

# Securing the Bomb

## An Agenda for Action

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***This report is dedicated to the thousands of Americans, Russians, and others who are working to ensure that nuclear stockpiles are secure and accounted for, and cannot fall into hostile hands. May they get the support they need.***



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## EXECUTIVE SUMMARY

Today, scores of nuclear terrorist opportunities lie in wait in countries all around the world—sites that have enough nuclear material for a bomb that are not adequately defended against the threats that terrorists and criminals have already shown they can mount. While programs to eliminate these opportunities are making progress, much more remains to be done than has been done to date. Indeed, because disputes over access to sensitive sites and other bureaucratic obstacles have been allowed to fester, the amount of nuclear material secured in the two years immediately following the 9/11 attacks was actually *less* than the amount secured in the two years immediately before the attacks. Sustained presidential leadership is urgently needed to sweep aside the obstacles to progress and forge a fast-paced global partnership to secure every nuclear weapon and every kilogram of weapons-usable nuclear material, wherever it may be.

The purpose of this report is to make the case for actions that could be taken *now* and that, within the next few years, could drastically reduce the danger that a terrorist nuclear attack could ever occur. To make this case, we outline the continuing danger, describe the progress and problems of existing programs to address it, and recommend a plan of action for a faster and stronger response to the threat.

**A continuing global danger.** An attack using an actual nuclear explosive—either a stolen nuclear weapon or an improvised terrorist bomb made from stolen nuclear material—would be among the most difficult types of attack for terrorists to accomplish. But the danger is real. This report debunks in detail a series of myths, listed in the table below, that have led policy-makers around the world to downplay the danger. The facts are that the amount of inadequately secured bomb material in the world today is enough to make thousands of nuclear weapons; that terrorists are actively seeking to get it; and that with such material in hand, a capable and well-organized terrorist group plausibly could make, deliver, and detonate

at least a crude nuclear bomb capable of incinerating the heart of any major city in the world. Securing the vast stockpiles of nuclear weapons and materials around the world is an essential priority—for non-proliferation, for counter-terrorism, and for homeland security. If the world's existing stockpiles of nuclear weapons and weapons-usable nuclear materials can be reliably secured, nuclear terrorism can be reliably prevented: no terrorist access to material means no bomb.

This report identifies three particularly urgent areas for action:

*Russia.* The Russian government and economy have stabilized, nuclear workers and guards are now being paid a living wage on time, and the most glaring security deficiencies have largely been fixed. But serious security problems remain. Experts who visit Russia's nuclear sites continue to report broken intrusion detectors, nuclear-material accounting systems never designed to detect the theft of nuclear material, and "security culture" problems ranging from guards turning off detectors when they are annoyed by the false alarms to security gates propped open for convenience. The security manager at Seversk, one of Russia's largest nuclear-material processing facilities, reports that guards routinely patrol without ammunition in their guns, to avoid accidental firing. At the same time, threats to these facilities appear to be growing: Russian official sources report four incidents of terrorist reconnaissance on Russian nuclear warheads from 2001 to 2002; the Russian state newspaper reports that the 41 heavily armed terrorists who seized hundreds of hostages at a Moscow theater in October 2002 first considered seizing a Moscow site with enough highly enriched uranium (HEU) for dozens of nuclear weapons; and a 2003 criminal case revealed that a Russian businessman had been offering \$750,000 for stolen weapon-grade plutonium for sale to a foreign client—and had succeeded in making contact with residents of the closed nuclear weapon city of Sarov, to attempt to arrange the purchase.

## *Debunking Seven Myths of Nuclear Theft and Terrorism*

<b>MYTH</b>	<b>TERRORISTS DO NOT WANT TO CARRY OUT A NUCLEAR ATTACK.</b>
<b>REALITY</b>	<b>SOME TERRORISTS ARE ACTIVELY SEEKING NUCLEAR WEAPONS AND MATERIALS FOR USE IN SUCH AN ATTACK.</b>
<b>MYTH</b>	<b>TERRORISTS COULD NOT REALISTICALLY GET A NUCLEAR BOMB OR NUCLEAR MATERIAL TO MAKE ONE.</b>
<b>REALITY</b>	<b>AROUND THE WORLD, ENOUGH NUCLEAR MATERIAL FOR THOUSANDS OF NUCLEAR WEAPONS IS NOT ADEQUATELY PROTECTED AGAINST DEMONSTRATED TERRORIST AND CRIMINAL THREATS.</b>
<b>MYTH</b>	<b>TERRORISTS COULD NOT MAKE A NUCLEAR BOMB IF THEY HAD THE MATERIAL (OR SET OFF A BOMB IF THEY HAD ONE).</b>
<b>REALITY</b>	<b>NUMEROUS AUTHORITATIVE STUDIES HAVE CONCLUDED THAT IF THEY GOT THE NEEDED NUCLEAR MATERIAL, A WELL-ORGANIZED TERRORIST GROUP COULD PLAUSIBLY MAKE AND USE A CRUDE NUCLEAR BOMB.</b>
<b>MYTH</b>	<b>ONLY STATE-SPONSORED TERRORISTS COULD PLAUSIBLY CARRY OUT A NUCLEAR ATTACK.</b>
<b>REALITY</b>	<b>A STATE SPONSOR WOULD NOT BE NEEDED EITHER TO STEAL NUCLEAR MATERIAL OR TO MAKE IT INTO A BOMB.</b>
<b>MYTH</b>	<b>BORDER DEFENSES CAN RELIABLY PREVENT NUCLEAR BOMBS OR MATERIALS FROM BEING SMUGGLED INTO THE UNITED STATES.</b>
<b>REALITY</b>	<b>THERE ARE SO MANY ROUTES INTO THE UNITED STATES, AND NUCLEAR MATERIALS AND BOMBS WOULD BE SO EASY TO HIDE, THAT BORDER SECURITY CAN NEVER BE MORE THAN A VERY POROUS LAST-DITCH LINE OF DEFENSE.</b>
<b>MYTH</b>	<b>NUCLEAR TERRORISM CAN RELIABLY BE PREVENTED WITH OFFENSIVE MILITARY ACTION.</b>
<b>REALITY</b>	<b>THE ACTIVITIES INVOLVED IN PUTTING TOGETHER A BOMB COULD BE SMALL AND EASY TO HIDE, SO THE WORLD COULD NEVER BE CONFIDENT THAT A GROUP BUILDING A BOMB WOULD BE FOUND AND STOPPED BEFORE IT WAS TOO LATE.</b>
<b>MYTH</b>	<b>STATES WILL NOT SEEK TO OBTAIN STOLEN NUCLEAR MATERIAL.</b>
<b>REALITY</b>	<b>STATES HAVE IN FACT ATTEMPTED TO BUY NUCLEAR WEAPONS OR MATERIALS WHEN MAKING THEIR OWN SEEMED TOO DIFFICULT, DANGEROUS, OR TIME-CONSUMING.</b>

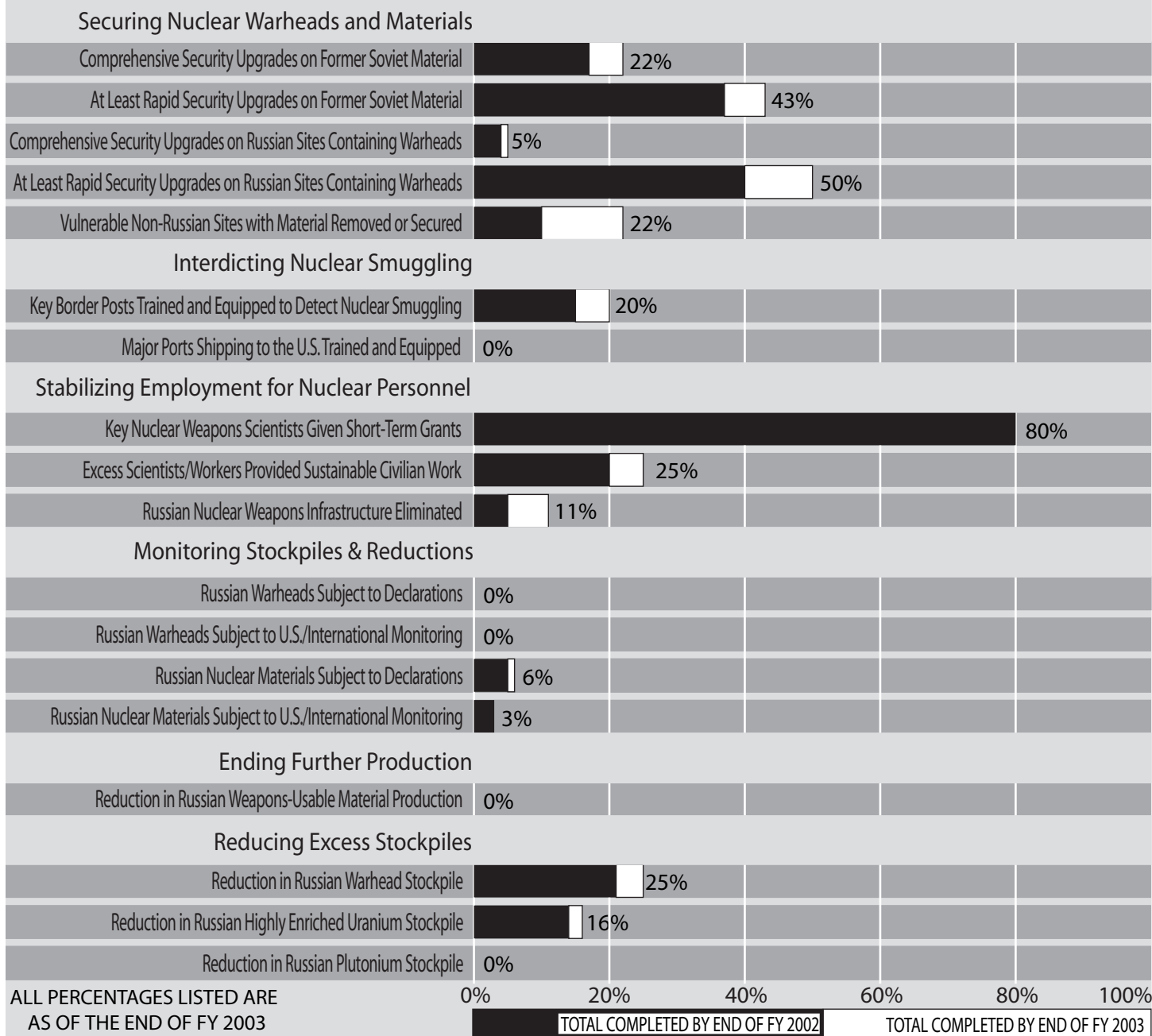
*Research reactors and related facilities.* Some 20 metric tons of HEU—enough for hundreds of nuclear weapons—exists as fuel for civilian research reactors around the world. More than 130 research reactors still use HEU as their fuel, in more than 40 countries. Most of these facilities have very modest security—in many cases, no more than a night watchman and a chain-link fence. Research-reactor fuel elements are small enough for a thief to put several of them into a backpack and carry them to a waiting vehicle. Chemical processing would be needed to extract the HEU from these fuel elements—but the processing required is reasonably straightforward, and all the details of the necessary processes are published in the open literature. The danger posed by irradiated HEU fuel at these facilities in many cases is almost as great as the danger posed by the fresh fuel: the irradiated material usually remains very highly enriched, most research

reactor irradiated fuel is not radioactive enough to prevent terrorists from stealing and processing it, and the chemical processes needed to extract the HEU are essentially the same as those for fresh, unirradiated fuel. When both fresh and unirradiated fuel are included, there are probably dozens of locations around the world where enough material for a bomb exists at a single site—and given the terrorists' demonstrated ability to carry out multiple coordinated attacks, the danger that they might strike more than one site to get their material cannot be discounted.

*Pakistan.* Pakistan's nuclear stockpiles are very small compared to those of Russia and the United States, and its facilities are believed to be heavily guarded. But the threat in Pakistan is very, very high—both from nuclear insiders sympathetic to extreme Islamic causes and from the large armed remnants of



## **Controlling Nuclear Warheads, Material, and Expertise: How Much Work Have U.S.-Funded Programs Completed?**



al Qaeda and the Taliban that still operate in the country. The insider threat was dramatically highlighted by the revelation of a global nuclear black market network led by Abdul Qadeer Khan, father of Pakistan's nuclear bomb, who out of some combination of greed and religious fervor peddled everything from uranium-enrichment centrifuges to actual bomb designs. Likewise alarming is the case of Sultan Bashiruddin Mahmood, the senior Pakistani nuclear

weapon scientist and Islamic extremist who, with a colleague, met with Osama bin Laden and discussed nuclear weapons at length. The possibility that the bomb design provided by the Khan network to Libya could fall into the hands of terrorists—or may have done so already—further emphasizes the urgency of keeping the ingredients for carrying out that recipe out of terrorist hands. The outsider threat in Pakistan is highlighted by the ability of a group of al Qaeda

fighters to hold off a substantial contingent of regular Pakistani army troops for days at a time in a pitched battle in early 2004. And the threat of outsiders and insiders working together is thrown into sharp relief by the two nearly successful assassination attempts against Pakistan's President in the past year.

**Continued progress in reducing the threat—but an urgent need for presidential action to overcome the obstacles.** Programs to reduce this danger are making genuine progress, demonstrating that effective action to address the threat is not only possible but is underway every day. During fiscal year (FY) 2003, for example, comprehensive security and accounting upgrades were completed on 35 tons of nuclear material—enough for over two thousand nuclear weapons—and over 30 tons of HEU were permanently destroyed. In the past year the rate at which vulnerable Soviet-supplied sites have been “cleaned out” of nuclear material has increased from one site every four years to three sites in seven months. Secretary of Energy Spencer Abraham and a number of other officials scattered through the government have worked hard to move this agenda forward—against countless obstacles.

But there remains a potentially deadly gap between the urgency of the threat and the scope and pace of U.S. efforts to address it. The 35 tons of material secured in FY 2003 represents only 6% of the estimated 600 tons of potentially vulnerable nuclear material in Russia. By the end of FY 2003, comprehensive security and accounting upgrades had been completed for only 22% of this material, and initial “rapid upgrades”—bricking over windows, installing detectors at doors—for only 43%. (Because the effort focused first on securing vulnerable sites with small amount of material, the fraction of sites secured is more impressive—comprehensive upgrades have been completed for 70% of the sites where the Department of Energy's security upgrade programs are working.) If progress continued at last year's rate, it would take 13 years to finish the job—just for the material in the former Soviet Union, leaving aside the insecure stockpiles in dozens of other countries throughout the world. Until that time, the world is relying, without transparency or confidence, on whatever security improvements Russia is able to afford on its own.

Meanwhile, for the Russian sites that store nuclear weapons themselves, dozens of sets of equipment the United States provided for a “quick fix” of security at Russia's nuclear warhead sites four years ago are still sitting in warehouses, uninstalled, more than two years after the 9/11 attacks.

As the figure shows, a broad range of metrics of progress tells a similar story: after more than a decade of effort, much less than half of the job has been done. Accelerated progress has been blocked by disputes over access to sensitive sites, liability provisions of threat reduction agreements, and other bureaucratic obstacles that have been allowed to fester unresolved, in some cases for years at a time. There remains too much grey space on this chart—grey space that represents thousands of insufficiently secure warheads, enough insecure nuclear material for tens of thousands more, and thousands of excess nuclear-weapons scientists and workers not yet permanently redirected to civilian work. The figure also shows how much of the work has been accomplished in the past year: as can be seen, in most cases the bars are only inching across the grey space, leaving many years to go at the current pace before these jobs are accomplished. Terrorists and thieves may not give the world the luxury of that much time.

*The budget picture.* For most of these programs, increased budgets would do little to accelerate the effort unless sustained high-level leadership succeeded in overcoming the non-monetary obstacles to progress (though there are important exceptions where money is a limiting factor). Budgets, nevertheless, are an important signal of priorities. The total budget for controlling nuclear warheads, materials, and expertise for FY 2002-2005 was only 16% higher than it would have been had the budget simply remained constant, in real terms, at its level from the end of the Clinton administration. And if Congress had simply approved the Bush administration's requests for each year, the real increase would have been only 2%. Though these efforts should be considered an essential component of the war on terrorism, military and homeland security spending increased far more. Total nuclear-threat-reduction spending remains less than one quarter of one percent of the U.S. military budget. Indeed, on average, the Bush administration

requests for nuclear-threat-reduction spending over FY 2002-2005 have been *less*, in real terms, than the last Clinton administration request, made long before the 9/11 attacks ever occurred.

*Actions by other states.* If it is clear that the U.S. government is not doing enough to reduce these dangers, it is even clearer that more action is needed from other governments. The Russian government, with its economy stabilized and its budget now in surplus, should be devoting far more resources to ensuring its stockpiles are secure, acting to remove the obstacles to cooperation, and helping to secure stockpiles around the world. European and Asian governments have repeatedly downplayed the threat and devoted only the most modest efforts to addressing it. Despite its promise, the \$20 billion “Global Partnership Against the Spread of Weapons and Materials of Mass Destruction,” has so far focused only a small fraction of its effort on the urgent task of securing the world’s nuclear stockpiles—and is still struggling to move from pledges and words to real action on the ground.

**Recommendations: A Security-First Agenda.** The United States and Russia, as the countries with by far the world’s largest stockpiles of nuclear weapons and materials, bear a special responsibility for reducing this danger. The U.S. and Russian Presidents, working with their international partners, must take immediate action to overcome the obstacles to accelerated progress. Breaking through these obstacles requires Presidential action, as many of these impediments cut across agencies and departments, and cannot be addressed by individual Ministers or Cabinet secretaries acting alone, however energetic or well-intentioned. A fast-paced global partnership is urgently needed, to ensure that every nuclear weapon and every kilogram of nuclear material is effectively secured and accounted for, wherever it may be in the world. If even a tenth of the effort and resources the U.S. government devoted to Iraq in the last year were devoted to this effort, there is good reason to believe that the job could be accomplished quickly.

An accelerated and strengthened effort to keep nuclear weapons and materials from being stolen and falling into the hands of terrorists would have many ingredients, but there are three elements that are es-

sential: removing the nuclear material entirely from the world’s most vulnerable sites; accelerating and strengthening the effort in Russia; and building a fast-paced global coalition to improve security for nuclear stockpiles around the world. The recent UN Security Council resolution obligating every state around the world to put in place effective security and accounting for its nuclear stockpiles and effective measures to block illicit trafficking in such items is an excellent first step, which should be followed up vigorously. The U.S. President, the Russian President, other world leaders, and the U.S. Congress must each take action to move this agenda forward.

*The U.S. President.* President Bush should issue a new Presidential directive on nuclear security that would (a) designate securing and accounting for all the world’s stockpiles of nuclear weapons and weapons-usable materials as a top national-security priority; (b) set target dates of achieving high security for every nuclear warhead and every kilogram of weapons-usable nuclear material in the former Soviet Union within four years and worldwide within six years, while removing all nuclear material from the world’s most vulnerable sites within four years; and (c) appoint a senior official with full-time responsibility for leading the entire array of efforts focused on keeping nuclear weapons out of the hands of terrorists. President Bush should direct that official to prepare an integrated, prioritized plan, including measurable milestones for assessing progress, and to identify the most important obstacles to accelerated progress and the immediate steps needed to overcome them. President Bush should focus the government’s efforts intensely on forging the needed fast-paced global partnership to achieve these objectives, making them a central element of U.S. relations with Russia, Pakistan, and other key states. Programs to improve security and accounting for nuclear stockpiles should focus simultaneously on (a) accomplishing upgrades as rapidly as possible; (b) upgrading to a level sufficient to defeat demonstrated terrorist and criminal threats; and (c) ensuring that these security and accounting improvements will be maintained over the long haul, including after U.S. assistance phases out. To achieve these goals, it will be essential to work in genuine partnership with experts from the countries where the sites are located, involving them in all

aspects of conception, design, and implementation of these efforts.

President Bush should also launch several targeted initiatives, including (a) a “global cleanout” effort to remove weapons-usable nuclear material from the world’s most vulnerable sites as rapidly as possible, establishing a task force that consolidates all the necessary resources, authority, and expertise to accomplish that mission; (b) a new reciprocal initiative with Russia to secure, monitor, and dismantle thousands of the most dangerous warheads in both countries (including many tactical warheads, and all warheads not equipped with modern electronic locks or comparably reliable means to prevent unauthorized use); (c) a new effort to gain political commitments, starting with the participants in the Global Partnership, to an effective common standard for nuclear security and an offer of assistance to any state willing to join that commitment but unable to afford to do so; and (d) a comprehensive effort to maximize the chances of recovering stolen nuclear material and stopping nuclear smuggling, including among other elements a plan to make capabilities like those of the U.S. Nuclear Emergency Support Team (NEST) available worldwide on short notice.

Using the excellent rapport he has established with President Putin, President Bush should make breaking through the logjams that are slowing progress in securing nuclear weapons and weapons-usable material a key focus of the next U.S.-Russian summit, seeking agreement on steps ranging from solving the access problem to gaining a Russian commitment to sustaining high levels of security with Russia’s own resources after U.S. assistance phases out.

*The Russian President.* Russian President Putin should (a) make clear that security for every Russian nuclear weapon and every kilogram of Russian weapons-usable nuclear material is a critical priority for Russia’s own national security; (b) appoint a full-time official accountable to him to lead the effort; (c) assign sufficient Russian budget resources to shift the effort to secure these sites from U.S. assistance to genuine partnership, and to sustain security at these sites for the long haul; (d) direct his government to remove the obstacles to U.S.-Russian and global cooperation

in these areas, intervening from the Presidential level where necessary; (e) direct that nuclear weapons and materials be consolidated in a far smaller number of buildings and sites, in order to achieve higher security at lower cost; (f) ensure that effective procedures and adequately trained personnel are put in place to maintain high standards of security and accounting for Russia’s nuclear stockpiles; and (g) ensure that effective nuclear security and accounting laws and regulations are in place that every facility must meet if it is to be allowed to continue to operate with nuclear weapons or weapons-usable nuclear materials, and improve the authority and resources of the regulators charged with making sure facilities meet these standards.

*The Group of Eight and Other Leading States.* The leaders of the G-8 group of industrialized democracies should make fast-paced action to keep nuclear weapons and weapons-usable materials worldwide from being stolen and falling into the hands of terrorists the central focus of their Global Partnership Against the Spread of Weapons and Materials of Mass Destruction. At the G-8 summit planned for June 2004, the G-8 leaders should (a) agree on the priority of securing all nuclear stockpiles worldwide; (b) agree to put the “global” in the Global Partnership, expanding to secure such stockpiles wherever they may be (as President Bush has suggested), and simultaneously expand beyond the original \$20 billion target, to provide the resources to accomplish that objective; (c) set a challenging timetable for doing so; (d) announce a minimum global security standard that their countries will each commit to meet and to help other states meet; (e) agree to cooperate to remove nuclear material entirely from all the world’s most vulnerable sites as rapidly as possible; and (f) agree on a mechanism for setting priorities, dividing up tasks, and coordinating implementation.

The leaders of other key states—including, but not limited to, Pakistan, India, and China—must also recognize that securing these stockpiles is crucial to their own security and to the world, and move quickly to meet the threat. Pledges and words are no longer enough—to win the race to secure these stockpiles before they are stolen, rapid *action* is required.

*The U.S. Congress.* The U.S. Congress should (a) act to make clear that it agrees that securing nuclear stockpiles worldwide is a top priority for the homeland security of the United States; (b) exert effective, performance-based oversight—setting clear goals and holding the Executive Branch accountable for meeting them, while allowing the flexibility needed to seize opportunities and adapt approaches as circumstances change; (c) remove some of the current legislative constraints, giving the President permanent authority to waive certification requirements, allowing unlimited use of threat-reduction funds wherever in the world they may be needed to address threats to U.S. and world security, and allowing the Mayak storage

facility to be used for any nuclear material that poses a proliferation threat; (d) use in-depth hearings with independent witnesses to keep abreast of progress and problems; and (e) mandate key initiatives and legislate solutions when the Congress concludes that the Executive Branch needs help—or direction—to launch new initiatives or solve key problems.

**A Time to Act.** The danger is real, and it is now. The terrorists will not wait for the world to act. President Bush himself has set the bar, saying “the nations of the world must do all we can to secure and eliminate” these stockpiles, and warning “history will judge harshly those who saw this coming danger but failed to act.”



# 1 INTRODUCTION

Today, scores of nuclear terrorist opportunities lie in wait in countries all around the world—sites that have enough nuclear material for a bomb that are not adequately defended against the threats that terrorists and criminals have already shown they can mount. Closing these opportunities is a crucial part of the war on terrorism. Until they are closed, the danger that terrorists could launch a nuclear attack that could incinerate the heart of any major city in the world will remain unacceptably high. A fast-paced global partnership is urgently needed, to remove the weapons-usable nuclear material entirely from the hardest-to-defend sites, and ensure that every site where nuclear warheads or materials remain is effectively secured, wherever it may be in the world.

Today's nuclear agenda is crowded with urgent threats. North Korea's nuclear weapons, Iran's nuclear efforts, Libya's former nuclear weapon program, the global black-market nuclear supply network created by Pakistan's Abdul Qadeer Khan and his co-conspirators—these dangers and more must be urgently addressed. But the danger that inadequately secured nuclear weapons or the materials to make them might be stolen and fall into the hands of terrorists or hostile states must be addressed with equal urgency and sustained high-level focus—it cannot be relegated to the bureaucratic back-burner. A sea-change in the level of sustained presidential leadership devoted to reducing the dangers posed by inadequately secured nuclear stockpiles is needed, to overcome the myriad obstacles that have slowed these crucial efforts.

President Bush *has* focused sustained attention on addressing the danger that terrorists might acquire weapons of mass destruction (WMD). But he

has focused his administration's attention first and foremost on the danger that hostile states might give such weapons to terrorists, and much less on the many other potential terrorist pathways to the bomb. Eliminating the danger that Iraq might give WMD to terrorists was the stated reason for war with Iraq, for which the administration was willing to put over a hundred thousand American troops in harm's way, spend many tens of billions of dollars, and invest America's precious credibility. As the President put it in his 2003 State of the Union address:

... the gravest danger facing America and the world, is outlaw regimes that seek and possess nuclear, chemical, and biological weapons. These regimes could...give or sell those weapons to terrorist allies, who would use them without the least hesitation.<sup>1</sup>

Unfortunately, as we will discuss at length in the next chapter of this report, the belief that terrorists could only get and use a nuclear bomb with the help of a hostile state is a dangerous myth. There is a very real danger that terrorists could get a nuclear bomb not by the conscious decision of a state, but by inadvertence—by states' failing to invest in the measures needed to secure nuclear stockpiles from theft.

An attack using an actual nuclear explosive—either a stolen nuclear weapon that terrorists had succeeded in getting and detonating, or a bomb they made themselves, with stolen plutonium or highly enriched uranium (HEU)—would be among the most difficult types of attack for terrorists to accomplish. But the danger is real. As discussed in the next chapter, numerous studies have concluded that a capable and

<sup>1</sup> President George W. Bush, "State of the Union Address" (Washington, D.C.: The White House, January 28, 2003; available at <http://www.whitehouse.gov/news/releases/2003/01/20030128-19.html> as of April 29, 2004). Similarly, in his speech at the Citadel in South Carolina in December, 2001, a critical early outline of his approach to the war on terrorism and the battle to keep WMD out of terrorist hands, he said: "Rogue states are clearly the most likely sources of chemical and biological and nuclear weapons for terrorists." See President George W. Bush, "President Speaks on War Effort to Citadel Cadets" (Washington, D.C.: The White House, January 28, 2003; available at <http://www.whitehouse.gov/news/releases/2001/12/20011211-6.html> as of April 29, 2004).

well organized terrorist group might well be able to make at least a crude nuclear bomb if they could get stolen HEU or plutonium. And enough of these materials to make many thousands of nuclear weapons, scattered in hundreds of buildings in dozens of countries, remains dangerously insecure.

