and eliminate all HEU from civilian sites within 10 years.

A global partnership. The problem of insecure nuclear material is global. Solving it will require forging a global coalition of countries willing to work together to improve security for nuclear materials, wherever they may be. Given the devastating global economic impact that a nuclear terrorist attack would have, every country has a strong self-interest in cooperating to reduce this threat.

But because of the intense secrecy surrounding nuclear stockpiles and their security arrangements, building that global effort will not be easy. Cooperation with states such as Pakistan, India, Israel, and China to improve security for nuclear stockpiles whose locations remain secret will be a serious challenge, requiring considerable creativity in developing approaches that can make it possible to provide information, advice, and equipment to improve security without compromising nuclear secrets or contributing to these states' nuclear weapons programs. One step that should be taken immediately is to strengthen the IAEA's Office of Nuclear Security, which carries credibility in some quarters that U.S. assistance programs do not, with more money, more people, and a broader action plan.

New security standards for nuclear weapons and their essential ingredients should be part of this global effort. A United Nations Security Council resolution passed in April 2004 creates a binding legal obligation on every state to provide "appropriate effective" security and accounting for its nuclear stockpiles. This new obligation creates an opportunity to build a global standard by fleshing out, through the IAEA, the key elements that a nuclear security system must include to meet the "appropriate effective" requirement.

None of this will happen without sustained lead-

ership and political heavy lifting from the White House and its counterparts around the world. President Bush should appoint a senior full-time White House official, with the access needed to walk in and ask for presidential action when needed, to lead these efforts and to keep them on the front burner at the White House. That official would be responsible for finding and fixing the obstacles to progress in the scores of existing U.S. programs—scattered across several cabinet departments and focused on various pieces of the job—and for setting priorities, eliminating overlaps, and seizing opportunities for synergy.

The 9/11 Commission called for a "maximum effort" to keep nuclear weapons out of terrorist hands. The steps described here are an initial sketch of such an effort. If the world can muster the will to change its past approaches, there remains an excellent chance of preventing a nuclear 9/11.

Recommended reading

David Albright, "Al Qaeda's Nuclear Program: Through the Window of Seized Documents," *Special Forum* 47 (Berkeley, Calif.: Nautilus Institute, November 6, 2002) (available at http://69.44.62.160/archives/fora/Special-Policy-Forum/47_Albright.html as of November 9, 2004).

David Albright and Holly Higgins, "A Bomb for the Ummah," *Bulletin of the Atomic Scientists* 59, no. 2 (March/?April 2003) (available at http://www.thebulletin.org/?issues/?2003/?ma03/?ma03albright.html).

Graham Allison, *Nuclear Terrorism: The Ultimate Preventable Catastrophe* (New York: Times Books, 2004).

Matthew Bunn and Anthony Wier, *Securing the Bomb: An Agenda for Action* (Washington, D.C.: Nuclear Threat Initiative and the Project on Managing the Atom, Harvard University, May 2004).

Matthew Bunn, Anthony Wier, and John P. Holdren, *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan* (Washington, D.C.: Nuclear Threat Initiative and the Project on Managing the Atom, Harvard University, March 2003).

Charles D. Ferguson and William C. Potter (with Amy Sands, Leonard S. Spector, and Fred L. Wehling), *The Four Faces of Nuclear Terrorism* (Monterey, Calif.: Center for Nonproliferation Studies, Monterey Institute of International Studies, 2004).

Paul Leventhal and Yonah Alexander, *Preventing Nuclear Terrorism* (Lexington, Mass.: Lexington, 1987).

"Yes, this is all of it... Well, almost all of it... OK, at least some of it."