The danger that these materials might be stolen and used for nuclear terror cannot be eliminated through offensive action or defenses at home. The cornerstone of an effective response is intensive cooperation with states around the world, to secure these stockpiles before terrorists and criminals can reach them. Unfortunately, focused on Iraq and other matters, the President has devoted only modest attention to moving such cooperation forward. It has been treated as something that is important, but not urgent—an issue that can largely be left to specialists.

The destructive power of even the crude sort of nuclear bomb that terrorists might be able to produce is terrifying. As we detailed in a report last year, a bomb with the explosive power of 10,000 metric 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 over \$1 trillion in direct economic damage.<sup>2</sup> It is worth remembering just how awesome the power of nuclear weapons is: 10,000 metric tons of TNT is over 20 million pounds of high explosive—enough to fill a cargo train a hundred cars long. America and its way of life would never be the same again.

As recent bombings in Madrid and Moscow make clear, moreover, America is not the only possible target of such an attack: the potential for terrorist acquisition of a nuclear bomb is a threat to every nation in the world. Indeed, even if it were New York or Washington that was attacked, the economic reverberations, many times those of the 9/11 attacks, would devastate economies around the globe. As a result, insecure nuclear material anywhere is a threat to everyone, everywhere. Every nation has a common

interest in blocking this threat—which is why a global partnership to address it could be successful.

There are two pieces of good news in this picture. First, producing their own HEU or plutonium is almost certainly beyond the capability of subnational terrorist groups. (See “Could Terrorists Produce Their Own Bomb Material?” p. 18.) Hence, if the world’s existing stockpiles of nuclear weapons and weapons-usable nuclear materials can be reliably secured, nuclear terrorism can be reliably prevented: no material, no bomb. The key is securing these stockpiles so they cannot be stolen. Once such items have been stolen, they could be virtually anywhere, and the problems of finding and recovering them, or keeping them from being made into a bomb and delivered to a major city, increase beyond measure.

Second, technology is readily available to secure these stockpiles—and indeed, huge quantities of nuclear weapons and materials already have excellent security arrangements in place. Securing the remaining stocks is a big job, but a doable one. It is a job that can only be accomplished, however, through building in-depth partnerships with countries around the globe, in the very difficult and sensitive area of nuclear security. It is not a question of whether the technology is available, but of whether world leaders can muster the political will to overcome the secrecy, mistrust, and bureaucratic obstacles that dangerously slow the needed cooperation.

Indeed, the progress already made demonstrates the basis for hope that this can happen. Since the collapse of the Soviet Union—history’s first-ever collapse of an empire armed with tens of thousands of nuclear weapons and enough nuclear material for tens of thousands more—the United States and other countries have been working with the states of the former Soviet Union to secure, monitor, and reduce these stockpiles. These efforts have had real, demonstrable successes, representing an excellent investment in U.S. and world security. Enough nuclear material for thousands of nuclear weapons has been

<sup>2</sup> See 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; available at [http://www.nti.org/e\\_research/cnwm/overview/report.asp](http://www.nti.org/e_research/cnwm/overview/report.asp) as of April 29, 2004), pp. 15–19.



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.

The year since our last report was issued has seen important additional successes (see discussion in “Key Developments and Progress in the Past Year,” p. 39):

- During fiscal year (FY) 2003, comprehensive security and accounting upgrades were completed for an additional 35 tons of potentially vulnerable weapons-usable nuclear material in Russia—enough for thousands of nuclear weapons.<sup>3</sup>
- Rapid security upgrades were installed at some 10 to 20 additional nuclear warhead storage sites, and comprehensive security upgrades were completed at two additional sites—with work underway that should allow comprehensive upgrades to be completed at a significantly larger number of sites in FY 2004.
- Thirty tons of highly enriched uranium (HEU)—enough to make some two thousand nuclear weapons—were permanently destroyed, converted for use in civilian U.S. nuclear reactors.
- Stockpiles of HEU were airlifted out of three dangerously vulnerable sites—in Romania, Bulgaria, and Libya—substantially increasing the rate of such removals.

- Equipment and training for detecting smuggled nuclear materials were provided for a minimum of 19 additional sites in several countries.

These successes demonstrate again that effective action to address the threat is not only possible, but is underway every day. The governments, organizations, and individuals responsible for these successes deserve the world’s heartfelt thanks.

But despite these successes, most of the job remains to be done. The 35 tons of material secured last year, for example, represents less than six percent of the estimated 600 tons of potentially vulnerable HEU and separated plutonium outside of nuclear weapons in the former Soviet Union. As of the end of FY 2003, after more than a decade of effort, comprehensive security and accounting upgrades had been completed for only 22% of this weapons-usable nuclear material.<sup>4</sup> An additional 21% of this material has had the initial round of rapid upgrades completed—bricking over windows, installing nuclear material detectors at doors—bringing the total to 43% of the material that had some level of upgrades completed.<sup>5</sup>

Because the effort concentrated first on upgrading particularly vulnerable sites with small quantities of nuclear material—though still enough for a bomb, if stolen—the fraction of sites completed is more impressive. Seventy percent of the sites with nuclear weapons or the nuclear materials needed to make them where DOE’s cooperative security upgrade program has been working now have comprehensive upgrades in place.<sup>6</sup>

But for the more than 300 tons of material for which neither rapid nor comprehensive upgrades have been completed, the United States and the world have neither transparency nor confidence that the

<sup>3</sup>The 35-ton figure was publicly confirmed by Secretary of Energy Spencer Abraham in “Remarks to the Second Moscow International Nonproliferation Conference,” September 19, 2003 (available at <http://www.ceip.org/files/projects/npp/resources/moscow2003/abrahamremarks.htm> as of April 29, 2004). This figure was supplemented and clarified by personal communications from Department of Energy officials, July and September 2003.

<sup>4</sup>DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, D.C.: DOE, February 2, 2004; available at <http://www.mbe.doe.gov/budget/05budget/content/defnn/nn.pdf> as of April 29, 2004).

<sup>5</sup>Personal communication from DOE official, March 2004.

<sup>6</sup>Abraham, “Remarks to the Second Moscow International Nonproliferation Conference,” op. cit.

material is secured from theft; the world is relying on the security improvements Russia has chosen to implement on its own since the Soviet Union collapsed. (See "Nuclear Security in Russia Today," p. 31.) If even a tenth of one percent of this material were to be stolen, the world could face an unparalleled catastrophe. If progress continued at last year's rate of 35 tons per year, it would take 13 years to finish the job—just for the material in the former Soviet Union, leaving aside the insecure stockpiles in dozens of other countries throughout the world. Comprehensive security upgrades have been completed for an even smaller fraction of Russia's nuclear warhead sites, including sites that store readily transportable tactical weapons that may not be equipped with modern, difficult-to-bypass electronic locks to prevent unauthorized use.

Secretary of Energy Spencer Abraham, National Nuclear Security Administration head Linton Brooks, NNSA Deputy Administrator for Defense Nuclear Nonproliferation Paul Longworth, and a number of other officials scattered through the government have worked hard to move this agenda forward, against countless obstacles. Shortly after the 9/11 attacks, Abraham and Russian Minister of Atomic Energy Alexander Rumiantsev agreed to accelerate cooperation in securing nuclear warheads and materials, and they have established a group of senior officials from both sides that meets regularly to attempt to work through specifics of achieving that objective. That group has launched a pilot project at one sensitive site to test approaches to dealing with the access issue, perhaps the biggest single obstacle to progress in securing nuclear stockpiles. Abraham and Rumiantsev have met repeatedly, and they report that they speak by telephone every two weeks between meetings.<sup>7</sup>

But the reality is that many of the key obstacles slowing progress today (including access to sensitive sites, approaches to liability in the event of an accident, cumbersome visa procedures, and more) cut across departments, and can only be effectively addressed

by the U.S. and Russian Presidents or by senior officials reporting to them who have authorities that stretch across agency boundaries. (See "What Are the Main Impediments to Action?" p. 74.) The lesson of past arms control negotiations is very clear: where the President is personally involved day-to-day in pushing these efforts forward, making the hard decisions, and sweeping aside the inevitable obstacles, these efforts succeed. When that is not the case, they fail. And that level of presidential involvement simply does not exist today—meaning that problems and obstacles are allowed to fester, unsolved, for months or even years at a time.

The point is simple: there is in fact more, much more, that it is in President Bush and President Putin's power to do to reduce this threat. By taking action *now*, these two Presidents could reduce the threat to a fraction of what it is today within a few years.

In the ordinary political debate, it is easy enough for administration officials to point to their genuine successes and brush aside critics who argue that more must be done.<sup>8</sup> But imagine how the debate would be reframed if the world lost the race to secure these stockpiles before terrorists and thieves got to them. In the spring of 2004 in the United States, the hearings of the 9/11 Commission have focused the nation's attention on the critical question of whether the sketchy and ambiguous warnings available before the 9/11 attacks should have led to additional action that might have prevented them. What would this debate be like if the hearings were instead focusing on a nuclear terrorist attack that had happened two years after the 9/11 attacks?

Testifying before such a hearing, U.S. officials would have to acknowledge that the warnings that signaled what needed to be done in this case were unambiguously clear. Consider:

- Osama bin Laden has publicly said that he is seeking nuclear weapons.<sup>9</sup>

<sup>7</sup>Remarks by both Abraham and Rumiantsev, "Second Moscow International Nonproliferation Conference," September 19, 2003 (only Abraham's comments are available on-line), and personal communications with DOE officials, March, July, and September 2003.

<sup>8</sup>For an example, see Abraham, "Remarks to the Second Moscow International Nonproliferation Conference," op. cit.

<sup>9</sup>Bin Laden described the pursuit of weapons of mass destruction as his "religious duty." See "Interview with Bin Laden: 'World's Most Wanted Terrorist,'" *ABCNews.com* (available at [http://more.abcnews.go.com/sections/world/DailyNews/transcript\\_binladen1\\_](http://more.abcnews.go.com/sections/world/DailyNews/transcript_binladen1_)

- Al Qaeda has repeatedly attempted to acquire stolen nuclear weapons or nuclear material, and has repeatedly attempted to recruit nuclear expertise to help them build a bomb.<sup>10</sup>
- Documents seized from al Qaeda safehouses in Afghanistan reveal a significant effort to pursue nuclear weapons.<sup>11</sup>
- Russian officials have acknowledged that terrorists carried out reconnaissance four times in 2001–2002 on Russian nuclear warhead storage sites and transport trains, the very locations of which are supposed to be state secrets in Russia.<sup>12</sup>
- The Russian state newspaper has reported that the 41 heavily armed terrorists who seized a theater and hundreds of hostages in Moscow in October 2002 first considered seizing the Kurchatov Institute, a Moscow facility with hundreds of kilograms of HEU, enough for dozens of nuclear weapons.<sup>13</sup>
- In 2003, a Russian criminal case revealed that a Russian businessman had been offering \$750,000 for stolen weapon-grade plutonium for sale to a foreign client.<sup>14</sup>
- The IAEA has documented 18 cases of seizure of stolen HEU or plutonium since 1992, confirmed by the states involved.<sup>15</sup>

Faced with these warnings, after a nuclear terrorist attack occurred, Bush administration officials, Clinton administration officials, and members of Congress would have some explaining to do:

- How would one explain that the amount of material secured in the two years following the 9/11 attacks was actually *less* than the amount of material secured in the two years before—because disputes over access to sensitive sites and other bureaucratic obstacles had been allowed to fester, without presidential intervention to resolve them?<sup>16</sup>
- How would one explain that more than two years after the 9/11 attacks, and more than two years after the general in charge of guarding Russia's nuclear warhead storage sites acknowledged that

990110.html as of April 29, 2004). Bin Laden has claimed that he already possesses nuclear or chemical weapons, and his deputy, Ayman al Zawahiri, has claimed specifically that al Qaeda has purchased nuclear bombs from former Soviet stockpiles. For Bin Laden's claim, see Hamid Mir, "Osama claims he has nukes: If US uses N-arms it will get same response." *Dawn Internet Edition* (Karachi, Pakistan), November 10, 2001 (available at <http://www.dawn.com/2001/11/10/top1.htm> as of April 29, 2004); for Zawahiri's claim (also reported by Mir), see Andrew Denton, "Enough Rope," (interview with Mir), *Australian Broadcasting Corporation*, March 22, 2004 (available at <http://www.abc.net.au/enoughrope/stories/s1071804.htm> as of April 29, 2004).

<sup>10</sup>For a summary and references, see Matthew Bunn, "The Demand for Black Market Fissile Material," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, 2003 (available at [http://www.nti.org/e\\_research/cnwm/threat/demand.asp](http://www.nti.org/e_research/cnwm/threat/demand.asp) as of April 29, 2004).

<sup>11</sup>For the best available summary, see David Albright, "Al Qaeda's Nuclear Program: Through the Window of Seized Documents," *Special Forum* 47 (Berkeley, Cal.: Nautilus Institute, November 6, 2002; available at [http://www.nautilus.org/fora/Special-Policy-Forum/47\\_Albright.html](http://www.nautilus.org/fora/Special-Policy-Forum/47_Albright.html) as of May 12, 2004).

<sup>12</sup>Two of these were on storage sites, two on transport trains. See Vladimir Bogdanov, "Propusk K Beogolovkam Nashli U Terrorista (A Pass To Warheads Found on a Terrorist)," *Rossiiskaya Gazeta*, November 1, 2002; Pavel Koryashkin, "Russian Nuclear Ammunition Depots Well Protected—Official," *ITAR-TASS*, October 25, 2001; and "Russia: Terror Groups Scoped Nuke Site," *Associated Press*, October 26, 2001.

<sup>13</sup>Bogdanov, "A Pass to Warheads Found on a Terrorist," *op. cit.*

<sup>14</sup>See "Nuclear Security in Russia Today," p. 31.

<sup>15</sup>International Atomic Energy Agency, "Calculating the New Global Nuclear Terrorism Threat" (Vienna, Austria: IAEA, November 1, 2001; available at [http://www.iaea.org/NewsCenter/PressReleases/2001/nt\\_pressrelease.shtml](http://www.iaea.org/NewsCenter/PressReleases/2001/nt_pressrelease.shtml) as of April 29, 2004).

<sup>16</sup>According to the Department of Energy's official data, 7% of the roughly 600 tons of potentially vulnerable nuclear material in the former Soviet Union received comprehensive security and accounting upgrades in the two fiscal years following the 9/11 attacks, while 9% of this material had received such upgrades in the two years before. DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, *op. cit.*, p. 446; DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, D.C.: DOE, February 12, 2003; available at <http://www.mbe.doe.gov/budget/04budget/content/defnn/nn.pdf> as of April 29, 2004), p. 624; DOE, *FY 2003 Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, D.C.: DOE, February 2002;

terrorists were carrying out reconnaissance at them, half of the equipment the United States had purchased for a “quick fix” of security at these sites nearly four years before was still sitting in warehouses—because of similar disputes that had also been allowed to linger unresolved? (See “Warhead Security: The Saga of the Slow ‘Quick Fix,’” p. 52.)

- How would one explain that the U.S. government had decided that in most cases it would *not* provide support for increasing security at some types of Russian nuclear warhead sites, leaving warheads there more vulnerable than they need to be, out of a fear that such upgrades might indirectly strengthen Russia’s nuclear capabilities?<sup>17</sup>
- How would one explain that a dispute over liability provisions was allowed to drag on for over a year, delaying the destruction of thousands of bombs’ worth of excess weapons plutonium, and putting a halt to new projects to retool Russia’s nuclear cities?
- How would one explain that summit after summit between the U.S. and Russian Presidents have gone by without presidential action to break through the logjams slowing progress in securing these

stockpiles—and that the agenda for U.S.-Russian cooperation agreed to at the September 2003 summit did not even mention the subject?<sup>18</sup>

- How would one explain that there is literally no one in the U.S. government with full-time responsibility for leading the many efforts in several Cabinet departments related to keeping nuclear weapons and materials out of terrorist hands? Or that there is no one in charge of prioritizing these efforts, overcoming obstacles to progress, eliminating gaps and overlaps, and keeping them on the front burner at the White House every day?

President Bush himself has set the bar, saying “the nations of the world must do *all we can* to secure and eliminate” these stockpiles [emphasis added], and warning that the consensus that nuclear proliferation cannot be tolerated “means little unless it is translated into action.”<sup>19</sup> The United States is demonstrably not meeting President Bush’s “do all we can” standard.

Nor was the United States doing all it could in the Clinton administration, or in the first Bush administration before that. Both the successes and the failures of threat reduction efforts since the approach was invented in the aftermath of the Soviet collapse have

available at <http://www.mbe.doe.gov/budget/03budget/content/defnn/nuclnonp.pdf> as of April 8, 2004), p. 106; Kenneth Sheely, “MPC&A Program Overview – Initiatives for Acceleration and Expansion,” (presentation to the 43rd Annual Meeting of the Institute of Nuclear Materials Management, Orlando, Florida, June 24, 2002). For more discussion, see Chapter 3, “Key Developments and Progress in the Past Year.”

<sup>17</sup>This policy applies to areas at operational sites used for handling nuclear weapons, such as the area at an air base where nuclear bombs might be loaded onto aircraft. For an official confirmation of this approach, see U.S. General Accounting Office (GAO), *Weapons of Mass Destruction: Additional Russian Cooperation Needed to Facilitate U.S. Efforts to Improve Security at Russian Sites*, GAO-03-482 (Washington, D.C.: GAO, March 2003; available at <http://www.gao.gov/new.items/d03482.pdf> as of April 29, 2004), pp. 33–34.

<sup>18</sup>“Joint Statement Between the United States of America and the Russian Federation” (Washington, D.C.: The White House, September 27, 2003; available at <http://www.whitehouse.gov/news/releases/2003/09/20030927-11.html> as of April 29, 2004); “Joint Statement by President Bush and President Putin” (Washington, D.C.: The White House, June 1, 2003; available at <http://www.whitehouse.gov/news/releases/2003/06/20030601-1.html> as of April 29, 2004); “Remarks by President Bush and Russian President Putin in Photo Opportunity, Catherine Palace, St. Petersburg, Russia” (Washington, D.C.: The White House, November 22, 2002; available at <http://www.whitehouse.gov/news/releases/2002/11/20021122-2.html> as of April 29, 2004). The only specific mention of work to secure nuclear weapons and materials in a agreed-upon summit statement came in the post-9/11 November 2001 summit statement: “Joint Statement by President George W. Bush And President Vladimir V. Putin on a New Relationship Between the United States and Russia” (Washington, D.C.: The White House, November 14, 2001; available at <http://www.whitehouse.gov/news/releases/2001/11/20011114-3.html> as of April 29, 2004).

<sup>19</sup>President George W. Bush, “Remarks by the President on Weapons of Mass Destruction Proliferation, Fort Lesley J. McNair, National Defense University, Washington, D.C.” (Washington, D.C.: The White House, February 11, 2004; available at <http://www.whitehouse.gov/news/releases/2004/02/20040211-4.html> as of April 29, 2004).

been thoroughly bipartisan—both parties, and both the Executive Branch and Congress, share the credit for what has been accomplished but also the blame for what has not.

While the U.S. government deserves criticism for the actions not taken, moreover, the United States has taken more effective action to address this threat than any other government. The Russian government, with its economy stabilized and its budget now in surplus, should be devoting far more resources to ensuring its stockpiles are secure, and to helping to secure stockpiles around the world. European and Asian governments have repeatedly downplayed the threat and devoted only the most modest efforts to addressing it. The \$20 billion “Global Partnership Against the Spread of Weapons and Materials of Mass Destruction,” despite its promise, has so far focused only a small fraction of its effort on the urgent task of securing the world’s nuclear stockpiles—and is still struggling to move from pledges and words to real action on the ground.<sup>20</sup>

The purpose of this report is to make the case for actions that could be taken *now*, which, within the next few years, could drastically reduce the danger that such an attack could ever occur. It is to argue for a strategy that *would* be a defensible approach to reducing the danger, meeting President Bush’s call to “do all we can.”

Building on our previous work,<sup>21</sup> this report:

- Seeks to debunk the myths that have led political leaders and policymakers to underestimate the seriousness and urgency of the threat of nuclear terrorism;

- Provides an updated assessment of the threat as it stands today, both in the former Soviet Union and in other countries around the world;
- Analyzes the resources of political leadership and money currently being devoted by the United States to reducing this threat, with an assessment of key developments in the past year;
- Provides an updated assessment, using quantifiable metrics, of the progress U.S.-funded programs have made to date in reducing this threat, and the current rate at which progress continues;
- Recommends an action agenda focused first on securing nuclear stockpiles and blocking nuclear smuggling, tailored to the actions that specific actors should take—including the U.S. President, the Russian President, the leaders of the G-8 industrialized democracies and other key states, and the U.S. Congress.

As with the previous reports in this series, this report focuses narrowly on the threat of terrorism with nuclear explosives. It does not address dispersal of radioactive materials with conventional explosives, or attacks on nuclear energy facilities, or any of the many non-nuclear means by which terrorists might seek to do catastrophic harm. Nor does it discuss the many important and useful cooperative threat reduction efforts focused on goals beyond controlling nuclear weapons and weapons-usable materials—from dismantling missiles and bombers to destroying chemical weapons to improving enforcement of export controls.<sup>22</sup>

Moreover, this report concentrates largely on programs that have been funded by the United States,

<sup>20</sup> Strengthening the Global Partnership Project, *Global Partnership Update*, no. 2 (November 2003; available at [http://www.sgpproject.org/publications/GP\\_update\\_2\\_&\\_Supplemental.pdf](http://www.sgpproject.org/publications/GP_update_2_&_Supplemental.pdf) as of April 29, 2004).

<sup>21</sup> Matthew Bunn, John P. Holdren, and Anthony Wier, *Securing Nuclear Warheads and Materials: Seven Steps for Immediate Action* (Washington, D.C.: Nuclear Threat Initiative and the Project on Managing the Atom, Harvard University, May 2002; available at [http://www.nti.org/e\\_research/securing\\_nuclear\\_weapons\\_and\\_materials\\_May2002.pdf](http://www.nti.org/e_research/securing_nuclear_weapons_and_materials_May2002.pdf) as of April 29, 2004) and Bunn, Wier, and Holdren, *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan* (March 2003; available at [http://www.nti.org/e\\_research/cnwm/overview/report.asp](http://www.nti.org/e_research/cnwm/overview/report.asp) as of April 22, 2004).

<sup>22</sup> Effective export controls are crucially important to preventing transfers of technologies that states could use to produce nuclear weapons, and may have some modest benefit in restraining terrorists’ ability to acquire some technologies that would be useful to their efforts to cobble together an improvised bomb. For an excellent discussion of al Qaeda’s nuclear weapons potential that

which has been the preeminent, but not the only, sponsor of threat reduction programs to date. We touch on other programs only briefly, as they have been much smaller in scope and much less information is publicly available about them. Nearly all cooperative threat reduction efforts to date have focused on the unique security hazards created by the collapse of the Soviet Union; hence, although we emphasize that the control of nuclear weapons, materials, and expertise is a global problem, and we make recommendations for efforts that would take place in countries around the world, most of our specific account of what has been accomplished so far also focuses on the former Soviet Union.

Finally, this report does not address a wide range of international efforts aimed at controlling nuclear arms that are not focused on the threat of theft and smuggling of nuclear materials—from negotiated nuclear arms reductions and restraints, to International Atomic Energy Agency (IAEA) safeguards, to international

nuclear export control arrangements, to the Comprehensive Test Ban Treaty (CTBT).<sup>23</sup>

This report and its predecessors have an on-line companion, "Controlling Nuclear Warheads and Materials" (available at <http://www.nti.org/cnwm>), which provides in-depth supporting information, including the most comprehensive assessments available anywhere of the individual programs focused on keeping nuclear weapons, materials, and expertise out of terrorist hands; an interactive threat reduction budget database; technical background; legislative updates; scores of photographs; and hundreds of annotated links to the best information on these efforts available on the web.

This report, in short, attempts to provide an answer to the question that former Senator Sam Nunn has repeatedly raised: "On the day after a nuclear terrorist attack, what would we wish we had done to prevent it? Why aren't we doing that now?"

includes a mention of export controls as one element of an effort to keep nuclear weapons out of terrorist hands, see Albright, "Al Qaeda's Nuclear Program," *op. cit.* For recent treatments of the broader threat reduction agenda, see *Reshaping U.S.-Russian Threat Reduction: New Approaches for the Second Decade* (Washington, D.C.: Russian American Nuclear Security Advisory Council and Carnegie Endowment for International Peace, November 2002; available at <http://www.ceip.org/files/pdf/Reshaping.Threat.Reduction.pdf> as of April 29, 2004); Robert J. Einhorn and Michèle Fluornoy, eds., *Protecting Against the Spread of Nuclear, Biological, and Chemical Weapons: An Action Agenda for the Global Partnership* (4 Vols.) (Washington, D.C.: Center for Strategic and International Studies, 2003; available at [http://www.csis.org/pubs/2003\\_protecting.htm](http://www.csis.org/pubs/2003_protecting.htm) as of April 29, 2004); and Michael Barletta, ed., *After 9/11: Preventing Mass-Destruction Terrorism and Weapons Proliferation* (Monterey, Cal.: Center for Nonproliferation Studies, Monterey Institute of International Studies, May 2002; available at <http://cns.miis.edu/pubs/opapers/op8/op8.pdf> as of April 29, 2004). While we point out in this report that much of the work needed to prevent nuclear weapons terrorism has not yet been done, a careful reading of the works just cited makes clear that the fraction of the job of controlling the chemical and biological complexes of the former Soviet Union (and the world) that is already accomplished is far less.

<sup>23</sup> A strong IAEA safeguards system does make a contribution to preventing nuclear terrorism, and in that context will be discussed briefly in this report: it does so by ensuring that nuclear material is accounted for on an international basis; requiring that states meet reasonable standards in accounting for their own nuclear material; identifying sites where accounting may be a problem; putting in place a cadre of inspectors, who sometimes take note if there appear to be serious security problems at a particular site; and encouraging states to fix potentially embarrassing problems before inspectors arrive. Moreover, some of the measures included in the Additional Protocol to safeguards agreements, if widely adopted, might help identify sites where terrorist activity using nuclear materials was taking place. See the brief discussion in Albright, "Al Qaeda's Nuclear Program," *op. cit.*

## 2 UPDATING THE THREAT

The danger that nuclear weapons or the materials and expertise needed to make them might fall into terrorist hands remains very real. Despite progress in the past year in improving security for some stockpiles of nuclear weapons and materials, and continued progress in the war on terrorism, the danger may be as great today as it was a year ago—because in other respects, the threat appears to be growing.

In Russia, where much of the security system for the world's largest stockpiles of nuclear weapons and materials collapsed with the Soviet Union, nuclear warheads and materials are becoming steadily more secure—but much more remains to be done, and fragmentary evidence suggest that the efforts of those who want stolen weapons or materials may be coalescing as never before. (See "Nuclear Security in Russia Today," p. 31.)

Elsewhere, deadly dangers are growing. With North Korea's claim that they have processed fuel rods containing enough plutonium for 6–8 nuclear weapons, the probability that terrorists could buy plutonium from that source—or that there could be another source of "loose nukes" if North Korea collapsed—has clearly increased.<sup>1</sup> The two nearly successful attempts to assassinate President Pervez Musharraf of Pakistan, the continuing strength of Islamic extremists there, and revelations that indicate that Pakistan was the source for nuclear technology not only for North Korea but for Iran and Libya as well, all combine to emphasize the danger that Pakistan's nuclear assets or nuclear secrets could fall into terrorist hands—through a change in government, insider or outsider

theft of a weapon or nuclear materials, or scientists providing critical help to a terrorist group. The case of senior Pakistani nuclear weapon scientist Sultan Bashiruddin Mahmood, an anti-American Islamic extremist who met with bin Laden at length and discussed nuclear weapons, highlights this danger.<sup>2</sup>

In the war on terrorism, the past year has seen events that both reduce and heighten the danger of a terrorist nuclear strike. As the United States and its allies continue to prosecute their battle against terrorists with global reach, more al Qaeda leaders and operatives have been killed or captured—but the group appears to have metastasized into a loosely connected movement with affiliated groups or cells all over the world. Attacks and attempted attacks continue around the world; senior U.S. officials report that terrorists remain capable of spectacular strikes in the United States and that attacks on U.S. soil may well occur in the months to come; Taliban guerilla activity in Afghanistan increased in 2003; and guerilla attacks in Iraq continue.

At the same time, with the invasion of Iraq and continuing Israeli-Palestinian violence, hostility toward the United States in the Islamic world has grown to "shocking" levels (as a recent report commissioned by the State Department puts it), providing al Qaeda and other groups with new opportunities to recruit—which could include recruits capable of providing nuclear weapon expertise or access to the materials needed to make a nuclear bomb.<sup>3</sup>

<sup>1</sup> See, for example, Ashton B. Carter, William J. Perry, and John M. Shalikashvili, "A Scary Thought: Loose Nukes in North Korea," *Wall Street Journal*, February 6, 2003. Iran's nuclear capabilities have also increased over the past year, but are not yet at the point where Iran could easily produce enough nuclear material for a bomb.

<sup>2</sup> See, for example, Kamran Khan and Molly Moore, "2 Nuclear Experts Briefed Bin Laden, Pakistanis Say," *Washington Post*, December 12, 2001; Kamran Khan, "Pakistan Releases Nuclear Scientists for Ramadan's End," *Washington Post*, December 16, 2001; and Peter Baker, "Pakistani Scientist Who Met Bin Laden Failed Polygraphs, Renewing Suspicions," *Washington Post*, March 3, 2002.

<sup>3</sup> See Advisory Group on Public Diplomacy for the Arab and Muslim World, Edward P. Djerejian, chairman, *Changing Minds, Winning Peace: A New Strategic Direction For U.S. Public Diplomacy in the Arab & Muslim World* (Washington, D.C.: U.S. Department of State, October 1, 2003; available at <http://www.state.gov/documents/organization/24882.pdf> as of April 29, 2004).

The bottom line is that al Qaeda, its affiliates, and its imitators remain a deadly and highly capable threat, to the United States and to other countries around the world. In raising the U.S. threat level in December 2003, Secretary of Homeland Security Tom Ridge announced that intelligence information indicated that al Qaeda terrorists expected soon to be able to carry out attacks that would “rival or exceed” the 9/11 attacks.<sup>4</sup>

As Director of Central Intelligence George Tenet told Congress in March 2004, al Qaeda, while damaged, remains “as committed as ever to attacking the U.S. homeland,” and “even catastrophic attacks on the scale of September 11 remain within al-Qa’ida’s reach.” Moreover, Tenet emphasized that al Qaeda’s ideology and “destructive expertise” had been widely disseminated to Islamic extremist groups throughout the world, ensuring that “a serious threat will remain for the foreseeable future...with or without al-Qa’ida in the picture.” Tenet emphasized that “for the growing number of jihadists interested in attacking the United States, a spectacular attack on the U.S. Homeland is the ‘brass ring’ that many strive for—with or without encouragement by al-Qa’ida’s central leadership.” Tenet warned in particular that the CIA saw “an increase in the threat from more sophisticated” chemical, biological, radiological, and nuclear weapons, concluding that al Qaeda “continues to pursue its strategic goal of obtaining a nuclear capability.”<sup>5</sup>

## **DEBUNKING SEVEN MYTHS OF NUCLEAR TERRORISM AND NUCLEAR THEFT**

The use of an actual nuclear bomb would be among the most difficult types of attack for terrorists to accomplish. Few terrorist groups would want to carry out an attack as horrifyingly destructive as a nuclear

blast, even if they could. Getting a nuclear bomb or the nuclear material to make one—particularly making the connection with people with access to such material and the ability to steal it—is difficult. Even after acquiring nuclear material, making a nuclear bomb—or setting off a stolen bomb—would be a great challenge. Smuggling a bomb to its intended target could be risky for the attacker.

Many policymakers and analysts appear to believe that these difficulties are so great that the danger of terrorists carrying out a nuclear attack is vanishingly small, unless, perhaps, they were sponsored by a state with nuclear capabilities. As one noted European analyst put it, “religious zealots or political extremists may present many dangers, but wielding nuclear bombs and killing hundreds of thousands of innocent people is not one of them.”<sup>6</sup>

We believe that this view is profoundly wrong. While a nuclear attack would by no means be easy for terrorists to carry out, the probability that terrorists could succeed in doing so is large enough to justify doing “everything in our power,” in President Bush’s words, to prevent it.

If world leaders were convinced, as we are, that the risk of a terrorist nuclear attack on a major city is substantial, and that there are actions that they could take that would dramatically reduce that risk, we believe they would act, and act swiftly, to reduce this deadly threat. Therefore dispelling the key myths that lead officials and policy elites to downplay the danger is crucial to building momentum for an effective response. Each of these myths, like all myths, contains an element of truth—but each is a dangerously weak reed on which to rest the world’s security against nuclear attack.

<sup>4</sup>“Threat Level Raised: Remarks by Secretary of Homeland Security Tom Ridge” (press release, Washington, D.C.: U.S. Office of Homeland Security, December 21, 2003; available at <http://www.whitehouse.gov/news/releases/2003/12/20031221.html> as of April 29, 2004).

<sup>5</sup>Director of Central Intelligence George J. Tenet, “The Worldwide Threat 2004: Challenges in a Changing Global Context,” Testimony to the United States Senate, Select Committee on Intelligence, February 24, 2004 (available at [http://www.cia.gov/cia/public\\_affairs/speeches/2004/dci\\_speech\\_02142004.html](http://www.cia.gov/cia/public_affairs/speeches/2004/dci_speech_02142004.html) as of April 29, 2004).

<sup>6</sup>Karl-Heinz Kamp, “Nuclear Terrorism is Not the Core Problem,” in “WMD Terrorism: An Exchange,” *Survival* (Winter 1998-1999), pp. 168–171.



## **Myth 1: Terrorists Do Not Want to Carry Out a Nuclear Attack**

**Myth:** Before the 9/11 attacks, it was often said that “terrorists want a lot of people watching, but not a lot of people dead.”<sup>7</sup> Many argued that terrorists would remain focused on violence at relatively modest scales, and would be highly unlikely to pursue the incineration of an entire city in a nuclear blast. Many security experts outside the United States still appear to believe that a serious terrorist effort to inflict destruction far beyond the scale of the World Trade Center or Pentagon attacks is highly unlikely.

**Reality:** This conclusion is correct for the vast majority of the world’s terrorist groups. Focused on local issues, seeking to become the governments of the areas now controlled by their enemies (and thus not wanting to destroy those areas), needing to build political support that might be undermined by the horror and wanton destruction of innocent life that would result from a nuclear attack, most terrorists probably would not want to get and use a nuclear bomb even if they could readily do so.<sup>8</sup>

But al Qaeda is different. They are focused on a global struggle, for which the immense power of nuclear weapons might be seen as necessary, not a local bat-

tle for which such weapons are unneeded. They have gone to considerable lengths to justify to their supporters and audiences the use of mass violence, including the mass killing of innocent civilians. And they have explicitly set inflicting the maximum possible level of damage on the United States and its allies as one of their organizational goals. Al Qaeda’s spokesman, Sulaiman Abu Ghaith, has argued that the group “has the right to kill 4 million Americans—2 million of them children,” in retaliation for the deaths the group believes the United States and Israel have inflicted on Muslims.<sup>9</sup>

Al Qaeda’s followers believe, in effect, that they brought down the Soviet Union—that the mujahedeen’s success in forcing the Soviet Union from Afghanistan was a key factor leading to the Soviet collapse. And they appear to believe that the United States, too, is a “paper tiger” which can be driven to collapse—that the 9/11 attacks inflicted grievous damage on U.S. economic power (Osama bin Laden once estimated the total cost at \$1 trillion), and that still larger blows are needed to bring the United States down. As bin Laden put it in a message to his followers in December 2001, “America is in retreat by the grace of God Almighty and economic attrition is continuing up to today. But it needs further blows. The young men need to seek out the nodes of the American economy and strike

<sup>7</sup> Brian M. Jenkins, “Will Terrorists Go Nuclear?” *Orbis* 29, no. 3 (Autumn 1985).

<sup>8</sup> For discussions, see, for example, Jessica Stern, *The Ultimate Terrorists* (Cambridge, Mass.: Harvard University Press, March 1999); Richard A. Falkenrath, Robert Newman, and Bradley Thayer, *America’s Achilles’ Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack* (Cambridge, Mass.: MIT Press, 1998); Bruce Hoffman, “Terrorism and WMD: Some Preliminary Hypotheses,” *Nonproliferation Review* 4, no. 3 (Spring-Summer 1997; available at <http://cns.mii.edu/pubs/npr/vol04/43/hoffma43.pdf> as of April 29, 2004); Gavin Cameron, *Nuclear Terrorism: A Threat Assessment for the 21<sup>st</sup> Century* (Basingstroke: McMillan Press, 1999); and Brian M. Jenkins, “Will Terrorists Go Nuclear? A Reappraisal,” in Harvey W. Kushner (ed.), *The Future of Terrorism: Violence in the New Millennium* (London: Sage, 1998), pp. 225–49. For a view highly skeptical of the threat, see Ehud Sprinzak, “The Great Superterrorism Scare,” *Foreign Policy* (Fall 1998; available at <http://radiobergen.org/terrorism/super-1.html> as of February 24, 2004).

<sup>9</sup> Sulaiman Abu Ghaith, in a series of articles published on al Qaeda’s website (originally [www.alneda.com](http://www.alneda.com), but unavailable at that address because governments have taken action against it), under the title *In the Shadow of the Lances*, in mid-2002. The series explained al Qaeda’s justification for mass killing in general and the September 11 attacks in particular. We are relying here on the translation provided in *MEMRI: Middle East Research Institute Special Dispatch Series*, no. 388, June 12, 2002 (available at <http://www.memri.org/sd.html> as of April 29, 2004). Abu Ghaith mentioned specifically that al Qaeda had a right to use weapons of mass destruction to kill this huge number of people. For a useful summary of al Qaeda and its thinking on inflicting mass death, see Anonymous, *Through Our Enemies’ Eyes: Osama Bin Laden, Radical Islam, and the Future of America* (Dulles, Va.: Brassey’s, 2002). RAND terrorism expert Bruce Hoffman describes this volume as “without doubt the preeminent work on bin Laden and al Qaeda,” and its anonymous author as “a 20-year veteran of the CIA’s operations directorate.” See Bruce Hoffman, “Al Qaeda, Trends in Terrorism, and Future Potentialities: An Assessment” (paper presented at the RAND Center for Middle East Public Policy and Geneva Center for Security Policy 3<sup>rd</sup> Annual Conference, “The Middle East After Afghanistan and Iraq,” Geneva, Switzerland, May 5, 2003).

the enemy's nodes."<sup>10</sup> The notion that major blows could cause the collapse of the United States is, in essence, al Qaeda's idea of how it will achieve victory. A nuclear blast incinerating a U.S. city would be exactly the kind of blow they want.

Bin Laden and his al Qaeda terrorist network have made their desire for nuclear weapons for use against the United States and its allies explicit, by both word and deed.<sup>11</sup> Bin Laden has called the acquisition of weapons of mass destruction (WMD) a "religious duty."<sup>12</sup> Intercepted al Qaeda communications reportedly have referred to inflicting a "Hiroshima" on the United States.<sup>13</sup> Al Qaeda operatives have made repeated attempts to buy stolen nuclear material from which to make a nuclear bomb. They have tried to recruit nuclear weapon scientists to help them. The extensive downloaded materials on nuclear weapons (and crude bomb design drawings) found in al Qaeda camps in Afghanistan make clear the group's continuing desire for a nuclear capability.<sup>14</sup> Detailed analysis of al Qaeda's efforts suggests that, had they not been

deprived of their Afghanistan sanctuary, and had they acquired nuclear material, their quest for a nuclear weapon might have succeeded within a few years—and the danger that it could succeed elsewhere still remains.<sup>15</sup>

As President Bush has summarized the situation, "These same terrorists are searching for weapons of mass destruction, the tools to turn their hatred into holocaust. They can be expected to use chemical, biological and nuclear weapons the moment they are capable of doing so. No hint of conscience would prevent it."<sup>16</sup> Indeed, the President has warned not only that al Qaeda is seeking weapons of mass destruction for use against the United States and its allies, but that, even after the removal of their Afghanistan sanctuary, "the evidence indicates that they are doing so with determination."<sup>17</sup>

Moreover, al Qaeda and its far-flung network of affiliates are not the only terrorists with such ambitions. Some statements by Chechen terrorists and

<sup>10</sup>This argument is outlined, and bin Laden quoted, in Hoffman, "Al Qaeda, Trends in Terrorism, and Future Potentialities: An Assessment," op. cit.

<sup>11</sup>For more on demand for stolen nuclear materials by both terrorist groups and hostile states, see Matthew Bunn, Anthony Wier, and John P. Holdren, "Appendix B. The Demand for Black Market Fissile Material," in *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan* (Washington, D.C.: Nuclear Threat Initiative and Project on Managing the Atom, Harvard University, March 2003; available at [http://www.nti.org/e\\_research/cnwm/overview/report.asp](http://www.nti.org/e_research/cnwm/overview/report.asp) as of April 29, 2004).

<sup>12</sup>"Interview with Bin Laden: 'World's Most Wanted Terrorist,'" *ABCNews.com*, 1999 (available at [http://more.abcnews.go.com/sections/world/DailyNews/transcript\\_binladen1\\_990110.html](http://more.abcnews.go.com/sections/world/DailyNews/transcript_binladen1_990110.html) as of February 23, 2004).

<sup>13</sup>See James Risen and Steven Engelberg, "Signs of Change in Terror Goals Went Unheeded," *New York Times*, October 14, 2001.

<sup>14</sup>For a discussion of known incidents involving al Qaeda attempts to acquire nuclear materials or expertise, with references, see Bunn, Wier, and Holdren, "Appendix B," in *Controlling Nuclear Warheads and Materials*, op. cit. The best available summary of al Qaeda's nuclear efforts, see David Albright, "Al Qaeda's Nuclear Program: Through the Window of Seized Documents," *Special Forum* 47 (Berkeley, Cal.: Nautilus Institute, November 6, 2002; available at [http://www.nautilus.org/fora/Special-Policy-Forum/47\\_Albright.html](http://www.nautilus.org/fora/Special-Policy-Forum/47_Albright.html) as of May 12, 2004). See also David Albright, Kathryn Buehler, and Holly Higgins, "Bin Laden and the Bomb," *Bulletin of Atomic Scientists* 58, no. 1 (January/February 2002; available at <http://www.thebulletin.org/issues/2002/jf02/jf02albright.html> as of April 29, 2004); Mike Boetcher and Ingrid Arnesen, "Al Qaeda Documents Outline Serious Weapons Program," *CNN*, January 25, 2002 (available at <http://www.isis-online.org/publications/terrorism/cnnstory.html> as of April 29, 2004); Gavin Cameron, "Multi-Track Microproliferation: Lessons from Aum Shinrikyo and Al Qaeda," *Studies in Conflict and Terrorism* 22, no. 4 (1999); and Kimberly McCloud and Matthew Osborne, "WMD Terrorism and Usama bin Laden" (Monterey, Cal: Monterey Institute for International Studies, Center for Nonproliferation Studies; available at <http://cns.miis.edu/pubs/reports/binladen.htm> as of April 29, 2004).

<sup>15</sup>Albright, "Al Qaeda's Nuclear Program," op. cit. Albright has likely examined more of the al Qaeda nuclear documents than any other analyst—certainly any other analyst outside the government.

<sup>16</sup>President George W. Bush, "Remarks by the President To United Nations General Assembly, U.N. Headquarters, New York, New York" (Washington, D.C.: The White House, November 10, 2001; available at <http://www.whitehouse.gov/news/releases/2001/11/20011110-3.html> as of April 29, 2004).

<sup>17</sup>President George W. Bush, "Introduction" in *National Security Strategy of the United States of America* (Washington, D.C.: The White House, September 2002; available at <http://www.whitehouse.gov/nsc/nss.pdf> as of April 29, 2004).

documents seized from them have also suggested an interest in large-scale nuclear terrorism—either by sabotage of a major nuclear facility or use of a nuclear bomb—and Chechen terrorists have repeatedly indicated an interest in the use of radiological weapons (including the placement of a container of radiological material in a Moscow park in 1995).<sup>18</sup> As noted above, Russian officials report that terrorists—presumably extremist Chechens—carried out reconnaissance on Russian nuclear warheads four times in 2001–2002 (twice on nuclear warhead storage sites and twice on warhead transport trains), even though the secrecy of the locations of these sites and the schedules for these trains is a fundamental part of the Russian approach to securing these assets.<sup>19</sup> Also, as discussed previously, it has been reported that the Chechen terrorists who seized a Moscow theater in October 2002 had originally considered attacking a Moscow facility with enough HEU for hundreds of nuclear weapons.

Similarly, in the mid-1990s, Aum Shinrikyo, the same Japanese terror cult that launched a deadly nerve gas attack in the Tokyo subways and attempted to carry out anthrax attacks, also actively sought nuclear weapons and the materials to make them.<sup>20</sup>

In short, in the last decade, three different terrorist groups in three different contexts have actively sought nuclear weapons, including attempting to buy or steal nuclear weapons or their essential ingredients. The world cannot assume that these groups will be the last. Even if al Qaeda could somehow be

destroyed completely, the threat of nuclear terrorism would be reduced, not eliminated.

### **Myth 2: Terrorists Could Not Realistically Get a Nuclear Bomb or Nuclear Material to Make One**

**Myth:** Many officials appear to believe that the nuclear materials needed to make a bomb would be nearly impossible for terrorists to get. A senior Clinton administration nonproliferation official, for example, told a reporter that the chances of terrorists acquiring nuclear weapons were “very, very slim,” because of the enormous difficulty of getting hold of the needed nuclear material.<sup>21</sup> Similarly, in December 2003, Russian Deputy Minister of Atomic Energy Sergei Antipov argued that “the nuclear thief does not stand a chance in Russia: it is nearly impossible to steal nuclear materials, let alone of weapons grade, such as plutonium or enriched uranium.”<sup>22</sup>

**Reality:** Not only do nuclear thieves stand a chance in Russia (and elsewhere), they have repeatedly been successful, stealing weapons-usable nuclear material without setting off any alarm or detector. The International Atomic Energy Agency (IAEA) database of illicit trafficking incidents, as noted above, includes 18 cases of seizure of stolen HEU or plutonium confirmed by the states involved (and more cases are known to have occurred that the relevant states have not been willing to confirm). In one case in 1992, for example, a worker at a facility manufacturing fuel from 90% enriched HEU exploited an accounting system designed to write off as normal losses to waste any difference

<sup>18</sup> Simon Saradzhyan, “Russia: Grasping Reality of Nuclear Terror,” *Belfer Center for Science and International Affairs Discussion Paper*, no. 2003-22 (March 2003; available at [http://bcsia.ksg.harvard.edu/BCSIA\\_content/documents/saradzhyan\\_2003\\_02.pdf](http://bcsia.ksg.harvard.edu/BCSIA_content/documents/saradzhyan_2003_02.pdf) as of April 29, 2004).

<sup>19</sup> See Vladimir Bogdanov, “Propusk K Beogolovkam Nashli U Terrorista (A Pass To Warheads Found on a Terrorist),” *Rossiiskaya Gazeta*, November 1, 2002; Pavel Koryashkin, “Russian Nuclear Ammunition Depots Well Protected—Official,” *ITAR-TASS*, October 25, 2001; and “Russia: Terror Groups Scoped Nuke Site,” *Associated Press*, October 26, 2001. While al Qaeda and Chechen terrorism are separate phenomena focused on separate causes, and are treated as such here, there are strong links between the two, including training of Chechen fighters in al Qaeda’s Afghan camps, al Qaeda fighters in Chechnya, and the like. For instance, the late Chechen commander Khattab was an Arab believed to have strong ties to al Qaeda. For Americans, this connection highlights the concern over possible Chechen terrorist acquisition of nuclear weapons or nuclear materials to make them.

<sup>20</sup> See, for example, Cameron, “Multi-Track Micro-Proliferation,” *op. cit.* For a discussion of Aum Shinrikyo’s nuclear efforts in particular, see Bunn, Wier, and Holdren, *Controlling Nuclear Warheads and Materials*, *op. cit.*, pp. 181–182, and references cited therein.

<sup>21</sup> Frank Gardner, “Al-Qaeda Was Making ‘Dirty Bomb,’” *BBC News*, January 31, 2003 (available at [http://news.bbc.co.uk/2/hi/uk\\_news/2711645.stm](http://news.bbc.co.uk/2/hi/uk_news/2711645.stm) as of April 29, 2004). The substance of this story, if correct, also provides alarming confirmation of al Qaeda’s continuing work on radiological and nuclear weapons.

<sup>22</sup> Quoted in Tatyana Sinitsina, “Does the Nuclear Thief Stand a Chance in Russia?” *RIA Novosti*, December 30, 2003.

## DEMONSTRATED TERRORIST AND CRIMINAL THREATS

Stealing enough weapons-usable nuclear material for a bomb, or a nuclear warhead itself, by no means would be an easy task for terrorists or thieves. An examination of past attacks and crimes involving high-value non-nuclear targets demonstrates the kinds of outsider and insider threats that terrorists and criminals have demonstrated they are able to pose—against which stockpiles of nuclear weapons and their essential ingredients must be protected.<sup>1</sup>

### *Outsider Threats*

**Large overt attack.** Terrorists have repeatedly demonstrated the ability to mount large overt armed attacks. In October 2002, for example, 41 heavily armed, well-trained, suicidal Chechen terrorists (the 19 women in the group all had explosives attached to their bodies) struck a Moscow theater in a carefully planned attack launched without warning, seizing hundreds of hostages.<sup>2</sup> The official Russian government newspaper reported that the group had considered seizing facilities at Moscow's Kurchatov Institute (where hundreds of kilograms of highly enriched uranium, enough for dozens of nuclear weapons, is located).<sup>3</sup>

**Multiple coordinated teams.** The 9/11 attacks provided an especially clear example of the use of multiple, independent, well-coordinated teams striking simultaneously. These attacks involved four teams, each with four to five well-trained, suicidal participants, from a larger organization with access to heavy weapons and explosives. The groups spent over a year collecting intelligence and planning without being detected, yet succeeded in striking without warning. Many nuclear facilities today have security systems designed only to handle a single team of attackers.

**Significant covert attack.** Criminals often use covert outsider attacks to strike their target without the defense even being aware until after the crime has been committed. In 2003, for example, thieves in India drilled through a wall to avoid a sophisticated alarm system at the front gates, in order to steal three canisters containing cobalt-60.<sup>4</sup>

**Use of deception and diversion.** Criminals have frequently used deception to trick their way through a target's defenses. In 1990, for example, thieves dressed as policemen tricked the guard at the Gardner Museum in Boston into letting them go into the museum and remove several priceless works of art, including a Rembrandt.<sup>5</sup>

**Use of unusual vehicles.** Criminal groups have frequently used a variety of vehicles to help them get through security systems. For instance, helicopters have been used in many recent prison escapes, such as in France and in Puerto Rico. Similarly, the six men convicted for planning a heist of \$500 million worth of diamonds from London's Millennium Dome in November 2000 used a bulldozer to break into the dome, then planned on using a speedboat along the Thames to escape.<sup>6</sup> The security plans at many nuclear facilities are not designed to cope with attackers arriving and departing in a helicopter.

### *Insider Threats*

**The desperate insider.** Insiders who are desperate for money—to provide for themselves or their families, to settle debts, to feed a drug habit—are inevitably a danger. This appears to have been the case with the 1992 theft of 1.5 kilograms of 90% enriched HEU from the Luch facility in Russia, for example.<sup>7</sup> While Russia's economic stabilization has reduced this danger, there are still frequent incidents of theft—sometimes involving major weapons systems—by soldiers and sailors seemingly desperate for money.<sup>8</sup> Insiders may be particularly prone to steal when they still have access but know that they will soon lose their jobs—as is the case with thousands of nuclear workers in Russia today.

**The vengeful, disgruntled insider—or former insider.** Insiders angry with their employers have both motive and opportunity to steal, or to help outsiders do so. In one case in the early 1990s, a group of six employees at a Halliburton facility in India admitted to stealing three radioactive sources and dumping them in a nearby river, simply because they were angry over a decision to transfer one of the six to another site. Disgruntled ex-employees, who are familiar with the location of valuable items and the facility's security system, and may still have good contacts among current employees, have also played a key role in many major crimes.<sup>9</sup>

**The greedy, corrupt senior insider.** Greed is the most common motivation for all kinds of inside jobs in high-value robberies, from Tiffany jewelry to precious artwork, from multimillion dollar armored car heists to stockpiles of integrated circuits worth much more than their weight in gold.<sup>10</sup> At guarded facilities, the guards themselves are often the insider criminal—representing 41% of the insider thefts at guarded facilities in one database.<sup>11</sup> A senior manager who tries to exploit his or her position to satisfy his or her greed poses a particular danger, because of his or her knowledge of the facility's defenses and ability to direct employees to take actions that may make a theft easier. The A.Q. Khan global nuclear black-market network is a case of the greedy senior insider on an epic scale. The case of Alexander Tyulyakov, a Deputy Director of Atomflot, the enterprise that maintains Russia's fleet of nuclear-powered icebreakers, is a smaller recent example: as described elsewhere in this report, Tyulyakov was arrested in August 2003 with more than a kilogram of apparently stolen natural uranium and illegal weapons. He had attempted to sell the uranium material for \$55,000.<sup>12</sup> While the material may or may not have been stolen from an Atomflot facility, the involvement of a senior manager of a facility that manages large quantities of weapons-usable HEU makes this a worrying case.

**The ideologically motivated insider.** An insider might betray the trust placed in him or her for ideological reasons—for the combination of ideology and money. Perhaps the most dangerous recent example in the area of nuclear security is the case of senior Pakistani nuclear weapon scientist Sultan Bashiruddin Mahmood, an anti-American Islamic extremist who after his retirement met with Osama bin Laden and discussed nuclear weapons at length.<sup>13</sup>

**The blackmailed insider.** Even if all the insiders are believed to be highly reliable, they might be coerced into joining a scheme against their wishes. In one case in England, thieves kidnapped a bank manager's wife to coerce him into helping them rob his safe.<sup>14</sup> Kidnapping to blackmail family members into carrying out certain actions has been a common Chechen terrorist tactic.<sup>15</sup> Such tactics are frequently successful.<sup>16</sup>

**Multiple insiders.** Conspiracies of multiple insiders, familiar with the weaknesses of the security system (and in some cases including guards or managers) are among the most difficult threats for security systems to defeat. Few nuclear facility security systems in place today could reliably defeat a well-planned conspiracy involving multiple well-placed insiders. Yet insider conspiracies are relatively common. In 1998, for example, an insider conspiracy at one of Russia's largest nuclear weapons facilities attempted to steal 18.5 kilograms of HEU—potentially enough for a bomb.<sup>17</sup>

**Insider-outsider collusion.** Perhaps the most dangerous threat—because it may be the threat best able to overcome typical nuclear security systems—is the threat of insiders and outsiders working together. This type of crime is distressingly common, with the insiders' roles ranging from simply providing information, to disabling critical security systems, to using armed violence to help the outsiders attain their objectives.<sup>18</sup>

The bottom line is that the threats against which nuclear weapons and weapons-usable nuclear materials must be protected, judged not by speculation but by the capabilities that terrorists and criminals have already demonstrated, are quite severe.

<sup>1</sup> For earlier examples of a similar approach to assessing the threat, see Robert Reinstedt and Judith Westbury, *Major Crimes as Analogs to Potential Threats to Nuclear Facilities and Programs*, N-1498-SL (Santa Monica, Cal.: RAND, April 1980); and Bruce Hoffman, Christina Meyer, Benjamin Schwarz, and Jennifer Duncan, *Insider Crime: The Threat to Nuclear Facilities and Programs*, R-3782-DOE (Santa Monica, Cal.: RAND, February 1990).

<sup>2</sup> See, for example, "118 Hostages are Dead in Moscow Theater Raid," *The Russia Journal*, October 27, 2002.

<sup>3</sup> Vladimir Bogdanov, "Propusk K Beogolovkam Nashli U Terrorista (A Pass To Warheads Found on a Terrorist)," *Rossiiskaya Gazeta*, November 1, 2002.

<sup>4</sup> "Radioactive material stolen from steel plant in eastern India," *Associated Press Newswires*, August 17, 2003.

<sup>5</sup> Elizabeth Neuffer, "Gardner: Masterwork of Crime Retracing the Steps of Robbery's Twisted Trail," *Boston Globe*, May 13, 1990. For other examples of the common deception tactic, see Reinstedt and Westbury, *Major Crimes as Potential Threats to Nuclear Facilities and Programs*, op. cit.

<sup>6</sup> John Tagliabue, "Latest in a Series of Bold Breaks Frees 3 Inmates at French Jail," *New York Times Abstracts*, April 15, 2003; "5 Use Copter to Break Out of Prison," *Los Angeles Times*, December 31, 2002; Sue Leeman, "Scotland Yard Foils Huge Jewel Heist," *Associated Press*, November 8, 2000.

<sup>7</sup> Public Broadcasting System, "Loose Nukes: Interviews," *Frontline*, 1996 (available at <http://www.pbs.org/wgbh/pages/frontline/shows/nukes/interviews/smimov.html> as of April 29, 2004).

<sup>8</sup> For several examples of apparently desperation-driven theft in the Russian armed forces, see Matthew Bunn et al., "Anecdotes of Nuclear Insecurity," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, January 16, 2004 (available at [http://www.nti.org/e\\_research/cnwm/threat/anecdote.asp](http://www.nti.org/e_research/cnwm/threat/anecdote.asp) as of April 26, 2004).

<sup>9</sup> For the India case, see "Radioactive Device Stolen From Halliburton India Unit," *Dow Jones Newswires*, October 11, 1993; for a discussion of disgruntled former insiders, see, for example, Reinstedt and Westbury, *Major Crimes as Analogs to Potential Threats to Nuclear Facilities and Programs*, op. cit.

<sup>10</sup> Larry McShane, "Cops Nab 6, Recover Most of Tiffany Loot," *Associated Press*, September 11, 1994; Jeffrey Fleishman and Sonya Yee, "Masterpiece is Stolen from a Vienna Museum," *Los Angeles Times* (May 12, 2003); Jim Herron Zamora and Sandra Ann Harris, "Armored Car Heist Seen as Part of Inside-Job Trend," *San Francisco Examiner*, November 26, 1997; "Chips Fall Into Wrong Hands," *American Shipper* 39, no. 7 (July 1, 1997), p. 40.

<sup>11</sup> Hoffman et al., *Insider Crime*, op. cit.

<sup>12</sup> For more on this case, see, for example, "Zamdirektora Atomflota Prodal Atomnyyu Bombu (Deputy Director of Atomflot Sold Atomic Bomb)," *Kommersant*, October 3, 2003; "Gryaznoe Delo (Dirty Business)," *Izvestia*, October 4, 2003; Nadezhda Popoova, "Yaderny Pogreb' Rossii Stal Prohodnym Dvorom (Russia's 'Nuclear Vault' Has Become Public Thoroughfare)," *Nezavisimaya Gazeta*, October 20, 2003; and "Russian Official Arrested for Trying to Sell Radioactive Material," *Agence-France Press*, August 28, 2003.

<sup>13</sup> Kamran Khan and Molly Moore, "2 Nuclear Experts Briefed Bin Laden, Pakistanis Say," *Washington Post*, December 12, 2001; Peter Baker, "Pakistani Scientist Who Met Bin Laden Failed Polygraphs, Renewing Suspicions," *Washington Post*, March 3, 2002.

<sup>14</sup> "Bank Heist Hostage Held Naked in Carpet," *The Herald* (Glasgow), March 23, 1999.

<sup>15</sup> Robyn Dixon, "Chechnya's Grimmiest Industry: Thousands of People Have Been Abducted by the War-Torn Republic's Kidnapping Machine," *Los Angeles Times*, September 18, 2000.

<sup>16</sup> Reinstedt and Westbury, *Major Crimes as Potential Threats to Nuclear Facilities and Programs*, op. cit.

<sup>17</sup> For discussions, with references, of many of the major theft cases, including this one, see Matthew Bunn, *The Next Wave: Urgently Needed New Steps to Control Warheads and Fissile Material* (Washington, D.C.: Carnegie Endowment for International Peace and the Project on Managing the Atom, Harvard University, April 2000; available at [http://bcsia.ksg.harvard.edu/BCSIA\\_content/documents/FullNextWave.pdf](http://bcsia.ksg.harvard.edu/BCSIA_content/documents/FullNextWave.pdf) as of May 5, 2004).

<sup>18</sup> See discussion of some incidents of this type in Hoffman et al., *Insider Crime*, op. cit.

between input and output that was less than 3% of the input. He simply stole small amounts of HEU day after day, finally stopping when he had 1.5 kilograms. His thefts were never detected; instead, he was caught by accident when friends he was talking with were arrested for unrelated crimes and he was swept along with them.<sup>23</sup>

In another case in 1993, a Russian naval officer walked through one of many well-known holes in the fence at a naval facility, easily snapped the padlock on a small shed with a crowbar, stuffed several kilograms of HEU from the shed into his backpack, and retraced his steps. No one noticed, and no alarms sounded. The theft was only detected hours later because he had carelessly left the door unlocked and the broken padlock lying in the snow. He and his co-conspirators were only caught months later, when one of them informed on the others. The military prosecutor in the case concluded that “potatoes are guarded better.”<sup>24</sup>

To be fair, in the decade since these cases, such extreme security lapses have largely been fixed, with several rounds of security upgrades that Russia has undertaken unilaterally, and upgrades that have been accomplished with U.S. and other international assistance. But at many facilities in Russia and elsewhere in the former Soviet Union, visitors continue to observe decaying fences, broken intrusion detectors, paper record systems for keeping track of how much nuclear material is on hand that were never designed for detecting thefts, and seals on nuclear material containers that could easily be broken and replaced with identical ones without detection. Russian officials themselves have warned that substantial increases in Russian spending on security at nuclear facilities are needed, given the threat. (See “Nuclear Security in Russia Today,” p. 31.)

An obvious question is: how big is the iceberg of which the known theft cases are the tip? As the U.S. Central Intelligence Agency (CIA) put it in early 2002:

Weapons-grade and weapons-usable nuclear materials have been stolen from some Russian institutes. We assess that undetected smuggling has occurred, although we do not know the extent or magnitude of such thefts. Nevertheless, we are concerned about the total amount of material that could have been diverted over the last 10 years.<sup>25</sup>

Inadequately secured nuclear material is not just a Russia problem—it is a global problem. The essential ingredients of nuclear weapons exist in hundreds of buildings in more than 40 countries around the world. In some cases, such as in Pakistan, even a substantial guard force may not be adequate to protect against the substantial insider and outsider threats to nuclear facilities.

Terrorists and criminals have already demonstrated that they are capable of mounting quite substantial threats—from the 9/11 threat of four independent but coordinated teams of four to five well-trained, suicidal terrorists each, striking without warning after collecting intelligence and planning the attack for years, to the incidents of theft and corruption by senior military officers and nuclear scientists, in Russia, Pakistan, and elsewhere. (See “Demonstrated Outsider and Insider Threats,” p. 14.) The security systems for most nuclear facilities in the world are simply not designed to be capable of withstanding some of these threats. In other words, if terrorists and criminals apply what they have already shown they can do to the mission of getting nuclear materials, there is a dangerously high chance they would succeed.

<sup>23</sup> See, for example, the interview with the thief, Leonid Smirnov, conducted by the Public Broadcasting System show *Frontline* in 1996 (available at <http://www.pbs.org> as of April 29, 2004). (The thief is referred to there as Yuri Smirnov, but most other accounts agree that his name is Leonid Smirnov.)

<sup>24</sup> See Oleg Bukharin and William Potter, “Potatoes Were Guarded Better,” *Bulletin of the Atomic Scientists* 51, no. 3 (May-June 1995; available at <http://www.thebulletin.org/issues/1995/mj95/mj95.bukharin.html> as of April 29, 2004).

<sup>25</sup> National Intelligence Council, *Annual Report to Congress on the Safety and Security of Russian Nuclear Facilities and Military Forces* (Langley, Va.: Central Intelligence Agency, February 2002; available at [http://www.cia.gov/nic/PDF\\_GIF\\_otherprod/russiannucfac.pdf](http://www.cia.gov/nic/PDF_GIF_otherprod/russiannucfac.pdf) as of April 29, 2004). Despite its “Annual Report” title, no similar reports have been published since then.

Making connections between the terrorists or hostile states who might want stolen nuclear materials and the insiders in a position to steal them, or to provide information that would help outsiders steal them, seems to have been particularly difficult in the past. Thieves who have stolen nuclear material have often had no particular buyer in mind, and have gotten caught as a result of their clumsy efforts to find a buyer. But the world cannot rely on criminals and terrorists failing to figure out how to make these connections. Given the case of the Russian businessman offering hundreds of thousands of dollars to anyone who could steal weapons-grade plutonium for sale to a foreign client, and the cases of terrorist scouts succeeding in finding out where Russian nuclear warhead storage sites were and where and when nuclear warhead transport trains were moving, critical parts of making these linkages already appear to be occurring. Moreover, substantial smuggling networks are shipping a wide variety of contraband back and forth across Russia's borders to the Central Asian states and beyond; for example, much of the burgeoning Afghan heroin crop is believed to be shipped through the Central Asian states and Russia to markets in Europe.<sup>26</sup> If even one of the cross-border criminal connections made by such means were successfully used to market stolen nuclear material to the terrorists seeking to get it, the world could face a devastating catastrophe.

### **Myth 3: Terrorists Could Not Make a Nuclear Bomb if They Had the Material (Or Set Off a Bomb if They Had One)**

**Myth:** Another critical myth is that, as one leading analyst argued, "actually building [a crude nuclear weapon] is extremely difficult. A number of coun-

tries with vast resources and expertise, such as Iraq, have struggled unsuccessfully to produce one. It is difficult to imagine that a small terrorist group would find bomb-building any easier."<sup>27</sup> The former Deputy Minister of Atomic Energy in charge of securing Russia's massive stockpiles of nuclear material has publicly stated that "we have to bear it in mind that even having any nuclear material does not mean that an explosive device can be made [by terrorists]. This is absolutely impossible."<sup>28</sup>

**Reality:** Unfortunately, this argument is also incorrect. The comparison to states' difficulties acquiring nuclear weapons conflates the difficulty of *producing the nuclear material* needed for a bomb—the key area on which Iraq spent billions of dollars—with the difficulty of making a bomb once the material is in hand. (The CIA, for example, estimated that getting stolen nuclear material from abroad would have cut the time Iraq required to make a bomb from years to months.<sup>29</sup>) And it fails to make the crucial distinction between making a safe, reliable, and efficient nuclear weapon suitable for delivery by a missile or a fighter aircraft—that is, the kind of nuclear weapon a typical state would want for its arsenal, whose design and construction does require substantial scientific and technical expertise—with the far simpler task of making a crude, unsafe, unreliable terrorist nuclear explosive that might be delivered by truck or boat.

If enough HEU is gathered in the same place at the same time, a nuclear chain reaction will occur. Indeed, considerable care has to be taken to prevent this from happening accidentally. The bomb that obliterated the Japanese city of Hiroshima at the end of World War II was a cannon that fired a projectile of HEU into rings of HEU—a so-called "gun-type" bomb. The basic

<sup>26</sup> U.S. Department of State, *International Narcotics Control Strategy Report: 2002* (Washington, D.C.: State Department, March 1, 2003; available at <http://www.state.gov/documents/organization/18181.pdf> as of April 29, 2004), pp. IX-101–IX-105.

<sup>27</sup> Kamp, "Nuclear Terrorism is Not the Core Problem," op. cit.

<sup>28</sup> Deputy Minister of Atomic Energy Alexander Kotelnikov, interviewed on "Secret Materials," *Russian Central TV*, November 29, 2002 (translated by BBC Monitoring Service).

<sup>29</sup> U.S. Central Intelligence Agency, *Iraq's Weapons of Mass Destruction* (Langley, Va.: October 2002; available at [http://www.cia.gov/cia/reports/iraq\\_wmd/Iraq\\_Oct\\_2002.htm](http://www.cia.gov/cia/reports/iraq_wmd/Iraq_Oct_2002.htm) as of May 17, 2004). A more detailed assessment by David Albright, a former United Nations inspector in Iraq, and Khidir Hamza, a former participant in Iraq's nuclear weapons program, concluded that if Iraq got stolen HEU, it could manufacture an implosion bomb using its existing design in less than two months; modifying the design for use with plutonium would take longer, but still less than a year. See David Albright and Khidir Hamza, "Iraq's Reconstitution of its Nuclear Weapons Program," *Arms Control Today* (October 1998; available at [http://www.armscontrol.org/act/1998\\_10/daoc98.asp](http://www.armscontrol.org/act/1998_10/daoc98.asp) as of May 17, 2004).

## COULD TERRORISTS PRODUCE THEIR OWN BOMB MATERIAL?

Revelations that Pakistani nuclear scientist Abdul Qadeer Khan and his co-conspirators had organized a far-flung nuclear black market that had supplied complete uranium enrichment centrifuges to Libya, Iran, and apparently North Korea have raised questions about whether access to such technology might allow even a terrorist group to produce highly enriched uranium (HEU) or plutonium for itself, rather than having to rely on obtaining already produced material from a state that already possesses it.<sup>1</sup> The Japanese terror cult Aum Shinrikyo apparently planned to try, having purchased a farm in Australia for its uranium deposits, and stolen documents relating to laser isotope enrichment.

To produce HEU first requires mining or obtaining uranium ore, converting that ore into a chemical form suitable for enrichment, and then enriching it—concentrating the isotope U-235, which is less than 1% of the uranium that occurs naturally, to at least (and likely far above) the 20 percent concentration defined as HEU.<sup>2</sup> A variety of enrichment technologies exist, each posing difficult obstacles. The Khan network was peddling centrifuge technology, which uses sets of hundreds or thousands of sophisticated, ultra-high-speed, spinning centrifuges to separate U-235 from the slightly heavier U-238. (It should be noted that the amount of enrichment work—and therefore the number of centrifuges—required to make a bomb's worth of HEU would be far less if the operator of the facility were able to get hold of low-enriched uranium rather than natural uranium as the starting material—much of the work of producing weapon-grade uranium has already been done in producing low-enriched uranium.) But even with complete centrifuges provided from the black market, building and operating an enrichment facility would be extraordinarily difficult for a terrorist group. Iran, for example, is a nation with a substantial indigenous science and technology base and substantial monetary resources, and Iran now admits that it had received complete centrifuge designs as early as 1987, yet for years thereafter, the Iranian enrichment program apparently made little progress—until an additional infusion of outside assistance allowed Iran to develop the capacity to manufacture and operate enrichment centrifuges.

For terrorists to produce their own plutonium would require both building a nuclear reactor and at least a crude facility to extract plutonium from spent fuel. (Alternatively, terrorists might arrange to steal spent fuel, avoiding the need for their own reactor—but spent power reactor fuel is massive and intensely radioactive, making it extremely difficult to steal.) Building a plutonium production reactor, operating it long enough to produce a bomb's worth of plutonium, and then separating that plutonium from the reactor's spent fuel appears well beyond the capabilities of any terrorist group known to date.

In short, even given the leakage of technology from the Khan network, producing their own bomb material would be beyond the plausible capabilities of known terrorist groups. Hence if the stockpiles of nuclear weapons and weapons-usable materials can be secured reliably and kept out of terrorist hands, nuclear terrorism can be reliably prevented.

<sup>1</sup> On Iran, see David Albright and Corey Hinderstein, "The centrifuge connection," *Bulletin of the Atomic Scientists* 60, no. 2 (March/April 2004; available at <http://www.thebulletin.org/issues/2004/ma04/ma04albright.html> as of March 15, 2004). On the Libya program, see IAEA, "Implementation of the NPT Safeguards Agreement of the Socialist People's Libyan Arab Jamahiriya: Report by the Director General," GOV/2004/12; February 20, 2004; available at <http://www.iaea.or.at/Publications/Documents/Board/2004/gov2004-12.pdf> as of March 15, 2004).

<sup>2</sup>This discussion is drawn from John Holdren and Matthew Bunn, "Technical Background," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, November 25, 2002 (available at [http://www.nti.org/e\\_research/cnwm/overview/technical.asp](http://www.nti.org/e_research/cnwm/overview/technical.asp) as of March 15, 2004).

principles that need to be understood to make a gun-type bomb are widely available in the open literature. Even when nothing of the kind had ever been done before, Hans Bethe, one of the technical leaders of the Manhattan Project, reports that the working principles of a gun-type bomb were "well taken care of" by one scientist and two of his graduate students during a summer study at Berkeley, before the bomb team ever arrived at Los Alamos.<sup>30</sup>

Gun-type weapons offer a simplicity and robustness that allows the builder to have high confidence that the weapon will perform properly without undergoing the trouble, expense, and likelihood of discovery associated with a test nuclear explosion.<sup>31</sup> A gun-type weapon is highly inefficient (meaning that only a small fraction of the nuclear-explosive material used actually fissions) and so requires a substantial amount of nuclear material. The Hiroshima bomb, which was a

<sup>30</sup>Richard Rhodes, *The Making of the Atomic Bomb* (New York, N.Y.: Simon & Schuster Touchstone, 1986), p. 417.

<sup>31</sup>Even the makers of the first gun-type nuclear weapon—the four-ton "Little Boy" exploded by the United States over Hiroshima on August 6, 1945—were confident enough of its performance to agree to its use in war without a test explosion first.



gun-type weapon, used approximately 60 kilograms of HEU metal.<sup>32</sup>

It is impossible to make an effective gun-type bomb with plutonium, because the rate of spontaneous fission is so high that the chain reaction will start as the two pieces in the gun get close to each other, blowing the weapon apart before any significant yield results.<sup>33</sup> Hence, if the material terrorists had available was plutonium, or if the amount of HEU they had available was too small for a gun-type weapon, they would have to attempt the more challenging task of designing and building an “implosion type” weapon. An implosion type weapon uses a set of precisely shaped explosives arranged around a less-than-critical mass of HEU or plutonium to crush the atoms of material closer together, increasing the chance that whenever one of those atoms splits and releases neutrons, those neutrons will hit and split another atom—and hence setting off the nuclear chain reaction.<sup>34</sup>

Designing and building an implosion bomb would be a significantly greater challenge for a terrorist group. In such a bomb, precision timing in setting off the explosives is crucial: if the explosives on one side go off much before the explosives on the other side, the nuclear material will be flattened rather than crushed to a smaller sphere, and there will be no nuclear explosion. In addition, an implosion device using either

weapon-grade plutonium or HEU requires a means for generating a burst of neutrons to start the chain reaction at the right moment, before the conventional explosion destroys the configuration that will sustain a nuclear chain reaction.<sup>35</sup> Solving these technical challenges of implosion weapons was a major part of the Manhattan Project effort at Los Alamos during World War II. It had never been done before, and the whole approach had to be invented from scratch.<sup>36</sup> Today, however, with the knowledge that it can be done, and substantial information on the needed explosives in the unclassified literature (explosive lenses and other shaped explosive charges are now in wide use for conventional military and even commercial applications), the challenge would be less, though still significant.

Unfortunately, repeated examinations of the question, “could resourceful terrorists design and build a crude nuclear bomb if they had the needed nuclear material?” by nuclear weapons experts in the United States and elsewhere have concluded that the answer is “yes”—for either type of nuclear bomb. These conclusions were drawn *before* the 9/11 attacks demonstrated the sophistication and careful planning and intelligence gathering of which al Qaeda is capable.<sup>37</sup> A detailed examination by the U.S. Office of Technology Assessment, drawing on all the relevant classified information, summed up the situation in a conclusory

<sup>32</sup> Federation of American Scientists, “Special Weapons Primer: Nuclear Weapon Design,” October 21, 1998 (available at <http://www.fas.org/nuke/intro/nuke/design.htm> as of April 29, 2004).

<sup>33</sup> Use of a gun-type design with plutonium is not entirely impossible; with a fast gun, the yield of a gun-type plutonium bomb might still be sufficient to destroy a city block or more. See discussion in Stanislav Rodionov, “Could Terrorists Produce Low-Yield Nuclear Weapons?” in *High-Impact Terrorism: Proceedings of a Workshop* (Washington, D.C.: National Academies Press, 2002; available at <http://books.nap.edu/books/0309082706/html/156.html> as of April 29, 2004).

<sup>34</sup> The Trinity and Nagasaki implosion bombs involved explosive “lenses” arranged around a six kilogram sphere of plutonium metal (itself surrounded by a reflector), with detonators arranged all around the sphere so that the explosives were set off from every side at the same time, creating a spherical shock wave moving inward that crushed the sphere to a much higher density.

<sup>35</sup> In this respect, terrorists might even *prefer* to have reactor-grade plutonium than weapon-grade plutonium: because of the far larger number of neutrons released continuously by reactor-grade plutonium, an implosion bomb with this material might be able to do without a neutron generator. (This was first pointed out to one of the authors (Bunn) by a Russian nuclear weapon designer who had been assigned to study possibilities for terrorist design and construction of a nuclear bomb.) The assured explosive yield of an implosion bomb with reactor-grade plutonium would typically be substantially lower than the yield of a device made from weapon-grade plutonium, however.

<sup>36</sup> See the excellent discussion in Rhodes, *The Making of the Atomic Bomb*, *op. cit.*

<sup>37</sup> See J. Carson Mark, Theodore Taylor, Eugene Eyster, William Maraman, and Jacob Wechsler, “Can Terrorists Build Nuclear Weapons?” in Paul Leventhal, and Yonah Alexander, *Preventing Nuclear Terrorism* (Lexington, MA: Lexington Books, 1987; available at <http://www.nci.org/k-m/makeab.htm> as of April 29, 2004). This remains the most authoritative unclassified treatment of the subject—in part because it represents something of a negotiated statement by experts with a range of views on the matter.

statement intended to apply to both gun-type and implosion-type devices:

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. They would not necessarily require a great deal of technological equipment or have to undertake any experiments. Only modest machine-shop facilities that could be contracted for without arousing suspicion would be required. The financial resources for the acquisition of necessary equipment on open markets need not exceed a fraction of a million dollars. The group would have to include, at a minimum, a person capable of researching and understanding the literature in several fields and a jack-of-all trades technician.<sup>38</sup>

Setting off a nuclear explosion with HEU can be done rapidly enough that DOE internal security regulations require that security for U.S. nuclear sites where enough material for a bomb is present be based on keeping terrorists out entirely, rather than catching them as they leave the site, to avoid “an unauthorized opportunity...to use available nuclear materials for onsite assembly of an improvised nuclear device”—that is, to prevent terrorists from being able to set off a nuclear explosion while they were still inside the facility where they stole the HEU.<sup>39</sup>

Given the importance of the question of whether terrorists could design and make a nuclear explosive, the answer has not been left to analysis alone, but has been subjected to “experiment” as well. In

1977, a Princeton undergraduate designed an implosion-type bomb for a senior paper; Freeman Dyson, a Manhattan Project veteran who was his professor, gave him an “A” on the paper, and the government then classified it.<sup>40</sup> Of the several official investigations of this kind that have occurred, two have been revealed publicly in some detail. In one effort in the 1960s (before the availability of the Internet or of a large fraction of the information that is unclassified and readily available today), two physicists who had just received their doctorates and had no knowledge of weapons-usable nuclear materials, nuclear weapons, or explosives were given the job of using unclassified information to design a nuclear bomb from scratch. (There were ultimately a total of three participants, as one of the original two dropped out and was replaced.) They quickly decided that designing a workable gun-type bomb would be too easy to show off their technical skills in a way that would improve their subsequent job prospects; instead, they successfully designed a workable implosion design.<sup>41</sup>

More recently, Senator Joseph Biden (D-DE), when serving as chairman of the Senate Foreign Relations Committee, asked the three U.S. nuclear weapons laboratories whether terrorists, if they had the nuclear material, could make a crude but workable nuclear bomb. The answer given was “yes.” Senator Biden reports that within a few months after he had asked the question, the laboratories had actually built a gun-type device, using only components that, except for the nuclear material itself, were off the shelf and commercially available without breaking any laws. The device was actually brought into a secure Sen-

<sup>38</sup> U.S. Congress, Office of Technology Assessment, *Nuclear Proliferation and Safeguards* (Washington D.C.: OTA, 1977; available at [http://www.wws.princeton.edu/cgi-bin/byteserv.prl/~ota/disk3/1977/7705\\_n.html](http://www.wws.princeton.edu/cgi-bin/byteserv.prl/~ota/disk3/1977/7705_n.html) as of April 29, 2004), p. 140. A million 1977 dollars would be approximately \$3.1 million in 2004 dollars. This report does, however, argue that under-appreciated difficulties of actually fabricating a gun-type device would make doing so essentially as difficult as designing and building an implosion bomb. After consulting with a number of nuclear weapon designers, we strongly disagree, at least with respect to a crude terrorist gun-type device that would not require high reliability or efficiency.

<sup>39</sup> U.S. Department of Energy, Office of Security Affairs, Office of Safeguards and Security, *Manual for Protection and Control of Safeguards and Security Interests, Chapter I, Protection and Control Planning* (Washington, D.C.: DOE, July 15, 1994; available at [http://www.fas.org/irp/doddir/doe/m5632\\_1c-1/m5632\\_1c-1\\_c1.htm](http://www.fas.org/irp/doddir/doe/m5632_1c-1/m5632_1c-1_c1.htm) as of April 29, 2004), par. 3.a.1.

<sup>40</sup> John Aristotle Phillips and David Michaelis, *Mushroom: The Story of the A-Bomb Kid* (New York, NY: William Morrow, 1978).

<sup>41</sup> See Dan Stober, “No Experience Necessary,” *Bulletin of the Atomic Scientists* 59, no. 2 (March/April 2003; available at <http://www.thebulletin.org/issues/2003/ma03/ma03stober.html> as of April 29, 2004). Expurgated declassified documents describing the effort are also available at the same site.)

ate hearing room to demonstrate the gravity of the threat.<sup>42</sup>

Having help from someone familiar with nuclear weapon design and construction would certainly be useful to terrorists trying to build a bomb—as would having actual bomb blueprints—though neither would be essential. Al Qaeda and its allies have actively attempted to recruit such help. For example, Osama bin Laden and his deputy Ayman al-Zawahiri met at length with two senior Pakistani nuclear weapons experts, Sultan Bashiruddin Mahmood and Chaudari Abdul Majeed—both Taliban sympathizers with extreme Islamic views—and pressed them for information on making nuclear weapons. While Mahmood and Majeed deny having supplied any useful information, Pakistani intelligence officials told the *Washington Post* that the two had provided detailed technical information, in violation of Pakistan's secrecy laws, in response to bin Laden's questions.<sup>43</sup> Similarly, in 2000, an official of Russia's National Security Council announced that the Taliban regime had attempted to recruit a nuclear expert from a Russian facility.<sup>44</sup> In 1998, a scientist at one of Russia's premier nuclear weapons laboratories was arrested for spying for both the Taliban and Iraq (in this case on advanced conventional weapons designs, not nuclear weapons—though the security services announced that this was by no means the first such espionage case at that laboratory).<sup>45</sup>

In recent months, the world has seen confirmed an extraordinary leakage of nuclear technology from Pakistan, including designs for uranium enrichment centrifuges, components for such centrifuges, com-

plete centrifuges apparently taken from Pakistan's own enrichment plant, consulting services for any problems the buyers might have, and even actual nuclear weapon blueprints. The leakers were apparently motivated both by money and by Islamic fervor.<sup>46</sup> Extreme Islamic views, including sympathy for al Qaeda and the Taliban, appear to be commonplace in Pakistan's military and nuclear establishment, as they are in broader Pakistani society. Abdul Qadeer Khan, the former head of Pakistan's nuclear weapons program who confessed to leading this clandestine nuclear network, is a strident nationalist prone to harsh Islamic rhetoric. In 1984 (three years before Iran now says it received complete centrifuge designs), Khan spoke of his opposition to "all the Western countries" as "enemies of Islam," and the possibility that nuclear technology might be shared among Islamic countries, specifically mentioning Iraq, Libya, and Iran:

All the Western countries, including Israel, are not only Pakistan's enemies but also enemies of Islam. ...All this is part of the Crusades, which the Christians and Jews had initiated against the Moslems 1000 years ago. Islam was the only religion which uprooted their culture and civilization and they have not forgotten it even today. ...All countries are aware that Moslems believe in monotheism and despite political disunity, they share each other's hardships. They are afraid that if Pakistan makes obvious progress in this field, then the whole Islamic world will stand to benefit. There is no such danger from India. You know that Iraq, Libya and Iran had increased ties with India in the hope that India would assist them in nuclear technology

<sup>42</sup> United States Senator Joseph Biden, Remarks to the Paul C. Warnke Conference on the Past, Present, and Future of Arms Control, Washington, D.C., January 28, 2004 (transcript provided by *Federal News Service*).

<sup>43</sup> See Khan and Moore, "2 Nuclear Experts Briefed Bin Laden, Pakistanis Say," *op. cit.*; and Khan, "Pakistan Releases Nuclear Scientists for Ramadan's End," *op. cit.* The most thorough available account of the incident and related issues is 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> as of April 29, 2004). Ummah is a term for the worldwide Islamic community.

<sup>44</sup> *RFE/RL*, Oct. 9, 2000.

<sup>45</sup> "Nuclear Center Worker Caught Selling Secrets," *Russian NTV*, Moscow, 16:00 Greenwich Mean Time, December 18, 1998 (translated by *BBC Summary of World Broadcasts*, December 21, 1998).

<sup>46</sup> As a sampling of the numerous articles on the issue, see Douglas Frantz and Josh Meyer, "For Sale: Nuclear Expertise," *Los Angeles Times*, February 22, 2004; David Rohde and Talat Hussain, "Delicate Dance for Musharraf in Nuclear Case," *New York Times*, February 8, 2004; John Lancaster and Kamran Khan, "Pakistani Scientist Apologizes; Nuclear Assistance Unauthorized, He Says," *Washington Post*, February 5, 2004.

but this was not the case and they were sorely disappointed. This is the reason why Western countries ignore India's nuclear program and its results and are after us.<sup>47</sup>

In 1998, when the United States bombed al Qaeda camps in Afghanistan in retaliation for the bombings of U.S. embassies in Africa, General Aslam Beg, who until shortly before had been in overall charge of Pakistan's nuclear program, told reporters that "by the grace of God" bin Laden had not been in the bombed camps and therefore had not been killed.<sup>48</sup> Beg is so powerful even in retirement that he openly told reporters during the ongoing investigation of nuclear leakage in Pakistan that Pakistani official investigators "would not dare" even question him—repeating it a second time for emphasis.<sup>49</sup> One Pakistani nuclear physicist critical of Pakistan's nuclear weapons programs has estimated that some 10 percent of Pakistan's nuclear experts—amounting to hundreds of people—hold extremist Islamic views that could motivate nuclear leakage.<sup>50</sup>

Not only scientific help but actual working bomb designs now appear to be potentially available, moreover. Libya, in its decision to roll back its weapons of mass destruction programs, has admitted receiving an implosion design that originated in Pakistan. The copy of the design that Libya acknowledged has been removed from Libya—but who knows how many other copies exist, where they have gone, and where they may go in the future? The possibility that al Qaeda has access to complete blueprints for an implosion-type nuclear explosive—or may soon get such access—is very real. The design is reportedly

one for a very simple and not very efficient implosion bomb—the type of implosion weapon that terrorists could most plausibly manufacture.<sup>51</sup>

Of course, even with a working design, and even if the nuclear material could be acquired, manufacturing a weapon to the specifications called for in the design would not be a trivial task. But the potential availability of a nuclear bomb recipe reinforces the urgency of keeping the ingredients needed to make that recipe out of terrorist hands.

A terrorist group that got hold of a stolen nuclear weapon would face somewhat different challenges. The difficulty of setting off a stolen weapon would depend substantially on the specifics of the weapon's design. Many U.S. nuclear weapons are equipped with "permissive action links" (PALs), which are effectively electronic locks, intended to make it difficult to detonate the weapon without first inserting an authorized code. Modern versions are designed to be integral to the weapon, making it very difficult to bypass the locking device and "hotwire" the weapon to detonate. They are also equipped with "limited try" features that will permanently disable the weapon if the wrong code is entered too many times, or if attempts are made to tamper with or bypass the lock.<sup>52</sup> Older versions do not have all of these features, and therefore would provide somewhat less of an obstacle to a terrorist group attempting to detonate a stolen weapon they had acquired.

In addition to PALs, for safety reasons many weapons are equipped with devices which prevent the weapon from detonating until it has gone through its expected

<sup>47</sup> Interview published in *Nawa-e Waqt* (Lahore), February 10, 1984 (translated by *BBC Summary of World Broadcasts*).

<sup>48</sup> Elizabeth Neuffer, "Nuclear Shadow: A U.S. Concern: Pakistan's Arsenal: Anti-American Mood Poses a Security Risk," *Boston Globe*, August 16, 2002.

<sup>49</sup> Quoted in David Rohde, "General Denies Letting A-Bomb Secrets Out of Pakistan," *New York Times*, January 27, 2004.

<sup>50</sup> Neuffer, "Nuclear Shadow: A U.S. Concern: Pakistan's Arsenal: Anti-American Mood Poses a Security Risk," *op. cit.* For further discussion of the problem of extreme Islamic views in Pakistan's nuclear establishment, see Albright and Higgins, "A Bomb for the Ummah," *op. cit.*

<sup>51</sup> William J. Broad, "Libya's Crude Bomb Design Eases Western Experts' Fear," *New York Times*, February 9, 2004.

<sup>52</sup> For discussions of PALs and their role, see, for example, Peter Stein and Peter Feaver, *Assuring Control Over Nuclear Weapons: The Evolution of Permissive Action Links* (Cambridge, Mass.: Center for Science and International Affairs, Harvard University, 1987); Peter Feaver, *Guarding the Guardians: Civilian Control of Nuclear Weapons in the United States* (Ithaca, N.Y.: Cornell, 1992); and Donald R. Cotter, "Peacetime Operations: Safety and Security," in Ashton B. Carter, John D. Steinbruner, and Charles A. Zraket, eds., *Managing Nuclear Operations* (Washington, D.C.: Brookings Institution, 1987).

flight-to-target sequence—for example, in the case of a nuclear artillery shell, the explosive acceleration of being fired from a cannon, followed by the coasting through the air of unpowered flight. These features, if designed to be very difficult to bypass, can also pose a serious obstacle to a terrorist group detonating a stolen weapon.

Unfortunately, what little information is publicly available suggests that older Soviet-designed weapons, particularly older tactical weapons, may not be equipped with modern versions of such safeguards against unauthorized use.<sup>53</sup> In both the United States and Russia, thousands of nuclear weapons, particularly older varieties, have been dismantled in recent years, and it is likely that most of the most dangerous weapons lacking modern safeguards have been destroyed. But neither country has made any commitment to destroy all of these weapons. Nuclear powers such as Pakistan, India, and China are not believed to incorporate equivalents to modern PALs in their weapons, but many of these weapons are believed to be stored in partly disassembled form.

Perhaps even more than in building a crude nuclear device of their own, terrorists seeking to detonate a stolen weapon would benefit greatly from the help of a knowledgeable insider, if such help could be procured. It may well be that an insider willing to help in stealing a weapon in the first place might also be willing to help in providing important information related to setting the weapon off. In the case of a weapon equipped with a modern PAL, without the actual use codes most insiders, too, would not be able to provide ready means to overcome the lock

and use the weapon. (After all, a principal purpose of PALs is to prevent insiders from being able to set the weapons off without authorization.) If they could not figure out how to detonate a stolen weapon, terrorists might choose to remove the nuclear material from it and seek to fashion it into a bomb—though if the weapon was a modern, highly efficient design using a modest amount of nuclear material, the material contained in it might not be enough for a crude, inefficient terrorist bomb. In any case, terrorists who had a stolen nuclear weapon would be in a position to make fearsome threats—for no one would know for sure whether they could set it off or not.

Several weaknesses of al Qaeda have led some analysts to argue that it could not plausibly carry out an attack with an actual nuclear explosive. First, many of the organization's recruits have little technical sophistication and expertise. For example, a 1999 al Qaeda progress report found in Afghanistan concludes that the attempt to make nerve gas weapons relying on the expertise the group could put together without recruiting specialists had "resulted in a waste of effort and money." The report recommended recruiting experts as the "fastest, cheapest, and safest" way to build the capability to make such weapons.<sup>54</sup> Unfortunately, however, a number of top al Qaeda personnel are technologically literate (bin Laden deputy al-Zawahiri is a medical doctor, while reported 9/11 mastermind Khalid Sheikh Muhammad, now in U.S. custody, is a U.S.-trained engineer),<sup>55</sup> and the group has repeatedly demonstrated an ability to carry out sophisticated research in the unclassified literature.<sup>56</sup> The most detailed unclassified analysis of al Qaeda's nuclear program concludes that it posed a serious threat

<sup>53</sup> See, for example, Bruce G. Blair, Testimony to the House National Security Committee, Subcommittee on Research and Development, March 17, 1997 (in which Blair reports that tactical nuclear weapons "built before the early 1980s lack the safety locks known as permissive action links"), and Bruce W. Nelan, "Present Danger: Russia's Nuclear Forces Are Sliding Into Disrepair and Even Moscow is Worried About What Might Happen," *Time Magazine Europe*, April 7, 1997 (which reports U.S. intelligence estimates that Russian tactical weapons "often" have external locks "that can be removed, and many have none at all").

<sup>54</sup> Alan Cullison and Andrew Higgins, "Forgotten Computer Reveals Thinking Behind Years of al-Qaeda Doings," *Wall Street Journal*, December 31, 2001, quoted in Albright, "Al Qaeda's Nuclear Program," op. cit.

<sup>55</sup> See, for example, Rohan Gunaratna, *Inside Al Qaeda: Global Network of Terror*, 3<sup>rd</sup> ed. (New York, N.Y.: Columbia University Press, 2003).

<sup>56</sup> For an account of al Qaeda's extensive research in the unclassified literature on biological weapons, for example, gleaned from materials recovered from al Qaeda safehouses in Afghanistan, see James B. Petro and David A. Relman, "Understanding Threats to Scientific Openness," *Science* 302 (December 12, 2003), p. 1989, with supporting on-line material (including a list of biological warfare references put together by al Qaeda experts).

while it was underway in the Afghanistan sanctuary, and could still succeed elsewhere.<sup>57</sup>

Others argue that a group with al Qaeda's structure of small cells would not be well-suited for what they argue would be a large, long-term project like making a nuclear bomb—particularly given the substantial disruptions al Qaeda has suffered from the international response to the 9/11 attacks. The deaths or arrests of a substantial number of senior al Qaeda leaders and operatives since 9/11, and the other disruptions of its operations, have undoubtedly reduced the probability of al Qaeda succeeding in pulling off a nuclear explosive attack. But the crucial question is: by how much? Unfortunately, as already noted, the conclusion of repeated technical studies is that the group needed to design and fabricate a crude nuclear explosive, once the needed materials were in hand, might be quite small—as small as a single al Qaeda cell. The ability of a cell-based organization like al Qaeda—or even one of the many loosely affiliated regional groups that now appear to be posing an increasing threat as the old central structure of al Qaeda is weakened—to make a crude nuclear explosive cannot be dismissed.

Similarly, some argue that in the absence of a stable sanctuary where a technical development effort could be undertaken over a substantial period of time, with large fixed facilities, it would be nearly impossible for a terrorist group to make a nuclear bomb—and that therefore the destruction of the Afghanistan sanctuary makes any nuclear attack by al Qaeda extremely unlikely.

The overthrow of the Taliban regime and the removal of al Qaeda's sanctuary in Afghanistan undoubtedly disrupted al Qaeda's nuclear efforts significantly. But two crucial points should be made. First, as noted earlier, large fixed facilities are not necessarily required for putting together a crude nuclear explosive, and the time required may be distressingly short (as suggested by the DOE regulation warning against the possibility of nuclear explosives being made while a terrorist group was still inside a building where they had stolen nuclear material). The building that South Africa used to assemble its nuclear weapons is a very ordinary-looking warehouse, with little external sign of the deadly activities that went on inside.<sup>58</sup> The world's first nuclear bomb, for the Trinity test, was put together in a small area at the base of a tower; the bomb was then lifted to the top of the tower with cables (with a truckload of mattresses underneath in case the bomb fell).<sup>59</sup> Testing of gun designs for the Hiroshima bomb was accomplished by firing projectiles into a pile of sand.<sup>60</sup> In short, the world simply cannot be confident that the facilities and activities needed to make a bomb would be noticed before it was too late.

Second, a wide range of possible sanctuaries still exist—from the mountains on both sides of the Afghan border to failed states such as Somalia to remote jungle and desert areas around the world, where it is believed new terrorist bases are being established. Indeed, in March 2004, CIA Director Tenet told the Senate Select Committee on Intelligence of his concern for the number of areas around the world where central governments have no consistent reach: "We count approximately 50 countries that have such

<sup>57</sup> Albright, "Al Qaeda's Nuclear Program: Through the Window of Seized Documents," op. cit.

<sup>58</sup> See discussion of "the Circle" building where South Africa's gun-type bombs were assembled after the program was transferred to Armscor, in David Albright, "South Africa and the Affordable Bomb," *Bulletin of the Atomic Scientists*, July/August 1994. The weapons were assembled on the first floor of the building, which had approximately 4,000 meters of floorspace. South Africa consciously avoided equipping the building with features that would have made its importance obvious—such as high-technology satellite communications on the roof. The only distinguishing feature of the building is an earth embankment on one side, intended to block the building from view from the road within a large Armscor site.

<sup>59</sup> For a discussion and a photograph of the small group assembling the bomb, see Lillian Hoddeson, Paul W. Henriksen, Roger A. Meade, and Catherine Westfall, *Critical Assembly: A Technical History of Los Alamos During the Oppenheimer Years, 1943-1945* (Cambridge, UK: Cambridge University Press, 1993), pp 367-370.

<sup>60</sup> For a discussion of initial testing of projectiles and targets for the gun, see Hoddeson et al., *Critical Assembly*, op. cit., pp. 116-119. A piece of cardboard in front of the gun, which the projectiles passed through, leaving a hole behind, was used to measure the projectiles' deviation from their intended path.

'stateless zones.' In half of these, terrorist groups are thriving."<sup>61</sup>

The bottom line, unfortunately, is that if a sophisticated terrorist group got a stolen nuclear bomb or enough nuclear material to make one, there can be few grounds for confidence that they would be unable to use it.

#### **Myth 4: Only State-Sponsored Terrorists Could Plausibly Carry Out a Nuclear Attack**

**Myth:** The next myth is that the only plausible way that terrorists could get a nuclear bomb or the ability to make one is from a state. Richard Butler, the Australian diplomat who once headed the United Nations inspectors in Iraq, put this belief simply:<sup>62</sup>

It is virtually certain that any acquisition by a terrorist group of nuclear explosive capability could be achieved only through the assistance of a state in possession of that capability—either given directly or provided by individuals within that state who have slipped out of its legal control.

This belief appears to be widespread within the administration.<sup>63</sup> As President Bush put it: "Rogue states are clearly the most likely sources of chemical and biological and nuclear weapons for terrorists."<sup>64</sup>

This belief determines the policy prescription: if the principal danger of terrorists acquiring weapons of mass destruction is that hostile states might provide them, then the key element of the solution is to take on those hostile states and make sure that they do not provide them. This is the idea that animates the preemptive doctrine laid out in the administration's *National Security Strategy*, and that was fundamental to the argument for going to war with Iraq. Indeed, al-

though the President has warned again and again of the danger that terrorists might get weapons of mass destruction, the key policy prescription he draws in speech after speech is that the United States must take on hostile states before they provide such weapons to terrorists. In his 2004 State of the Union address, for example, President Bush dwelled at length on the war on terrorism, arguing that to prevent mass terror, "we are also confronting the regimes that harbor and support terrorists, and could supply them with nuclear, chemical or biological weapons."<sup>65</sup> The need to secure existing stockpiles of weapons of mass destruction and their essential ingredients around the world went entirely unmentioned.

We believe that it is this myth above all others that has led many of the most senior officials of the United States government to place only modest priority on securing the world's stockpiles of nuclear weapons and materials.

**Reality:** Unfortunately, the belief that terrorists would need the help of a state to gain a nuclear capability is also wrong. As noted earlier, repeated authoritative studies have concluded—and experiment has demonstrated—that even without any help from a state, without access to the classified literature, potentially without any detailed knowledge of the relevant technical fields before they began their research, a small but dedicated and resourceful terrorist group could very plausibly design and build at least a crude nuclear bomb. And the danger that they could get the nuclear material needed to do so is very real.

Whatever steps are taken to reduce the already low chance that hostile states will actively decide to give nuclear weapons or the materials and expertise to make them to terrorists, such steps will do nothing to address the dozens of other terrorist pathways to the bomb around the world. These other pathways

<sup>61</sup> Tenet, "The Worldwide Threat 2004: Challenges in a Changing Global Context," op. cit.

<sup>62</sup> Richard Butler, *Fatal Choice: Nuclear Weapons and the Illusion of Missile Defense* (Boulder, Colo.: Westview Press, 2001), p. 89.

<sup>63</sup> Interviews with current and former Bush administration officials, 2003.

<sup>64</sup> President George W. Bush, "President Speaks on War Effort to Citadel Cadets: Remarks by the President at the Citadel, Charleston, South Carolina" (Washington, D.C.: The White House, December 11, 2001; available at <http://www.whitehouse.gov/news/releases/2001/12/20011211-6.html> as of April 29, 2004).

<sup>65</sup> President George W. Bush, "State of the Union Address" (Washington, D.C.: The White House, January 20, 2004; available at <http://www.whitehouse.gov/news/releases/2004/01/20040120-7.html> as of April 29, 2004).

are opened by inadvertence rather than by conscious hostile acts by foreign powers—and they can only be successfully addressed by cooperation on a global scale. Wherever there is a cache of insecure nuclear material, there is a vulnerability that an effective war on catastrophic terrorism must address—and quickly.

### ***Myth 5: Border Defenses Can Reliably Prevent Nuclear Bombs or Materials from Being Smuggled Into the United States***

**Myth:** Another mistaken belief is that it is possible to put in place around the United States and other major countries a security cordon effective enough to reduce to a low level the risk that nuclear weapons and materials might be smuggled in. Customs Commissioner Raymond Bonner, for example, was already arguing in mid-2002 that the measures the U.S. Customs Service had taken since the 9/11 attacks had made it “much, much, much less likely” that “an international terrorist organization could smuggle in...any kind of radiological material or any kind of nuclear device.”<sup>66</sup> Karl-Heinz Kamp, director of a major security studies institute in Germany, has argued that, “given their size and the transportation difficulties involved, most nuclear weapons are simply unsuitable for clandestine terrorist action.”<sup>67</sup> Putting radiation detectors in place at U.S. ports, airports, and the like, and at facilities that ship to the United States, has been the subject of substantial investment since the 9/11 attacks (though far less investment than would be needed to have a good chance of detecting even those things brought in by the most obvious routes). The millions of cargo containers that carry a large fraction of U.S. imports every year have been a particular focus of such efforts.

**Reality:** While some investment in improving border detection capabilities is certainly worthwhile, this last

line of defense will always be a very porous one. The physics of nuclear materials and nuclear weapons, the geography of the huge and complex U.S. borders, and the economics of the global flow of people and goods conspire to make the terrorists’ job easy and the defenders’ job very difficult. Once stolen, the nuclear material for a bomb could be anywhere, and it is very difficult to detect, especially if shielding is used to limit radiation emissions. Contrary to Kamp’s argument, typical nuclear weapons are not large, and could readily be smuggled across U.S. or other nations’ borders. The nuclear material needed for a bomb could easily fit in a suitcase. Even an assembled bomb could fit in a van, a cargo container, or a yacht sailed into a U.S. harbor, or the materials could be smuggled in and the bomb constructed at the site of its intended use. Terrorists have routinely used truck bombs that were physically larger than even a crude terrorist nuclear bomb would need to be.

At the same time, U.S. borders stretch for thousands of miles, and millions of trucks, trains, ships, and airplanes in which nuclear material might be hidden cross them every year. Hundreds of thousands of illegal immigrants and thousands of tons of illegal drugs cross U.S. borders every year, despite billions of dollars of investment in trying to stop them.<sup>68</sup> It is sometimes said that the easiest way to bring nuclear material into the United States would be to hide it in a bale of marijuana. Every nation’s border is vulnerable to various types of illicit movement, be it drugs, terrorists, or the material needed to unleash nuclear terror.

The radiation from plutonium, and especially from HEU, is weak and difficult to detect at any significant distance, particularly if the material is surrounded with shielding.<sup>69</sup> Thus it is simply not possible to design a system, for example, that could be flown in an airplane over a major city and quickly find where a nuclear bomb was hidden. Technology does exist, and

<sup>66</sup> Quoted in Carol Lin and Jeanne Meserve, “Customs Commissioner Demonstrates Anti-Terrorism Technology,” *CNN*, June 3, 2002.

<sup>67</sup> Kamp, “Nuclear Terrorism Is Not the Core Problem,” *op. cit.*

<sup>68</sup> Rensselaer Lee, “Nuclear Smuggling and International Terrorism: Issues and Options for U.S. Policy,” *CRS Report for Congress*, Order Code RL31539, August 17, 2002.

<sup>69</sup> For discussion, see John P. Holdren and Matthew Bunn, “Technical Background: A Tutorial on Nuclear Weapons and Nuclear Explosive Materials – Part Five,” *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, January 2004 (available at [http://www.nti.org/e\\_research/cnwm/overview/technical5.asp](http://www.nti.org/e_research/cnwm/overview/technical5.asp) as of April 29, 2004).



## NUCLEAR TERRORISM: WHY HASN'T IT HAPPENED ALREADY?

With a well-organized and well-financed terrorist group like al Qaeda seeking nuclear weapons for over a decade, nuclear stockpiles in the former Soviet Union and elsewhere around the world dangerously vulnerable to theft, and nuclear weapon designs and assistance available from a global nuclear black market supply network with its center in Pakistan, an obvious question arises: why has there been no terrorist nuclear attack already?

The short answer is that no one really knows. Several factors have probably been important in preventing a nuclear terrorist attack to date—and understanding those factors can help in assessing the scale of the danger, and in preventing such an attack in the future. Since 9/11, one part of the answer is that al Qaeda's leadership and operations have been greatly disrupted by the U.S.-led war on terrorism, including the removal of al Qaeda's Afghanistan sanctuary and the capture or death of large numbers of al Qaeda leaders and operatives. But what prevented the 9/11 attacks themselves from being nuclear?

**Terrorists daunted by the perceived complexity of the nuclear task.** Putting together a nuclear bomb would not be easy, even with the needed nuclear material in hand. Setting off a stolen nuclear bomb would also not be easy, particularly if it was equipped with modern, difficult-to-bypass electronic locks and other measures to increase the difficulty of unauthorized use. While a terrorist group that included a few individuals capable of researching and understanding the unclassified technical literature in several fields could plausibly make at least a crude nuclear bomb, al Qaeda and other terrorist groups may have had difficulty recruiting such technically capable individuals. With its extensive knowledge of conventional weapons and its success using such weapons to cause catastrophic damage, al Qaeda appears to have devoted only a modest fraction of its organizational effort—including the resource of technically capable recruits—to the pursuit of nuclear weapons. Moreover, as described earlier, many people mistakenly believe that it would take an effort on the scale of the Manhattan Project to make a bomb—and terrorists may well overestimate the difficulty of the task as well. Indeed, the Pakistani nuclear scientist who met with Osama bin Laden in Afghanistan, Sultan Bashiruddin Mahmood, is reported by his son to have told bin Laden that it was not easy to build a bomb, and that he “should forget it.”<sup>1</sup>

**Potential buyers and sellers unable to connect.** Each of the known cases of theft of HEU and plutonium had a critical weak point: the thieves did not know how to connect with a buyer. Typical nuclear workers in the former Soviet Union would have little idea how to make contact with al Qaeda or other terrorist operatives, and terrorist leaders may have found it difficult to make connections with people in the former Soviet Union in a position to help in stealing nuclear materials. Further increasing the difficulty is the fear of scams and sting operations: some thieves have been caught in sting operations, and it appears that al Qaeda and other buyers have repeatedly been the victims of scam artists selling materials that had nothing to do with nuclear weapons—such as the famous “red mercury” of the 1990s (which was often just mercuric oxide, a reddish powder available from any chemical supply store).

**Potential thieves deterred by the fear of getting caught.** Despite the lack of security cameras, nuclear material detectors, tamper-proof tags, and the like, when the Soviet Union collapsed, the personnel in Russia's nuclear establishment had spent decades under close surveillance by the KGB. The KGB's successor, the Federal Security Service (FSB), retains a strong presence at Russia's nuclear facilities. Many of those who might otherwise have been tempted to steal may have feared that the government's agents would somehow catch them, and that the punishment for such an infraction would be harsh.

**Patriotism and devotion to duty in Russia's nuclear establishment.** The patriotism and devotion to duty of the vast majority of the scientists, engineers, and workers in Russia's nuclear establishment—even in the face of unpaid wages and societal neglect of their critical missions—have been critical factors limiting the scale of nuclear theft and sale of nuclear knowledge to date. The world owes these men and women a debt of gratitude. Many Americans, accustomed to tales of theft and corruption in the new Russia, do not understand the depth of many Russians' willingness to endure hardship for a good cause. To take a non-nuclear example: during the siege of Leningrad in World War II, several scientists at an institute charged with breeding improved varieties of crops starved to death guarding the institute's stores of grain—unwilling to eat that grain, because it represented Russia's future.<sup>2</sup>

Ultimately, the most fundamental answer to this question is that the world has been lucky. It is time—it is past time—to stop relying on luck and put in place the security arrangements needed to ensure that nuclear weapons and their essential ingredients never fall into hostile hands.

<sup>1</sup> Peter Baker, “Pakistani Scientist Who Met Bin Laden Failed Polygraphs, Renewing Suspicion,” *Washington Post*, March 3, 2002, p. A1.

<sup>2</sup> This incident is discussed, for example, in Cary Fowler and Pat Mooney, *Shattering: Food, Politics, and the Loss of Genetic Diversity* (Tucson, AZ: University of Arizona, 1990), pp. 220-222.

is being further developed, to make it possible to detect HEU or plutonium in objects right in front of the detectors (as might be possible at controlled border crossings), including finding hidden nuclear material in everything from airline baggage to cargo containers. Programs are now underway to put these kinds of detection capabilities into place at an increasing number of sites. But the capabilities that are now being put in place should not be exaggerated. While U.S. Customs officers have been equipped with "radiation pagers," these would have essentially no chance of detecting HEU with even minor shielding, even if it was in the bag directly in front of the inspector. More sophisticated equipment that can detect both HEU and plutonium is being purchased—but by the end of fiscal year (FY) 2003, the U.S. Customs Service only had dozens of such pieces of equipment in place, not hundreds.<sup>70</sup>

Two points are crucial to understand. First, inspecting cargo as it arrives in the United States is not good enough: if a bomb were on a ship sailing into a major U.S. harbor, it could wreak horrible devastation before the ship ever pulled up to the dock to be inspected. That is why many of the new initiatives after the 9/11 attacks involve putting detectors in place at foreign ports that ship to the United States. But it will take an immense and continuing effort to ensure that detection at these ports is effective, that there are no ready possibilities for a customs official to be bribed to let a container through uninspected or to certify a container as inspected that was not, and that already inspected containers cannot be tampered with.

Second, and more fundamentally, the number of possible pathways to smuggle a nuclear bomb or its ingredients into the United States is immense, and intelligent adversaries will choose whichever pathway remains undefended. If an effective system were put in place to make it very difficult to get nuclear material into the country in a cargo container without

detection—and the country is a long way from that point today—then terrorists would bring their bomb in on a yacht, a fishing boat, or by some other means. Thousands of kilometers of U.S.-Canadian border are essentially unguarded wildlands. Thousands of coves, inlets, bayous, and mangrove swamps provide ready means to bring a boat to U.S. shores and unload a large box without being noticed.

*ABC News* has highlighted the problem dramatically. Shortly before the first anniversary of the 9/11 attacks, they shipped a 6.8 kilogram (15 pound) cylinder of depleted uranium by ocean freight from Istanbul to New York. The container did end up being among the roughly 2% of the more than 5 million cargo containers that enter the country each year that are chosen for inspection. But the inspectors did not notice the presence of the uranium. The same thing happened a year later, when the cylinder was shipped in a teak trunk in a container from Jakarta—no one inspected the trunk before it left Jakarta, high on U.S. lists of terrorist hotspots, and while the container was targeted for inspection when it arrived, the inspectors never noticed the uranium.<sup>71</sup>

None of this is to say that the United States and other countries should not invest in attempting to make the nuclear smuggler's job as difficult as possible; they should. But it will never be possible to be confident in this last-ditch line of defense: the length of the border, the diversity of means of transport, and the ease of shielding the radiation from plutonium or highly enriched uranium all improve the odds too much for the terrorists. All that realistically can be hoped for is to make the easiest paths for terrorists more difficult, and force them to use more difficult and chancier means to smuggle their nuclear terror. Primary reliance will still have to be placed on the first line of defense: keeping nuclear weapons and materials from being stolen in the first place.

<sup>70</sup> Commissioner Robert Bonner, Bureau of Customs and Border Protection, Department of Homeland Security, Testimony before the Infrastructure and Border Security Subcommittee, House Select Committee on Homeland Security, October 16, 2003.

<sup>71</sup> See, for example, "The ABC News Nuclear Smuggling Experiment: The Sequel," Natural Resources Defense Council, September 11, 2003 (available at <http://www.nrdc.org> as of April 29, 2004); see also "Border Breach? Customs Fails to Detect Depleted Uranium—Again," *ABC News*, September 10, 2003 (available at [http://abcnews.go.com/sections/wnt/Primetime/sept11\\_uranium030910.html](http://abcnews.go.com/sections/wnt/Primetime/sept11_uranium030910.html) as of April 29, 2004).

## **Myth 6: Nuclear Terrorism Can Be Reliably Prevented With Offensive Military Action**

**Myth:** President Bush and the senior officials of his administration repeatedly focus on maintaining the offensive against terrorist groups with global reach as the key to preventing catastrophic terrorism. As the President put it in his 2004 State of the Union address:

America is on the offensive against the terrorists. ...As part of the offensive against terror, we are also confronting the regimes that harbor and support terrorists, and could supply them with nuclear, chemical or biological weapons. The United States and our allies are determined: We refuse to live in the shadow of this ultimate danger.<sup>72</sup>

**Reality:** Such an offensive alone will not be able to prevent us from living in the shadow of this danger. Certainly it is crucial for the United States and its allies to do everything they can to destroy those terrorist groups that have nuclear ambitions. A successful offensive, keeping these groups constantly on the run and off balance, can greatly reduce the likelihood that they would succeed in carrying out a nuclear attack. Indeed, the war on these groups launched since the 9/11 attacks has undoubtedly led to substantial disruptions in their ability to manage and carry out large and complex operations.

But as attack after attack around the world have demonstrated, al Qaeda and a range of loosely affiliated groups retain the ability to carry out deadly operations. There is little prospect that U.S. intelligence on terrorist cells and their operations will ever be good enough to be confident that the terrorist operation needed to put together a crude nuclear device—perhaps only a cell of a few resourceful people, a machine shop, and off-the-shelf parts, other than the nuclear material itself—would be detected and destroyed before it could finish its deadly work. A strong of-

fense against terrorist groups with nuclear ambitions must be a critical part of the world's toolbox in reducing the danger of nuclear terrorism—but without a greatly increased effort to keep nuclear weapons and materials out of terrorist hands in the first place, offensive action cannot reduce the threat to an acceptable level.

## **Myth 7: States Will Not Seek to Obtain Stolen Nuclear Material**

**Myth:** The final myth applies to states, rather than terrorist groups, for the buyers of stolen nuclear weapons or nuclear materials might well be states rather than sub-state groups. A number of analysts argue that states would not be especially interested in a stolen nuclear weapon or stolen material to make one, because what they want is an indigenous capability to produce the material for as many nuclear weapons as they think they need. Like the other myths, this myth leads those who believe it to downplay the importance of securing nuclear weapons and materials so that they cannot be stolen. Khidhir Hamza, for example, once a senior figure in Iraq's nuclear weapons program, argued in late 2002 that indigenous production of nuclear material was Iraq's principal focus, and a far greater danger than the risk that Iraq would receive stolen nuclear material for use in a bomb.<sup>73</sup>

**Reality:** There is little doubt that states would *prefer* to have indigenous nuclear material production capabilities. But such capabilities are expensive and difficult to get. History demonstrates that states do indeed consider buying a bomb or the materials to make one if (a) they believe they can avoid the expense and difficulty of putting together their own nuclear material production facilities; (b) they see an urgent need to establish a nuclear deterrent before their own nuclear material production succeeds; or (c) they face an international nonproliferation effort that is making it very difficult to successfully establish their own nuclear material production facilities.

<sup>72</sup> President George W. Bush, "State of the Union Address," *op. cit.*

<sup>73</sup> Dr. Khidhir Hamza, Testimony to the U.S. House of Representatives, Committee on Government Reform, Subcommittee on National Security, Veteran Affairs, and International Relations, Hearing on "Combatting Terrorism: Preventing Nuclear Terrorism," September 24, 2002.

Iraq's case is illustrative: as Hamza himself has confirmed, Iraq repeatedly sought to purchase weapons-usable nuclear material from sources with connections in the former Soviet Union.<sup>74</sup> When Iraq realized, after its invasion of Kuwait, that the United States and an international coalition would respond, it launched a "crash program" to build one bomb quickly, using the HEU it already had from its research reactors—and certainly would have been desperately eager to receive stolen HEU at that time.<sup>75</sup>

Iran, too, has sought to purchase nuclear material. Iran put together a substantial procurement network to acquire a wide range of technologies and materials related to weapons of mass destruction, including from the former Soviet Union. Unclassified U.S. intelligence assessments have repeatedly reported that Iran was also seeking to purchase stolen fissile material for a nuclear bomb.<sup>76</sup>

Nor were these unique cases. Australia wanted to purchase a nuclear weapon, when it was considering the nuclear weapons option; Egypt explored the possibility of a purchase when it was pursuing a nuclear weapons program; Libya, realizing the weakness of its own indigenous science and technology base, is reported to have repeatedly attempted to purchase a nuclear weapon, including an unsuccessful approach to China; there are even reports that Indonesia sought

to purchase a bomb, decades ago.<sup>77</sup> The more non-proliferation efforts focused on limiting states' ability to build their own enrichment and reprocessing facilities succeed in the future, the more likely it is that additional states will pursue the purchase alternative in the future.

Ultimately, if worldwide efforts to secure nuclear weapons and the materials needed to make them fail, creating a situation in which any dictator or terrorist who wanted a nuclear bomb could buy its essential ingredients on a nuclear black market, nothing else the world does to stem the spread of nuclear weapons is likely to work. It is worth doing "everything in our power," in President Bush's words, to prevent that dark world from arising.

## PRIORITIZING THE MOST URGENT DANGERS

Determining which facilities around the world pose the most urgent dangers is crucial for setting priorities for action. This judgment must be made on the basis of a four-part threat-based framework, based on:

- **Quantity.** The quantity of nuclear material at a site (and in particular whether there is enough there for a bomb);<sup>78</sup>

<sup>74</sup> Interview with Hamza, September 24, 2002. See discussion of Iraq's efforts in Bunn, Wier, and Holdren, "Appendix B," in *Controlling Nuclear Warheads and Materials*, op. cit.

<sup>75</sup> For the International Atomic Energy Agency's official account of the "crash program," see IAEA, *Consolidated reports of the Director General of IAEA (under paragraph 16 of Security Council Resolution 1051/1996), S/1997/779*, October 8, 1997 (available at <http://www.iaea.org/worldatom/Programmes/ActionTeam/reports2.html> as of April 29, 2004), pp. 48–52; also, David Albright and Robert Kelley, "Has Iraq come clean at last?" *Bulletin of the Atomic Scientists* 51, no. 6 (November/December 1995; available at <http://www.thebulletin.org/issues/1995/nd95/nd95.albright.html> as of April 29, 2004).

<sup>76</sup> Most recently, see U.S. Director of Central Intelligence, *Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions, 1 January Through 30 June 2003* (Langley, Va.: CIA, November 2003; available at [http://www.cia.gov/cia/reports/721\\_reports/jan\\_jun2003.htm](http://www.cia.gov/cia/reports/721_reports/jan_jun2003.htm) as of April 29, 2004). Previous editions of the DCI's report are available at <http://www.cia.gov/cia/reports/index.html> as of February 24, 2004.

<sup>77</sup> Jim Walsh, "Surprise Down Under: The Secret History of Australia's Nuclear Ambitions," *Nonproliferation Review* 5, no. 1 (Fall 1997; available at <http://cns.miis.edu/pubs/npr/vol05/51toc.htm> as of April 29, 2004); Joseph Cirincione, with Jon B. Wolfsthal and Miriam Rajkumar, "Libya," in *Deadly Arsenal: Tracking Weapons of Mass Destruction* (Washington, D.C.: Carnegie Endowment for International Peace, 2002); Robert M. Cornejo, "When Sukarno Sought the Bomb: Indonesian Nuclear Aspirations in the Mid-1960s," *Nonproliferation Review* 7, no. 2 (Summer 2000; available at <http://cns.miis.edu/pubs/npr/vol07/72/72corn.pdf> as of April 29, 2004).

<sup>78</sup> In the case of large processing facilities, what needs to be considered is not only the quantity at any given time, but the throughput. Bulk processing of materials at large facilities in general makes accounting of the material more difficult, and increases opportunities for covert theft.

- **Form.** The form of the material at a site (especially whether the form is so difficult to steal, transport, and process that some groups that might be able to make a bomb from HEU or plutonium metal would not be likely to be able recover such metal from the material in its present form);<sup>79</sup>
- **Security level.** The effectiveness of the security and accounting arrangements at the site; and
- **Threat level.** The ambient threat level at the site and in the surrounding area (including the level of terrorist and organized crime activity, corruption, theft of non-nuclear items, levels of pay and morale for site personnel, and so on).

Fortunately for the world, information in all these categories is not publicly available for most nuclear sites. What is more distressing is that neither the U.S. government nor any other government or international organization has a comprehensive database of where all the warheads, plutonium, and HEU sites are located in the world, how much is estimated to be at each site, in what forms, and with what levels of security—let alone a database that includes the crucial fourth factor of threat level. The U.S. government is now pulling together the many sources of information it already has available into the first draft of such a database; we recommend that this effort be accelerated, and that the database identify both what is known (with what level of certainty), and what is not.

To avoid potentially providing targeting help to terrorists, this report does not discuss security weaknesses at particular facilities. Rather, the discussion below focuses on *classes* of facilities, and the levels of danger they pose.

Using the threat-based framework described above, with the information that is publicly available from a variety of sources, it appears that as of early 2004, the highest-priority dangers include:

- **Russia.** Russia has many scores of buildings with enough nuclear material for a bomb, in forms from

which terrorists could be expected to be able to recover it for use in weapons. Over the past decade, security and accounting arrangements at Russian nuclear facilities have perhaps improved from “poor” to “medium.” But the threat in Russia remains very high—as evidenced by the incidents of terrorist reconnaissance on Russian nuclear warheads, widespread corruption and insider theft (including in the military), and large, heavily armed, well-planned outsider terrorist attacks.

- **Research reactors with enough HEU for a bomb.** Those HEU-fueled research reactors that have enough HEU on-site for a nuclear bomb pose particularly grave dangers, as most of these facilities have very modest security—not enough, in most cases, to deal with any serious, well-armed terrorist theft attempt (or an armed insider theft effort). Research reactors with a third to a half the amount of material needed for a bomb pose a lesser, but still genuine danger—as al Qaeda has repeatedly demonstrated an ability to launch multiple, coordinated attacks at the same time.
- **Pakistan.** Pakistan’s nuclear stockpiles are very small compared to those of Russia or the United States, and its facilities are believed to be heavily guarded. But the threat in Pakistan is very, very high—both from insiders sympathetic to extreme Islamic causes, and from the large armed remnants of al Qaeda and the Taliban that still operate in the country.

Below, we discuss each of these particularly dangerous classes of facility in turn.

### ***Nuclear Security in Russia Today***

Nuclear security in Russia has improved significantly over the last decade, but serious weaknesses remain, and the threat—from outsider attacks, insider theft, and outsider-insider collusion—remains very high. Indeed, recent anecdotal evidence suggests that the “demand side” of nuclear smuggling is coalescing more than had been observed before.

<sup>79</sup> Obviously, if one or more actual nuclear weapons exist at the site, then on both the “quantity” and “form” criteria, the danger must be ranked as very high.

## KEEPING NORTH KOREAN BOMB MATERIAL OUT OF TERRORIST HANDS

North Korea poses another increasingly dangerous potential source of “loose” nuclear weapons and materials, beyond the serious dangers posed by nuclear weapons in the hands of the North Korean regime itself.

In the past three years, North Korea has expelled inspectors, withdrawn from the nuclear Nonproliferation Treaty (NPT), announced that it is reprocessing 8,000 fuel rods containing five to six bombs’ worth of plutonium (adding to the one to two bombs’ worth U.S. intelligence believes it probably already had), and restarted its plutonium production reactor. And North Korea is also pursuing the uranium path to the bomb, with technology that Pakistan’s Abdul Qadeer Khan has admitted his network provided.

If North Korea were to conclude that it had the nuclear weapons it needed for its own deterrent and had more nuclear material left over, there is a serious danger that it might choose to sell nuclear material to others. This is not likely, as any such sale would pose enormous dangers for the North Korean regime: the U.S. response, if it determined that North Korea was providing nuclear weapons or the materials to make them to terrorists, would surely mean the end of Kim Jong Il’s regime. The regime has pledged never to make such a transfer,<sup>1</sup> and for Kim Jong Il, a dictator with an obsessive desire for absolute control, putting the fearsome power of a nuclear bomb into the hands of a group over which he had no control, knowing that the result might well be that it would be used in a way that would lead to the utter destruction of his regime, would seem an unlikely gamble. The U.S. Defense Department’s own most recent comprehensive assessment of the proliferation threat concludes “the likelihood of a state sponsor providing such a weapon to a terrorist group is believed to be low.”<sup>2</sup> But the North Korean regime is desperate for cash, and has a history of selling whatever arms it can to whoever is willing to buy them. Few would want to leave it solely in Kim Jong Il’s hands to decide whether terrorists should have the bomb or not.

Moreover, should the North Korean regime collapse—a not unrealistic possibility—there would be a serious danger that nuclear weapons or the materials to make them could go missing in the ensuing chaos.<sup>3</sup> Unfortunately, the Proliferation Security Initiative, valuable though it is, cannot reliably prevent a transfer of material that would fit in a briefcase, or a weapon that would easily fit in a van.

These dangers are increasing month by month, with North Korea’s reactor producing more plutonium, and its covert uranium enrichment program potentially moving closer to fruition. Yet as of the spring of 2004, the six-party negotiations on the Korean nuclear crisis have made virtually no progress. The U.S. demand that North Korea must verifiably

The biggest improvements in nuclear security are the result of Russia’s stabilization. Russia in 2004 is a very different country from Russia in 1992, or even Russia in 1998. The economy has been growing steadily for several years, the Russian government has stabilized, the federal budget has shifted from huge deficits to noticeable surpluses, and the government has asserted stronger control over key sectors and facilities. As a result, nuclear workers are getting paid a reasonable wage, on time, reducing the danger that desperation might motivate someone to steal nuclear material or sell nuclear secrets. Nuclear facility guards are no longer leaving their posts to forage for food (though pay for nuclear guards apparently remains low). No longer are alarm systems shutting down because the facility failed to pay its electric bill.

In addition, with funds from the United States, Russia’s own budget, and limited support from other coun-

tries, substantial improvements have been made in security and accounting for nuclear materials and nuclear warheads at many sites. Seventy percent of the facilities with weapons-usable nuclear material or nuclear weapons where the U.S. Department of Energy (DOE) program has been working have completed comprehensive security and accounting upgrades, generally designed to protect facilities against theft by a single insider, a small group of well-armed, well-trained outsiders, or both together.<sup>80</sup> While covering 70% of the facilities, such upgrades cover only 22% of the potentially vulnerable nuclear material, as progress has been slowed by disputes over how much access U.S. experts will receive at the huge and highly sensitive nuclear facilities in Russia’s ten closed nuclear cities, where a large fraction of Russia’s nuclear material resides.<sup>81</sup> (See “Key Developments and Progress in the Past Year,” p. 39.) Several rounds of security

<sup>80</sup> Abraham, “Remarks to the Second Moscow International Nonproliferation Conference,” op. cit.

<sup>81</sup> As these facilities are located in fenced-in, guarded cities, with an additional fence and guard force for the nuclear facility itself, the danger of overt, armed outsider attack is probably less at these facilities than the danger of insider theft. A number of incidents,

and irreversibly dismantle its entire nuclear program before the United States takes any significant steps in return has given the North little incentive to agree—and has deflected some of the criticism from other parties from North Korea to the United States.

But as the talks drag on, North Korea continues to build. Delay poses deadly dangers. The time has clearly come for the United States, working with its partners in the six-party talks, to make a serious proposal that would offer the North compelling incentives for each step in the complete and verifiable dismantlement of its nuclear weapons program. This would not be rewarding the North's violations of the NPT, but offering "more for more"—security assurances, normalization of relations, and energy and economic assistance (largely provided by the North's neighbors) in return for a dismantlement and inspection package going far beyond what the North has contemplated before. If the North did agree, threat reduction programs could potentially be used to remove or eliminate its nuclear and missile capabilities, as has been done following Libya's far-seeing decision to give up its weapons of mass destruction. By posing a genuine test of the North's willingness to eliminate its nuclear capabilities, putting such a proposal on the table would also help build the needed international coalition for more forceful action should negotiations fail.

Whatever the outcome in North Korea, securing the vast stockpiles of nuclear weapons and materials in the rest of the world will remain an essential priority—for nonproliferation, for counter-terrorism, and for homeland security. Indeed, ensuring that the world's nuclear stockpiles are locked down is a key element of resolving the North Korean crisis itself, for whatever verifiable arrangements are negotiated to stop North Korean production of nuclear material, they might be sidestepped if North Korea secretly acquired stolen nuclear material from abroad.

<sup>1</sup> See, for example, statements quoted in Selig Harrison, "Inside North Korea: Leaders Open to Ending Nuclear Crisis," *Financial Times*, May 4, 2004.

<sup>2</sup> U.S. Department of Defense (DOD), *Proliferation: Threat and Response* (Washington, D.C.: DOD, January 2001; available at <http://www.defenselink.mil/pubs/ptr20010110.pdf> as of September 19, 2002), p. 61.

<sup>3</sup> See, for example, Ashton B. Carter, William J. Perry, and John M. Shalikashvili, "A Scary Thought: Loose Nukes in North Korea," *Wall Street Journal*, February 6, 2003.

upgrades have been undertaken at the direction of the Russian government, in response to terrorist incidents from 1999 to the present. Russian officials report that these have included: increased protective forces at some nuclear facilities; enlarged areas around facilities where access is restricted; an increase in the frequency of training and exercises simulating possible terrorist attacks; and investments in portal monitors, intrusion detectors, security cameras, and the like at individual sites.<sup>82</sup>

By these means, the most egregious weaknesses of the 1990s—gaping holes in fences, lack of any detec-

tors or cameras to monitor material—have largely been addressed. It would no longer be true to say, in the words of a Russian military prosecutor in a highly enriched uranium theft case from the early 1990s, that "potatoes were guarded better."<sup>83</sup>

Nevertheless, a variety of indicators suggest that serious weaknesses remain:

- Physical protection experts who visit Russia's nuclear facilities continue to report problems such as dilapidated fences, vegetation allowed to grow up to fence lines (so that attackers would not be seen until they reached the fence), antiquated or broken

however, have confirmed that at some of these sites there are well-worn paths through holes in the fence around the city, and in some cases holes in the fence around the nuclear facility itself as well.

<sup>82</sup> See, for example, Yuri Volodin, Boris Krupchatnikov, and Alexander Sanin, "MPC&A Regulatory Program in the Russian Federation: Trends and Prospective," in *Proceedings of the 43<sup>rd</sup> Annual Meeting of the Institute for Nuclear Materials Management, Orlando, Florida, June 23–27, 2002* (Northbrook, Illinois: INMM, 2002); and Dmitry Kovchegin, "Approaches to Design Basis Threat in Russia in the Context of Significant Increase of Terrorist Activity," in *Proceedings of the 44<sup>th</sup> Annual Meeting of the Institute for Nuclear Materials Management, Phoenix, Arizona, July 13–17, 2003* (Northbrook, Illinois: INMM, 2003, available at [http://bcsia.ksg.harvard.edu/publication.cfm?program=CORE&ctype=paper&item\\_id=398](http://bcsia.ksg.harvard.edu/publication.cfm?program=CORE&ctype=paper&item_id=398) as of April 16, 2004).

<sup>83</sup> Bukharin and Potter, "Potatoes Were Guarded Better," op. cit.

intrusion detectors, ineffective tamper-indicating devices, undermanned guard forces without night-vision goggles or hardened fighting positions, material accounting systems that would not be able to detect that material had been removed in a timely manner, and the like.<sup>84</sup>

- In general, at each new facility where Russia grants access to U.S. personnel and cooperative work begins, U.S. and Russian experts rapidly agree that a wide range of security and accounting upgrades are needed.
- Both Russian and American experts have reported a systemic problem of inadequate security culture at many sites—intrusion detectors turned off when the guards get annoyed by their false alarms, doors left open, senior managers allowed to bypass security systems, effective procedures for operating the new security and accounting systems either not written or not followed, and the like.<sup>85</sup> As one particularly troubling example, the security manager at Seversk, one of Russia's largest plutonium and HEU processing facilities, has reported that guards routinely patrol with no ammunition in their weapons—to avoid accidental-firing incidents.<sup>86</sup>
- Nuclear security and accounting systems at Russia's nuclear sites continue to be severely underfinanced, often making it impossible to improve or maintain

existing systems unless U.S. funds are available to do so. In March 2003 testimony to the Russian Duma, then-Minister of Atomic Energy Alexander Rumiantsev warned that \$450 million was needed over the next six years to bolster security at Russia's nuclear facilities, that guard forces at nuclear facilities had been cut back due to budget constraints, and that 4–5 times current spending was needed to secure Russian nuclear power plants from sabotage. "Everything boils down to money," he said. At the same hearing, Yuri Vishnevsky, then chairman of Russia's nuclear regulatory agency, said that the government program to ensure nuclear and radiological safety and security received only 10–15% of the funds it required each year.<sup>87</sup>

- As also noted above, in November 2002, Vishnevsky reported that a recent series of inspections of security arrangements at Russia's civilian nuclear facilities revealed violations of Russian physical protection regulations that would cost some \$200 million to correct. The funds were needed "to modernize technical defense equipment, as well as for preparing and arming the security services at nuclear sites."<sup>88</sup>

While most nuclear workers are now receiving adequate pay, the threat of insider theft remains. The number of people employed in nuclear weapons work in Russia is still expected to be reduced by tens

<sup>84</sup> Interviews with U.S. laboratory personnel, 2002–2004.

<sup>85</sup> Indeed, on one visit to a facility whose security had been upgraded with U.S. assistance, the U.S. General Accounting Office found that the gate to the central storage facility for the site's nuclear material was left wide open and unattended. At another site, guards did not respond when visitors entering the site set off the metal detectors, and the portal monitors to detect removal of nuclear material were not working. See U.S. General Accounting Office (GAO), *Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; Further Enhancements Needed*, GAO-01-312 (Washington, D.C.: General Accounting Office, February 28, 2001; available at <http://www.gao.gov/cgi-bin/getrpt?rptno=GAO-01-312> as of April 29, 2004), pp. 12–13. For a useful discussion of the security culture problem generally, see Igor Khripunov and James Holmes, eds., *The Human Factor and Security Culture: Challenges to Safeguarding Fissile Materials in Russia* (Athens, Georgia: Center for International Trade and Security, University of Georgia, November 2002; available at <http://www.uga.edu/cits/publications/Humanfactor.pdf> as of February 23, 2003). See also Irina Kupriyanova, "Assessing the Effectiveness of the U.S. Nuclear Material Accounting, Control, and Physical Protection Program in Russia," *Yaderny Kontrol*, no. 2 (March–April 2002).

<sup>86</sup> Igor Goloskokov, "The Reform of Ministry of Internal Affairs Detachments Guarding Russian Nuclear Facilities," *Yaderny Kontrol*, no. 4 (2003) (translated and summarized by Dmitry Kovchegin). Goloskokov was the Deputy Director of the Siberian Chemical Combine at the time of this writing.

<sup>87</sup> Robert Serebrennikov, "2002 Saw Several Thefts of Nuclear Materials, Isotope Products in Russia," *ITAR-TASS*, March 5, 2003.

<sup>88</sup> See, for example, James Heintz, "Russian Official Says Nuclear Material Disappeared From Country's Plants," *Associated Press*, November 15, 2002, and "Head of Russia's Nuclear Regulatory Agency Admits Leakage of Weapons-Grade and Reactor-Grade Nuclear Materials From Atomic Facilities," *Nuclear.ru*, November 15, 2002.



of thousands of people over the next few years, and adequate provisions for civilian re-employment have not yet been made—meaning that there are thousands of people in Russia today who have access to nuclear materials or secrets but who expect to lose their jobs soon, creating a potential motivation to set something aside for a “rainy day.”

Moreover, as the case of Pakistan’s Abdul Qadeer Khan shows very clearly, theft and sale of nuclear materials and secrets may be motivated by the desire to get rich, not by desperation. That appears to have been the case with Alexander Tyulyakov, deputy director of Atomflot, the state-owned firm that maintains Russia’s nuclear-powered icebreakers: he was arrested in August 2003 with 1.1 kilograms of stolen natural uranium, described in some reports as mixed with thorium or radium, and an illegal handgun.<sup>89</sup> While there has been no suggestion that this was material that could have been used to make a nuclear bomb, Atomflot handles tons of weapons-usable highly enriched uranium, and this is the first documented case of theft involving the senior management of a facility handling such material. This is particularly worrisome, as thefts involving senior managers are among the hardest for any security system to prevent.

<sup>89</sup> Tyulyakov was arrested in August, formally charged in September, and convicted in November. It is not clear yet whether this material came from Atomflot or some other facility. According to Atomflot’s Director, as quoted in *Nezavisimaya Gazeta*, Tyulyakov had no authority over nuclear materials. The same article also noted, though without any reference, that Russian investigators are inclined to conclude that Tyulyakov had “dozens” of accomplices, not only at Atomflot, but also in other places in Russia. For more on this case, see, for example, “Zamdirektora Atomflota Prodal Atomnyyu Bombu (Deputy Director Of Atomflot Sold Atomic Bomb),” *Kommersant*, October 3, 2003; “Gryaznoe Delo (Dirty Business),” *Izvestia*, October 4, 2003; Nadezhda Popoova, “‘Yaderny Pogreb’ Rossii Stal Prohodnym Dvorom (Russia’s ‘Nuclear Vault’ Has Become Public Thoroughfare),” *Nezavisimaya Gazeta*, October 20, 2003; “Russian Official Arrested for Trying to Sell Radioactive Material,” *Agence-France Press*, August 28, 2003; “Na Vyselki Za Banku Radiatsii (To Prison for a Jar of Radiation),” *Nezavisimaya Gazeta*, November 26, 2003 (translation by A. Dianov, Department of Energy-Moscow); “V Murmanske K 1.5 Godam Zaklyuchenii Prigovoren Zamdirektora ‘Atomflota,’ Pitavshiyca Prodat’ Radioaktivnie Materiali (In Murmansk, Deputy Director Of Atomflot Receives 1.5 Year Sentence For Trying To Sell Radioactive Materials),” *RIA Novosti*, November 25, 2003; David Filipov, “Conviction Underscores Threat of Nuclear Theft: Russian Fleet Officials Stored, Tried to Sell Radioactive Material,” *Boston Globe*, November 26, 2003. The radium story comes from “Na Vyselki Za Banku Radiatsii (To Prison for a Jar of Radiation),” *Nezavisimaya Gazeta*, November 26, 2003, while the mention of thorium is through personal communication with a Russian non-governmental expert who had reviewed the official government analysis of the material, October 2003. For a longer summary of the story, see Monterey Institute for International Studies Center for Nonproliferation Studies, “Gryaznaya Bomba V Yadernom Chemodanchike (Dirty Bomb In A Nuclear Suitcase),” Abstract 20030560, *NTI Research Library: NIS Nuclear Trafficking Database*, October 3, 2003 (available at <http://www.nti.org/db/nistraff/2003/20030560.htm> as of April 29, 2004). For a discussion of Atomflot, with links to additional information, see Center for Nonproliferation Studies, Monterey Institute of International Studies, “Russia: Atomflot (Murmansk Shipping Company),” *Nuclear Threat Initiative Research Library*. We are grateful to Dmitry Kovchegin for providing English summaries of some of these accounts.

<sup>90</sup> “‘Enormous damage’ from Equipment Theft in Russian Navy,” *RTR-TV* (Moscow), December 6, 2003 (translated by BBC Monitoring Service).

Theft and corruption throughout Russia’s military remains rampant; over 1,200 military officers were prosecuted for crimes in 2003. And theft and pilfering at Russian naval bases continues at epidemic proportions: Russia’s Audit Chamber reported that submarines arrive for decommissioning with half of their precious metals and electronic equipment already stolen.<sup>90</sup> It would be surprising indeed if this problem of theft and corruption did not exist at all in Russia’s nuclear sector.

Moreover, there are disturbing indications that demand for stolen nuclear weapons or materials may be becoming more focused and sophisticated. The reports of terrorist reconnaissance on Russian nuclear warhead storage sites and trains in 2001 and 2002, and the report that the terrorists who seized a Moscow theater in October 2002 considered seizing a Russian facility with enough HEU for dozens of nuclear bombs certainly confirm that terrorist interest in Russia’s vast nuclear complex remains strong. Similarly, the case of the Russian businessman who had been offering \$750,000 for stolen weapon-grade plutonium for sale to a foreign client—and had succeeded in making contact with residents of the closed city of Sarov, home of one of Russia’s premier nuclear weapons design laboratories—gives cause for continued concern. Even

though in this case the businessman linked up with scam artists and was caught, who can be confident that there is no one in Russia's vast nuclear infrastructure who could be convinced to provide plutonium in return for \$750,000?<sup>91</sup>

While this and other past cases suggest that it has been very difficult to make the connection between Russians who may be willing to consider stealing material and terrorists such as those in al Qaeda who may want it, it also now appears that a significant fraction of the Afghan heroin crop is being smuggled through Russia on its way to European markets—creating crime linkages and transport routes from the heart of Russia to Afghanistan and Pakistan that might be exploited for nuclear smuggling.<sup>92</sup>

In short, the shape of the danger of nuclear theft from Russian facilities has changed in recent years—but the danger remains very real, and the need for action to ensure that every warhead and every kilogram of weapons-usable nuclear material in Russia is secure against both outsider and insider threats remains urgent.

### ***The Threat From Research Reactor Fuel***

Some 20 metric tons of HEU—enough for hundreds of nuclear weapons—exists as fuel for civilian research reactors around the world.<sup>93</sup> More than 130 research reactors still use HEU as their fuel, in more than 40 countries,<sup>94</sup> and an unknown number of shut-down research reactors still have HEU fuel on-site. Most of these facilities have very modest security—in many

cases, no more than a night watchman and a chain-link fence.

Only a fraction of these facilities have enough fresh, unirradiated HEU on-site for a bomb—but that fraction grows substantially when irradiated HEU fuel is included as well, as it should be. Fortunately for the world, data is not publicly available on how much HEU fuel of what types exists at each site—but it seems clear that if both fresh and irradiated fuels are included, there are dozens of sites around the world where there is enough HEU in research reactor fuel to make a nuclear bomb. The potential use of research reactor HEU in nuclear weapons is not just a hypothetical concern: as discussed in the previous section on nuclear terrorism myths, Iraq, in its “crash program” to make one nuclear bomb as quickly as possible after its invasion of Kuwait, planned to use both fresh and irradiated HEU from its research reactors.<sup>95</sup>

Unlike the huge, massive fuel assemblies used in nuclear power reactors, these research reactor fuels are typically in fuel elements that are small and easy to handle—typically less than a meter long, several centimeters across, and weighing a few kilograms. In most cases, a thief could easily put several of them at a time into a backpack, to be carried out to a waiting vehicle.

In general, the HEU in these fuel elements would require some processing before it could be used in a bomb—but the kind of processing required is reasonably straightforward, and all the details of the necessary processes are published in the open litera-

<sup>91</sup> Fortunately, the two residents of Sarov who agreed to a deal with him were scam artists who attempted to pawn off a container of mercury, claiming it was a container for plutonium. The sellers were arrested for fraud; the buyer was killed in a car crash that investigators concluded was probably unrelated. For a good summary of Russian press reporting of the case, see “Plutonium Con Artists Sentenced in Russian Closed City of Sarov,” *NIS Export Control Observer*, no. 11 (November 2003; available at [http://cns.miis.edu/pubs/nisexcon/pdfs/ob\\_0311e.pdf](http://cns.miis.edu/pubs/nisexcon/pdfs/ob_0311e.pdf) as of February 24, 2004), pp. 10-11.

<sup>92</sup> U.S. Department of State, “Europe and Central Asia: Russia,” in *International Narcotics Control Strategy Report: 2003* (Washington, D.C.: State Department, March 1, 2004; available at <http://www.state.gov/g/inl/rls/nrcrpt/2003/vol1/html/29838.htm> as of April 22, 2004).

<sup>93</sup> The 20 ton estimate is from see David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities, and Policies* (Oxford, UK: Oxford University Press for the Stockholm International Peace Research Institute, 1997).

<sup>94</sup> James Matos, Argonne National Laboratory, personal communication, September 2002, based on updates to International Atomic Energy Agency, *Nuclear Research Reactors in the World*, IAEA-RDS-3 (Vienna, Austria: IAEA, September 2000).

<sup>95</sup> For a detailed discussion based on the discoveries of the IAEA Iraq Action Team after the 1991 Gulf War, see Albright, Berkhout, and Walker, *Plutonium and Highly Enriched Uranium 1996*, op. cit., pp. 344–349.

ture. While there is a broad range of different types of research reactor fuel, a very typical fuel is a mixture of uranium and aluminum, with aluminum cladding. To separate out the uranium from the aluminum, such fuel could be cut into pieces, dissolved in acid, and the uranium separated from the resulting solution by well-known processes. Converting the chemical forms of uranium that would be recovered by these means to metal would also involve straightforward processes, all of which are published in the open literature. As one analysis put it, separating the uranium from research reactor fuel can be done “using commonly available equipment...all readily available in countries with even very modest chemical industries.... [A]ll process chemistry data are published.”<sup>96</sup> It is very likely that a terrorist group with the level of technical expertise required to make a nuclear bomb from HEU metal would also be able to solve the challenge of getting HEU metal from research reactor fuel.

**The danger of irradiated research reactor fuel.** It is important to understand that “spent” research reactor fuel also poses a serious proliferation threat. First, irradiated research reactor fuels typically remain very highly enriched: many fresh research reactor fuels are 90% enriched, and are still more than 80% enriched after irradiation.<sup>97</sup> (The bomb that incinerated the Japanese city of Hiroshima was made from 80% enriched uranium.<sup>98</sup>)

Second, most of these fuel elements are not radioactive enough to prevent them from being stolen and

processed for bomb material. Fuel that emits more than 100 rem/hour at 1 meter is considered “self-protecting” under international standards, meaning that it is too radioactive for thieves to plausibly steal. This standard should be reconsidered, for in the case of suicidal terrorists who do not care about increasing their chance of cancer years afterward, 100 rem/hour would provide little deterrent.<sup>99</sup> But in any case, most irradiated HEU research reactor fuel in the world does not meet this standard. Because the fuel elements are small, are not irradiated to the same power densities as power reactor fuel, and in many cases have been sitting in pools cooling for decades, most of this material could be stolen almost as easily as the fresh material could be.

Third, because of the very modest level of radioactivity, for terrorists who do not care about their long-term cancer risks, getting the uranium out of this material for use in a bomb would be little more difficult than getting the uranium out of fresh, unirradiated fuel. The same chemical processes described above could be used. Thus, *kilogram for kilogram, irradiated research reactor fuel poses only a modestly lower proliferation danger than fresh research reactor fuel*—and there is far more irradiated HEU fuel at poorly secured reactor sites around the world than there is fresh fuel.<sup>100</sup> The danger posed by research reactor spent fuel stands in stark contrast to the modest theft threat posed by nuclear power reactor spent fuel assemblies, which are huge, heavy, and intensely radioactive, making them quite difficult to steal and process.

<sup>96</sup> Argonne National Laboratory research report, 1977. Full reference available from the authors on request.

<sup>97</sup> An enrichment level of 90% means that 90 out of every 100 uranium atoms are U-235, with the remaining 10 being U-238. Research reactors typically irradiate such fuels until they have fissioned just under 50% of the U-235 atoms. This means that of the remaining uranium atoms, 45 of every 55 are U-235 atoms, with the 10 original U-238 atoms still remaining—an enrichment of just over 80%.

<sup>98</sup> Federation of American Scientists, “Special Weapons Primer: Nuclear Weapon Design,” October 21, 1998 (available at <http://www.fas.org/nuke/intro/nuke/design.htm> as of April 29, 2004).

<sup>99</sup> For a useful discussion, with references to U.S. laboratory studies on the self-protection issue, see Edwin Lyman and Alan Kuperman, “A Re-Evaluation of Physical Protection Standards for Irradiated HEU Fuel” (paper presented at the 24<sup>th</sup> International Meeting on Reduced Enrichment for Research and Test Reactors, Bariloche, Argentina, November 5, 2002).

<sup>100</sup> For a discussion of these stockpiles, see Iain G. Ritchie, “Growing Dimensions: Spent Fuel Management at Research Reactors,” *IAEA Bulletin* 40, no. 1 (March 1998; available at <http://www.iaea.org/Publications/Magazines/Bulletin/Bull401/article7.html> as of April 29, 2004). Some analysts have pointed to the modest interest that commercial reprocessing firms have had in separating uranium from research reactor fuel, to argue that such separations would be very difficult. But there is a huge difference between separating enough uranium to be of commercial interest, and separating the much smaller amount needed for a bomb—and there is a huge difference between separations that meet all modern safety regulations and quick and dirty separations that might be done by terrorists.

## **Security of Pakistan's Stockpile**

Pakistani nuclear weapons are believed to be stored in partly disassembled form.<sup>101</sup> In addition to the weapons and materials associated with the weapons program, Pakistan has an HEU-fueled research reactor supplied by the United States.

Pakistan's nuclear facilities are believed to be heavily guarded, though they probably are not equipped with state-of-the-art physical protection and material control and accounting technologies.<sup>102</sup> Clearly, either state collapse or the rise of an extremist Islamic government in Pakistan—neither of which can by any means be ruled out—could pose severe dangers of nuclear assets becoming available to terrorists or hostile states.

Even in the current environment, however, both insider and outsider threats to Pakistan's stockpiles appear to be dangerously high. The revelation that Abdul Qadeer Khan, the father of Pakistan's bomb, had for decades been secretly leading a global black-market nuclear supply network providing centrifuge designs, centrifuge parts, complete centrifuges, uranium hexafluoride, and even bomb designs to clients including (at least) North Korea, Iran, and Libya highlights the grave danger that insiders in Pakistan's nuclear complex, motivated by money, sympathy to extreme Islamic causes, or both, might help terrorists get a bomb or bomb material from Pakistan's stockpiles. So does the case of Sultan Bashiruddin Mahmood, the former head of Pakistan's plutonium production program, who, with a colleague from the nuclear program, established an Islamic charity to support the Taliban in Afghanistan, met with Osama bin Laden there, had extensive discussions in which bin Laden asked for technical information on nuclear, chemical,

and biological weapons, and was placed under house arrest for a time on suspicion of passing nuclear secrets to al Qaeda.<sup>103</sup> The danger that insiders might pass material or weapons to al Qaeda, or facilitate an outsider attack, appears to be very real.

Similarly, the threat from a possible terrorist attack on a Pakistani nuclear weapon depot appears dangerously high. In the winter of 2003–2004, terrorists who apparently had inside information twice almost succeeded in assassinating Pakistan's President. Large armed remnants of al Qaeda operate in the nearly lawless tribal zones on Pakistan's border with Afghanistan. Indeed, some combination of al Qaeda, Taliban, and Pakistani fighters was able to hold off thousands of Pakistani regular army troops for days at a time in a pitched battle in the tribal zones in early 1994. If 41 heavily armed terrorists can strike without warning in the middle of Moscow, how many might appear at a Pakistani nuclear weapon storage site? Would the guards at the site be sufficient to hold them off—and would the guards choose to fight, or to cooperate?

## **A Global Threat**

The identification of these three categories as the highest priority threats is by no means intended to minimize the threats that exist elsewhere around the world. There is probably no country where nuclear weapons and materials are located—including the United States—that does not have more to do to ensure that its nuclear stockpiles are secured and accounted for to a level sufficient to defeat demonstrated terrorist and criminal threats. This is a global problem, which can only be solved through a global partnership for nuclear security. Every state has an interest in ensuring that the essential ingredients of nuclear weapons never fall into terrorist hands.

<sup>101</sup> See, for example, Lee Feinstein, James C. Clad, Lewis A. Dunn, and David Albright, *A New Equation: U.S. Policy Toward India and Pakistan After September 11* (Washington, D.C.: Carnegie Endowment for International Peace, May 2002; available at <http://www.ceip.org/files/pdf/wp27.pdf> as of January 13, 2003), especially the chapter by Albright.

<sup>102</sup> The sparse information that is publicly available is summarized in Nathan Busch, *Assessing the Optimism-Pessimism Debate: Nuclear Proliferation, Nuclear Risks, and Theories of State Action* (Ph.D. dissertation, University of Toronto, 2001).

<sup>103</sup> Khan and Moore, "2 Nuclear Experts Briefed Bin Laden, Pakistanis Say," *op. cit.*; Khan, "Pakistan Releases Nuclear Scientists for Ramadan's End," *op. cit.*; and Baker, "Pakistani Scientist Who Met Bin Laden Failed Polygraphs, Renewing Suspicions," *op. cit.*

# 3 KEY DEVELOPMENTS AND PROGRESS IN THE PAST YEAR

If judged by the standards used for most government programs, intended to go on for many years, the year since our March 2003 report<sup>1</sup> was published has been one of significant progress—though also some substantial setbacks—in efforts to secure, monitor, and reduce nuclear stockpiles, block nuclear smuggling, and control nuclear expertise around the world. But if judged, as it should be, by the central question of whether the nations of the world will succeed in securing these stockpiles before thieves and terrorists get to them, the progress of the past year appears dangerously slow. As Winston Churchill once said, “It is no use saying ‘We are doing our best.’ You have got to succeed in doing what is necessary.”

This section reviews progress and key developments of the past year in each of six categories of effort needed to keep nuclear weapons, materials, and expertise out of terrorist hands: securing nuclear warheads and materials; interdicting nuclear smuggling; stabilizing employment for nuclear personnel; monitoring nuclear stockpiles; ending further production; and reducing nuclear stockpiles. For each of these categories, this section provides an updated assessment of the fraction of the job that has been accomplished, and the current pace of progress, using a set of rough metrics developed in our previous report.<sup>2</sup> Fundamentally, we are asking two questions:

- How much of what needs to be done to keep nuclear weapons, materials, and expertise out of the hands of terrorists and hostile states has already been accomplished?
- How fast is what is left to be done being finished, and in particular, how much has been finished in the year since our last report?

Unfortunately, as will be described below, across a broad range of measures, the answers are that much more remains to be done than has been accomplished to date, and if the current rate of progress does not dramatically accelerate, the key actions needed to keep nuclear weapons and materials out of the hands of terrorists and hostile states will not be completed for many years to come.

The measures used in this section provide only rough summary estimates of the rate of progress. We have relied on official government measures and data where possible, but in many cases these are not available. The fact is that the U.S. government has no comprehensive plan for accomplishing these tasks, and has not put forward a comprehensive set of milestones that would allow the Congress and the public to fully understand how much progress is being made, and where prolonged delays suggest the need for a change in approach. We have thus been forced to devise our own set of measures. We would like nothing better than to have the U.S. government correct our estimates by putting forth a comprehensive set of measures of its own, which could be openly debated. Until that occurs, we will continue to provide the best measurable assessments we can from outside the government.

As we discussed at length in last year’s report, top-level quantitative measures of the kind used in this section are at best rough indicators of the state of progress, and can be misleading if viewed out of context. In the case of programs focused on permanently changing the way a foreign government performs a government function—such as improving security for nuclear stockpiles, or improving countries’ capabilities to interdict nuclear smuggling—focusing only on how many sites have equipment installed or how

<sup>1</sup> 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; available at [http://www.nti.org/e\\_research/cnwm/overview/report.asp](http://www.nti.org/e_research/cnwm/overview/report.asp) as of May 3, 2004).

<sup>2</sup> Bunn, Wier, and Holdren, *Controlling Nuclear Warheads and Materials*, op. cit., pp. 61–83.

many people have been trained is inevitably incomplete. If the people using this equipment or receiving this training do not have strong incentives to provide good security, or do not work in organizational structures well-suited to doing so, the job will not get done even with the best equipment and training in the world.<sup>3</sup>

Indeed, experience in other areas of international assistance suggests that programs that focus *only* on providing equipment and training to accomplish a specific technical mission—from tax collection in Bolivia to health care delivery in Botswana—usually have little long-term benefit. The program helps for a while, and then the trainees move on to other jobs, the equipment breaks or wears out, and the system is back to where it started. Only if the programs focus on modifying the entire *system* in which the function is performed (from the power and budgets of the agencies doing the work, to the regulations specifying what work should be done, to the way the people doing the work are recruited, hired, trained, paid, and promoted) do such assistance programs typically have long-term benefits.<sup>4</sup> Assessing how well programs are doing in the complex job of changing the way thousands of people in a foreign country do their jobs day to day, and how much of this will last after the assistance program comes to an end, is extraordinarily difficult. Nevertheless, much of the future of threat reduction is in these areas, and many of the most important factors for ensuring U.S. and world security in these areas are difficult-to-measure intangibles.<sup>5</sup> (See “Achieving Sustainable Security,” p. 48.)

Moreover, such top-line metrics must take into account that the problem these programs are trying to address is dynamic, not static. As discussed in the last chapter, the Russian government and the Rus-

sian economy are not the same as those that existed a dozen years ago or even six years ago, and that makes an important difference in assessing both the overall threat level and what types of upgrades or retooling efforts might be most effective. Tens of tons of nuclear material are destroyed every year in the U.S.-Russian HEU Purchase Agreement, hundreds or thousands of nuclear weapons are dismantled, and tons of new weapons-usable plutonium are separated by reprocessing, all of which affects the total number of nuclear weapons and the total amount of nuclear material to be secured.

## CROSSCUTTING DEVELOPMENTS

Before reviewing the developments and progress in each of the six categories just mentioned, it is important to review crosscutting developments that frame the larger picture. During the past year, there was slow but steady progress in securing and eliminating nuclear stockpiles in the former Soviet Union, and vulnerable stocks of HEU were removed from several countries. President Bush’s public statements continued to highlight the danger posed by weapons of mass destruction (WMD) falling into terrorist hands—but with the distractions of Iraq, North Korea, Iran, the Khan-centered proliferation network, and more, very little presidential attention was focused on overcoming the obstacles to accelerated progress in securing the world’s nuclear stockpiles. Consider:

- Two summit meetings with President Putin came and went with no noticeable effort to overcome these obstacles and no public reference to the need to secure these stockpiles; at their September 2003 summit, President Bush and President

<sup>3</sup> A useful discussion of the critical importance of how well individual people perform their roles to maintaining good security for nuclear material, see Igor Khripunov and James Holmes, eds., *The Human Factor and Security Culture: Challenges to Safeguarding Fissile Materials in Russia* (Athens, Georgia: Center for International Trade and Security, University of Georgia, November 2002; available at <http://www.uga.edu/cits/documents/pdf/Humanfactor.pdf> as of May 3, 2004).

<sup>4</sup> See, for example, Merilee S. Grindle, ed., *Getting Good Government: Capacity Building in the Public Sectors of Developing Countries* (Cambridge, Mass.: Harvard Institute for International Development, 1997).

<sup>5</sup> See, for example, the discussion in *Reshaping U.S.-Russian Threat Reduction: New Approaches for the Second Decade* (Washington, D.C.: Russian American Nuclear Security Advisory Council and Carnegie Endowment for International Peace, November 2002; available at <http://www.ceip.org/files/pdf/Reshaping.Threat.Reduction.pdf> as of April 29, 2004).

Putin laid out an agenda for U.S.-Russian cooperation that did not mention this subject at all.<sup>6</sup>

- No senior official with direct access to the President was appointed to lead all the disparate elements of the U.S. effort; it remains true that there is no one in overall charge of the U.S. government's efforts to prevent a nuclear terrorist attack on U.S. soil.<sup>7</sup>
- No integrated and prioritized plan for these efforts was put in place.<sup>8</sup>
- President Bush launched an important initiative to strengthen national laws controlling WMD stockpiles and transfers. In his address to the UN General Assembly in September 2003, he called for a new UN Security Council resolution that would require all states to pass laws prohibiting individuals and subnational groups from acquiring or transferring WMD, and "to secure any and all sensitive materials within their own borders."<sup>9</sup> The final version of the resolution was approved by the Security Council in April 2004.<sup>10</sup>
- President Bush delivered a major speech in February 2004 outlining a series of proposed steps to strengthen the global effort to stem the spread of nuclear weapons. In that speech, the President emphasized that the nations of the world "must do all we can" to secure nuclear stockpiles around the

world, and suggested expanding the G-8 Global Partnership worldwide, calling on additional nations to contribute to that partnership.<sup>11</sup> But he offered no new initiatives to get nuclear stockpiles secured more rapidly, and pledged no new U.S. investments to address the issue. As will be discussed in the next chapter, the administration's budget, released the week before the speech, offered no noticeable increases in U.S. efforts to secure these dangerous stockpiles around the world.

- The 2003 Evian summit of the G-8 group of industrialized democracies, representing the first anniversary of the G-8's announcement of the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction, came and went with little action on securing and reducing nuclear stockpiles. By the time of the summit, participants in the Global Partnership had pledged some \$18 billion toward the \$20 billion target decided on in 2002, though by the spring of 2004, only tens of millions of non-U.S. funds had actually been spent. Most of the partnership's effort has focused on programs to dismantle aging submarines and destroy chemical weapons stockpiles—but there is little sign as yet of significant funding or priority from any of the non-U.S. participants to secure nuclear stockpiles around the world, and the heads of state

<sup>6</sup> See "Joint Statement Between the United States of America and the Russian Federation" (Washington, D.C.: The White House, September 27, 2003; available at <http://www.whitehouse.gov/news/releases/2003/09/20030927-11.html> as of April 29, 2004).

<sup>7</sup> This is largely *not* the job of the Department of Homeland Security (DHS), as that job is presently defined. They are charged with detecting efforts to smuggle nuclear material into the country, and with efforts to find such material if it is already in the country—but although the threat to homeland security begins abroad, they are not charged with securing nuclear weapons and materials around the world.

<sup>8</sup> In March 2003, the administration did submit a report required by Congress which does cut across agency boundaries to provide summaries of the work being done by many of the programs working to secure and reduce former Soviet stockpiles of nuclear weapons, material, and infrastructure. But this document is better described as a list than a plan—it sets few measurable milestones, and includes no assignment of priorities or resources. Executive Office of the President, *Plan for Securing Nuclear Weapons, Material, and Expertise of the States of the Former Soviet Union*, March 2003 (available at [http://www.nti.org/e\\_research/official\\_docs/dos/2003adminplan.pdf](http://www.nti.org/e_research/official_docs/dos/2003adminplan.pdf) as of May 3, 2004)

<sup>9</sup> President George W. Bush, "President Bush Addresses U.N. General Assembly" (New York, New York: The White House, September 23, 2003; available at <http://www.whitehouse.gov/news/releases/2003/09/20030923-4.html> as of February 20, 2004).

<sup>10</sup> United Nations Security Council, *Resolution 1540 (2004)*, April 28, 2004 (available at [http://www.un.org/Docs/sc/unsc\\_resolutions04.html](http://www.un.org/Docs/sc/unsc_resolutions04.html) as of May 12, 2004).

<sup>11</sup> President George W. Bush, "Remarks by the President on Weapons of Mass Destruction, Fort Lesley J. McNair, National Defense University, Washington, D.C." (Washington, D.C.: The White House, November 10, 2001; available at <http://www.whitehouse.gov/news/releases/2004/02/20040211-4.html> as of February 18, 2004).

at the summit proposed no new efforts toward that end.<sup>12</sup>

- Much of the modest amount of high-level attention that was focused on this agenda in the last year was sucked into an obscure dispute over liability provisions in threat reduction agreements, which could readily have been resolved had there been any willingness to explore sensible compromises.<sup>13</sup> In July and September 2003, the administration allowed two major threat reduction agreements to expire—one on technical cooperation toward disposition of excess weapons plutonium, and the other the Nuclear Cities Initiative (NCI) agreement—rather than compromising on the liability issue. This action has delayed destruction of thousands of bombs' worth of excess weapons plutonium by more than a year.

At the agencies, Secretary of Energy Abraham and senior officials of his department continued to work to move this agenda forward, stepped up the pace of removing HEU from vulnerable facilities, and had some successes chipping away the obstacles to progress (as will be described in more detail below). Defense Department threat reduction efforts passed a significant milestone in finally getting Russian approval for DOD access to an initial set of nuclear weapon storage sites (also described in more detail below). The State Department made significant progress in strengthening the Proliferation Security Initiative—which will allow some dangerous transfers to be stopped, though the extent to which such means can stop the transfer of nuclear materials that can fit in a briefcase should not be exaggerated.<sup>14</sup>

While the U.S. Congress has often taken a leadership role on these issues in the past—from the initial creation of the Nunn-Lugar effort in 1991, to adding hundreds of millions of dollars to secure nuclear stockpiles in the aftermath of the 9/11 attacks—in the 2003 legislative season Congress took little additional action to reduce these threats. For most of the programs in these areas, Congress simply approved the budgets and the authorities the administration requested. Congress did act to grant the administration the authority it sought to spend both Department of Defense (DOD) and Department of Energy (DOE) threat reduction funds to reduce threats in countries outside the former Soviet Union, but at the same time, it denied funding for a modest initiative to purchase additional LEU blended from weapons HEU (intended both to destroy additional HEU and to create a fuel reserve for U.S. reactors in the event of a disruption in supply).

Moreover, at the urging of House Republicans, Congress responded to recent cases where changes in the Russian approach had turned some U.S.-funded threat reduction facilities into expensive white elephants (such as a large facility for destroying heptyl fuel, which has no fuel to destroy because Russia recycled it into its space program) with a series of additional restrictions and requirements for threat reduction programs. Some of these may tend to constrain progress more than they strengthen it. While provisions relating to an accelerated effort to remove weapons-usable nuclear material from vulnerable sites were proposed in several pieces of legislation, the only one that made it into law was an additional \$5 million for that purpose in the Energy and Water

<sup>12</sup>For a useful assessment, see "Global Partnership Update: A Post-Evian Assessment" (Washington, D.C.: Strengthening Global Partnership Project, Center for Strategic and International Studies, July 2003; available at <http://www.sgpproject.org/GP%20Update%20no1.pdf> as of April 29, 2004).

<sup>13</sup> See, for example, Peter Slevin, "U.S.-Russia Plutonium Disposal Project Languishing," *Washington Post*, May 10, 2004; Kenneth N. Luongo, letter to Secretary of State Colin Powell, Secretary of Energy Spencer Abraham, and National Security Advisor Condoleezza Rice, July 2, 2003, available at <http://www.ransac.org> as of May 12, 2004); and R. Douglas Brubaker and Leonard S. Spector, "Liability and Western Assistance to Russia: Time for a Fresh Look?" *Nonproliferation Review* 10, no. 1 (Spring 2003; available at <http://cns.mii.edu/pubs/npr/vol10/101/brub.pdf> as of May 12, 2004).

<sup>14</sup>For more on the PSI, see U.S. Department of State, "Proliferation Security Initiative," no date (available at <http://www.state.gov/t/np/c10390.htm> as of May 12, 2004). Also, read the interview with PSI architect U.S. Undersecretary of State John Bolton, in Wade Boese, "The Proliferation Security Initiative: An Interview With John Bolton," *Arms Control Today*, December 2003 (available at [http://www.armscontrol.org/act/2003\\_12/PSI.asp](http://www.armscontrol.org/act/2003_12/PSI.asp) as of May 12, 2004).



appropriations bill. The large energy bill debated in the Congress in 2003, if it had passed, would have substantially *weakened* constraints on civil commerce in HEU—the easiest material in the world for terrorists to use for a nuclear bomb.<sup>15</sup>

In short, although President Bush pledged in his 2003 State of the Union address that “we will do everything in our power” to keep terrorists from getting and using WMD, the fact is that when it comes to securing nuclear stockpiles from theft, the United States is manifestly not doing everything in its power to reduce this threat.<sup>16</sup>

But as noted earlier, the United States is nonetheless doing more to address this issue than any other state in the world. Russia continues to drastically underfund its programs to secure its own stockpiles and facilities, to put countless roadblocks in the path of U.S.-Russian cooperative efforts to secure them, and to take a remarkably lethargic approach to discussions focused on overcoming the obstacles to cooperation. The other members of the G-8, along with other leading states around the world, continue to put only the most modest priority on securing nuclear warheads and materials around the world. As but one of countless examples, the member states of the International Atomic Energy Agency (IAEA) have so far refused to

make the agency’s efforts to help states secure their nuclear facilities and block nuclear smuggling part of the agency’s regular budget—and the total amount voluntarily pledged to the effort over the years since the 9/11 attacks is over \$23 million, roughly the cost to carry out comprehensive security and accounting upgrades at two or three of the hundreds of buildings around the world requiring such upgrades.<sup>17</sup> Governments around the world, in short, are all failing to meet President Bush’s “everything in our power” test.

## SECURING NUCLEAR WARHEADS AND MATERIALS

The overall goal in this category is simple: every nuclear weapon and every kilogram of nuclear material anywhere in the world must be secured and accounted for, to stringent standards. Key developments in this area in the last year included:

- During Fiscal Year (FY) 2003, comprehensive security and accounting upgrades were completed on 35 tons of potentially vulnerable nuclear material in Russia, some 6% of the estimated 600-ton stockpile.<sup>18</sup>
- Potentially vulnerable HEU was removed from three additional facilities, in Romania, Bulgaria,

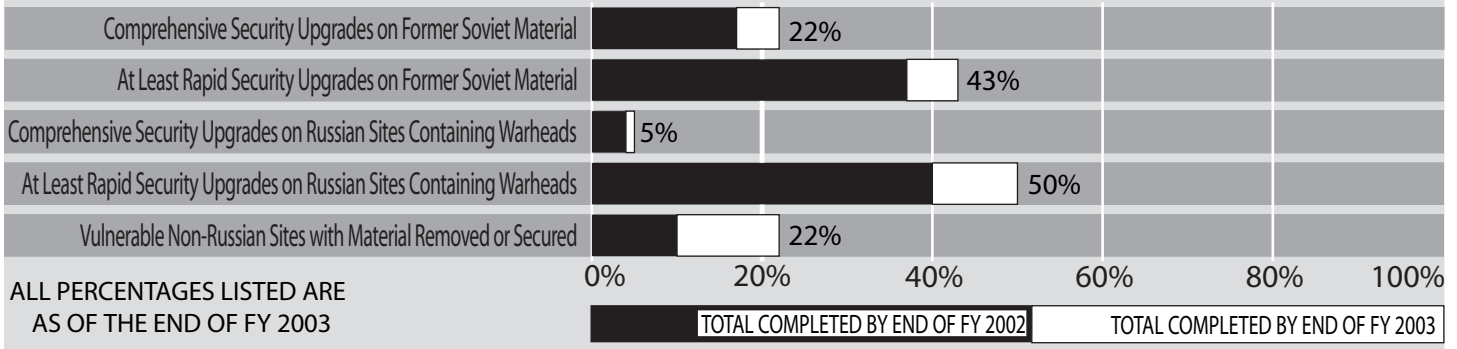
<sup>15</sup> For a discussion of these Congressional actions, see Anthony Wier, “Legislative Update,” *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, January 2004 (available at [http://www.nti.org/e\\_research/cnwm/overview/legislative.asp](http://www.nti.org/e_research/cnwm/overview/legislative.asp) as of May 3, 2004); see also William Hoehn, “Final Report of Activity in the First Session of the 108<sup>th</sup> Congress Affecting U.S.-Former Soviet Union Cooperative Nonproliferation Programs” (Washington, D.C.: Russian-American Nuclear Security Advisory Council, April 2004; available at <http://www.ransac.org> as of May 6, 2004). The energy bill provision related to civil HEU would have removed, for at least five years, the current prohibition on exporting HEU to producers of medical isotopes who do not pledge to switch to LEU when appropriate targets for doing so are available, and who do not cooperate with U.S. efforts to develop such targets. The Canadian firm MDS Nordion, the world’s largest supplier of medical isotopes and largest consumer of U.S.-supplied HEU, has essentially ceased cooperating with U.S. efforts to develop the means to convert production to LEU. See, for example, Daniel Horner, “Nordion Headed for ‘Showdown’ With U.S.?” *Nuclear Fuel*, March 15, 2004.

<sup>16</sup> President George W. Bush, “State of the Union Address” (Washington, D.C.: The White House, January 28, 2003; available at <http://www.whitehouse.gov/news/releases/2003/01/20030128-19.html> as of April 29, 2004).

<sup>17</sup> Because of such funding constraints, to date the IAEA has relied on donor states to fund actual upgrades, and has used its funds for physical protection peer reviews, drafting of recommendations and standards, training courses and workshops, maintenance of an international physical protection database, and the like. See IAEA, Director General, “Nuclear Security – Measures to Protect Against Nuclear Terrorism,” GC (47)/17, August 20, 2003 (available at <http://www.iaea.org/About/Policy/GC/GC47/Documents/gc47-17.pdf> as of May 12, 2004); Anita Nilsson, Office of Nuclear Security, IAEA, “IAEA Nuclear Security Programme” (presentation to the Inter-Parliamentary Conference, Strasbourg, November 20-21, 2003; available at <http://www.sgpproject.org/events/Strasbourg%202003%20speeches/1> as of May 13, 2004).

<sup>18</sup> The 35-ton figure was provided in Abraham, “Remarks to the Second Moscow International Nonproliferation Conference,” September 19, 2003 (available at <http://www.ceip.org/files/projects/npp/resources/moscow2003/abrahamremarks.htm> as of May 6, 2004).

**Figure 3-1**  
**How Much Securing Work Have U.S.-Funded Programs Completed?**



and Libya. Removals of irradiated Soviet-supplied HEU did not move forward, however, because of bureaucratic delays in Russia in completing the legally required analyses and documentation, and a U.S.-Russian agreement to facilitate these operations remained unsigned.<sup>19</sup>

- The UN Security Council passed a resolution requiring all states, among other things, to “develop and maintain appropriate effective measures to account for and secure” their nuclear stockpiles.<sup>20</sup>
- Discussions of ways to accelerate security upgrades continued, in a committee set up by the Department of Energy (DOE) and Russia’s Federal Agency for Atomic Energy (FAAE, formerly the Ministry of Atomic Energy or MINATOM), and the two sides began a pilot project to demonstrate approaches to providing adequate assurances that U.S. taxpayer funds were being appropriately spent at particularly sensitive nuclear sites.<sup>21</sup>
- Officials from the Department of Defense nuclear warhead security upgrade program finally were

permitted to visit the first set of Russian nuclear warhead storage facilities, allowing contracting for vulnerability assessments and upgrade designs to move forward.<sup>22</sup> DOE’s warhead security upgrade efforts with the Russian Navy moved toward completion with a contract signed for upgrades at the last Russian Navy warhead site, and work at Strategic Rocket Forces sites expanded.<sup>23</sup>

- The Mayak Fissile Material Storage Facility was completed, after a decade of effort. As of the spring of 2004, however, no material had yet been loaded into the facility, and no transparency agreement had been reached. Moreover, unless current U.S. and Russian policies constraining the use of this facility are changed, Russia only expects to load 25 tons of excess plutonium into the facility, leaving three-quarters of its storage space empty.<sup>24</sup>
- The DOE Inspector General reported that DOE’s efforts to take back U.S.-supplied HEU from facilities around the world did not cover two-thirds of the 17 tons of U.S.-supplied HEU that existed abroad when the program restarted in 1996, and were only

<sup>19</sup> Interviews with DOE and Russian officials, September 2003 and April 2004.

<sup>20</sup> United Nations Security Council, Resolution 1540, S/Res/1540 (2004), April 28, 2004.

<sup>21</sup> Paul Longworth, Deputy Administrator, National Nuclear Security Administration, Testimony to U.S. Senate, Armed Services Committee, Subcommittee on Emerging Threats and Capabilities, March 10, 2004, supplemented with interviews with DOE officials, January and March, 2004.

<sup>22</sup> Interviews with Department of Defense officials, January, February, and April, 2004.

<sup>23</sup> U.S. Department of Energy (DOE), *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, D.C.: DOE, February 2, 2004; available at <http://www.mbe.doe.gov/budget/05budget/content/defnn/nn.pdf> as of February 19, 2004), pp. 443–450; interview with DOE official, April 2004.

<sup>24</sup> Matthew Bunn, “Mayak Fissile Material Storage Facility,” *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, January 2004 (available at [http://www.nti.org/e\\_research/cnwm/securing/mayak.asp](http://www.nti.org/e_research/cnwm/securing/mayak.asp) as of May 12, 2004).

likely to succeed in taking back half of the material covered, some 15% of the total.<sup>25</sup>

- IAEA Director General Mohammed ElBaradei met with President Bush and emphasized, among other items, the need to remove nuclear material from dangerous sites around the world. The President reportedly agreed and gave the job of designing an initiative to Secretary of Energy Spencer Abraham, who had already been developing an initiative along similar lines.<sup>26</sup> In the spring of 2004, following legislation that had been debated the previous years, a bipartisan Senate group introduced legislation providing DOE with expanded authority to carry out this mission as quickly as possible.<sup>27</sup>
- The United States continued to press for cooperation in securing nuclear facilities with key states such as China, Pakistan, and India, but very little progress was made. Bilateral and IAEA-led efforts to review security and recommend improvements in states with more modest nuclear programs continued.

The best overall measure of progress in this area would be one that was performance-based: the fraction of buildings containing warheads or nuclear material that had demonstrated the ability to defend against a specified threat.<sup>28</sup>

Unfortunately, for nuclear warheads and materials in the former Soviet Union, such data does not yet exist

(and even less data of this kind is available for nuclear stockpiles in much of the rest of the world). The best publicly available surrogate is the fraction of material that is at sites with two defined levels of security and accounting equipment upgrades installed with U.S. assistance—“rapid” upgrades and “comprehensive” upgrades.<sup>29</sup> By its nature, however, this measure does not include the progress Russia has made in upgrading security on its own, without U.S. or other foreign assistance (see “Nuclear Security in Russia Today,” p. 31). Nor does it include harder-to-measure but crucial progress in areas such as providing training or strengthening independent regulation of nuclear security and accounting, areas which presumably have benefits for securing and accounting for *all* nuclear materials in Russia, not just those for which U.S.-funded equipment is being installed.

### ***Securing Metric 1: Security Upgrades on Former Soviet Nuclear Material***

**Fraction accomplished.** Within the former Soviet Union, as of the end of fiscal year (FY) 2003, some 22% of the potentially vulnerable nuclear material outside of nuclear weapons—estimated to amount to roughly 600 tons—had “comprehensive” security and accounting upgrades installed.<sup>30</sup> An additional 21% of the material had initial “rapid” upgrades installed, for a total of 43% with either rapid or comprehensive U.S.-funded upgrades completed.<sup>31</sup> Upgrades are underway on a significant additional amount of material. Because the effort concentrated first on upgrading

<sup>25</sup> See DOE, Office of Inspector General, *Audit Report: Recovery of Highly Enriched Uranium Provided to Foreign Countries*, DOE/IG-O638 (Washington, D.C.: DOE, February 2004; available at <http://www.fas.org/irp/agency/doe/ig-heu.pdf> as of May 3, 2004).

<sup>26</sup> Interviews, April 2004. After meeting with Bush, ElBaradei publicly emphasized the need to “clean up all clean up all the nuclear materials that lie around.” See Louis Charbonneau, “UN Nuclear Head Sees No Tolerance of WMD Seekers,” *Reuters*, March 19, 2004.

<sup>27</sup> As of this writing (spring 2004), this legislation was expected to be offered as an amendment to the Senate defense authorization bill.

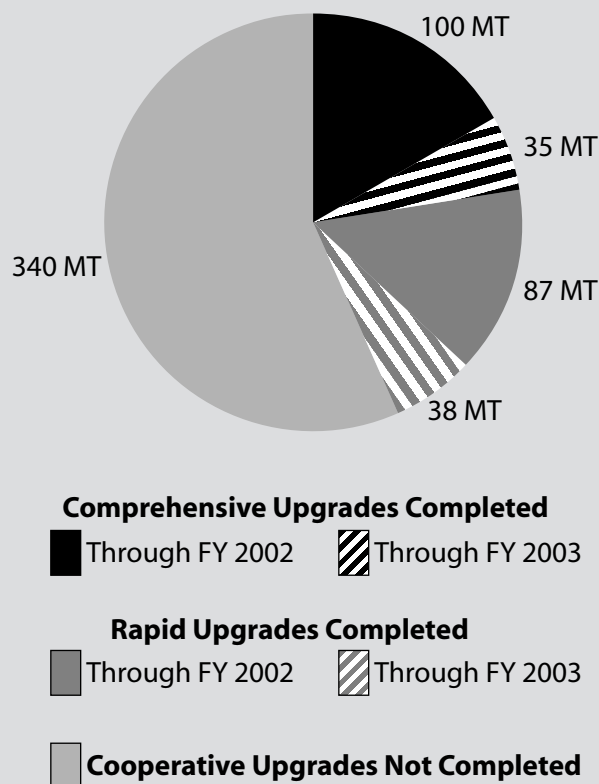
<sup>28</sup> This demonstration could be through realistic performance testing, where exercises are run in which insiders attempt to smuggle something out, or outsiders attempt to break in and steal something (such exercises are required at major nuclear facilities in the United States and some other countries), or through other means of rigorously assessing overall system vulnerabilities.

<sup>29</sup> Rapid upgrades include items such as installing nuclear material detectors at the doors, putting material in steel cages that would take a considerable time to cut through, bricking over windows, and counting how many items of nuclear material are present. “Comprehensive” upgrades represent the installation of complete modern security and accounting systems, designed to be able to protect the facility against at least modest insider and outsider theft threats.

<sup>30</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 446.

<sup>31</sup> Personal communication from DOE program official, February 2004. For a more detailed discussion of the MPC&A program, see Matthew Bunn, “Material Protection, Control, and Accounting,” *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, March 2003 (available at [http://www.nti.org/e\\_research/cnwm/securing/mpca.asp](http://www.nti.org/e_research/cnwm/securing/mpca.asp) as of May 3, 2004).

**Figure 3-2**  
**Status of Security Upgrades on Russian**  
**Weapons-Usable Nuclear Material**



MT = Metric Ton

pressive: 70% of the sites with nuclear weapons or the nuclear materials needed to make them where DOE's cooperative security upgrade program has been working now have comprehensive upgrades in place.<sup>32</sup> Figure 3-2 shows the amount of material with comprehensive or rapid upgrades completed as a fraction of the total amount of potentially vulnerable nuclear material.<sup>33</sup> Comprehensive upgrades have been completed for nearly all of the material at civilian sites in the former Soviet Union, and for materials in Russia's naval complex. But progress in securing the vast amount of material in the defense complex of Russia's Federal Agency for Atomic Energy (FAAE, formerly the Ministry of Atomic Energy, or MINATOM), has been slow, as debates over how much access to the very sensitive sites in this complex Russia will allow for U.S. personnel have slowed or stymied efforts for years. Some 500 tons of the estimated 600 tons of potentially vulnerable weapons-usable nuclear material outside of nuclear weapons in the former Soviet Union is in the FAAE's defense complex, and as of the end of FY 2003, comprehensive upgrades had been completed on only 11% of this material, and rapid upgrades on an additional 30%.<sup>34</sup>

**Rate of progress.** During FY 2003, comprehensive upgrades were completed on an additional 35 tons of weapons-usable nuclear material in Russia, increasing the fraction with comprehensive upgrades from 17% to 22%.<sup>35</sup> If that rate were simply maintained without change, it would take another 13 years to complete

particularly vulnerable sites with small quantities of nuclear material—though still enough for a bomb, if stolen—the fraction of sites completed is more im-

<sup>32</sup> The 70% figure was provided by Secretary of Energy Spencer Abraham in "Remarks to the Second Moscow International Nonproliferation Conference," September 19, 2003 (available at <http://www.ceip.org/files/projects/npp/resources/moscow2003/abrahamremarks.htm> as of March 4, 2004). This figure was supplemented and clarified by personal communications from DOE officials, September 2003.

<sup>33</sup> The precision in this figure is illusory. The DOE estimate of 600 tons of material outside of warheads is extremely uncertain. The breakdowns of how much material is in particular buildings and sites—from which the estimates of the percentage covered to date are drawn—are little more than guesses in some cases. Russia has never formally declared how much HEU or separated plutonium it has, how much of those stockpiles are in warheads, or how much material is in each of its many different facilities. In some cases this information is still considered a state secret in Russia.

<sup>34</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 444, and U.S. Department of Energy, Moscow Office, *Summary of DOE Programs in Russia: FY '03 Accomplishments and FY '04 Goals* (Moscow: U.S. Embassy, January 2004), p. 42.

<sup>35</sup> The 35-ton figure was provided in Abraham, "Remarks to the Second Moscow International Nonproliferation Conference," op. cit. Seventeen percent at the end of FY 2002 is from DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, D.C.: DOE, February 2003; available at <http://www.mbe.doe.gov/budget/04budget/content/defnn/nn.pdf> as of May 3, 2004), p. 624. While 35 tons would come to 5.8% of DOE's estimate of 600 tons of potentially vulnerable nuclear material, rounding apparently led to the total increasing by only 5% (for example, the previous figure might have been just under 17%, and the current year's just over 22%).

comprehensive upgrades on the potentially vulnerable nuclear material in Russia. Although Secretary of Energy Spencer Abraham and other senior DOE officials repeatedly take credit for having accelerated the effort after 9/11, by shifting the target date for completion from 2011 to 2008, that acceleration remains a hope rather than an accomplished fact. Indeed, as noted in the introduction, on the ground, the pace of upgrades has actually *slowed* after September 11, rather than accelerating. By DOE's figures, 7% of the estimated 600 tons of nuclear material outside of weapons in Russia received comprehensive upgrades in the two fiscal years following September 11, while 9% of the material had received such upgrades in the two years immediately prior.<sup>36</sup> This modest slow-down occurred despite \$150 million in supplemental appropriations for the effort in response to September 11.<sup>37</sup> The principal cause of this slow-down was that the program was slowly but surely completing the work that could be done until the problem of access to the most sensitive sites, with the largest amounts of materials, was resolved. As a result, much of the supplemental funding went to important efforts other than installing upgrades at additional sites, such as better equipment for guard forces, improved Material Protection, Control, and Accounting (MPC&A) training, and regulatory support.<sup>38</sup> Indeed, during FY 2004, DOE is expecting the rate for completing upgrades to be somewhat slower than the FY 2003 rate, with only an additional 4% of Russia's potentially vulnerable nuclear material—some 24 tons—slated to receive comprehensive upgrades during the year.<sup>39</sup>

Meeting DOE's plans to complete the effort by the end of 2008 thus would require a dramatic acceleration from the current pace: after struggling to make progress at the rate of 4–5% per year, DOE now expects to increase to well over 20% per year at the very end, accomplishing comprehensive upgrades for fully half of all the vulnerable nuclear material in Russia in 2007–2008, the last two years before the target date.<sup>40</sup> In other words, after taking more than a dozen years to get the first half of the material done, DOE hopes to get the second half done in just two years. Although much of the remaining upgrade work is at buildings with large amounts of nuclear material—so that each building completed contributes substantially to the overall percentage of material covered—the dramatic acceleration that DOE envisions occurring in 2007–2008 appears unlikely to be achieved unless there is a dramatic change in the level of sustained attention focused on overcoming the obstacles to accelerating these efforts, coming from both the U.S. White House and the Russian Kremlin. In particular, to have any hope of meeting the target, the access problem would have to be solved nearly immediately.

**Caveats and uncertainties.** In essence, there are three goals that programs to improve security must achieve:

- Security must be improved *fast enough*, so that the security improvements get there before thieves and terrorists do.

<sup>36</sup> Specifically, DOE's data indicate that comprehensive upgrades were completed on 2% of the material in FY 2002 and 5% of the material in FY 2003, compared to 6% in FY 2000 (the program's best year to date, by this measure) and 3% in FY 2001. DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 446; DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 624; DOE, *FY 2003 Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, D.C.: DOE, February 2002; available at <http://www.mbe.doe.gov/budget/03budget/content/defnn/nuclnonp.pdf> as of April 8, 2004), p. 106; Kenneth Sheely, "MPC&A Program Overview – Initiatives for Acceleration and Expansion," (paper presented to the 43rd Annual Meeting of the Institute of Nuclear Materials Management, Orlando, Florida, June 24, 2002).

<sup>37</sup> DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 627.

<sup>38</sup> U.S. General Accounting Office (GAO), *Weapons of Mass Destruction: Additional Russian Cooperation Needed to Facilitate U.S. Efforts to Improve Security at Russian Sites*, GAO-03-482 (Washington, D.C.: GAO, March 2003; available at <http://www.gao.gov/new.items/d03482.pdf> as of April 8, 2004), pp. 27–28.

<sup>39</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 446.

<sup>40</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 446.

## ACHIEVING SUSTAINABLE SECURITY

Spending billions to put in place modern security equipment at sites around the world that was not used effectively, or that ended up broken or unused in three years' time, would clearly not meet the goal of securing the world's nuclear stockpiles from theft. Security measures must not only be improved quickly, but sustained for the long haul, and must include not only improved equipment but changes in the way that the thousands of people guarding or working with nuclear weapons and materials around the world do their jobs every day. Means have to be found to wean sites from dependence on international assistance, and to convince all of the critical personnel involved that practices such as guards patrolling without ammunition, security gates being left open for convenience, or security personnel turning off detectors that generate an annoying number of false alarms cannot be continued.<sup>1</sup> As Gen. Eugene Habiger, former "security czar" at the U.S. Department of Energy (DOE) has put it, "Good security is 20% hardware and 80% culture."<sup>2</sup>

Changing security cultures in a lasting way, so that high security will be maintained long after international assistance phases out, will require: (a) gaining credible high-level commitments from each country where upgrades are taking place that security will be sustained after international assistance comes to an end; (b) consolidating nuclear weapons and materials in the smallest possible number of locations, so more security can be provided at lower cost; and (c) ensuring that the right *resources, incentives, and organizations* are put in place to sustain effective security and accounting practices for the long haul.<sup>3</sup>

### **Commitment**

President Bush should seek an explicit commitment from Russian President Putin to assign the necessary resources to sustain and improve the security and accounting systems now being put in place once U.S. assistance phases out. This commitment must then be translated into budgets and funding plans for individual ministries, agencies, and sites (as DOE has been struggling with its Russian counterparts to do). Similar high-level commitments should be sought from other governments, as participation in cooperative nuclear security upgrades expands. It is essential, however, that ongoing upgrades not wait on securing these commitments.

### **Consolidation**

The surest way to prevent nuclear theft from a building is to remove all the nuclear weapons or materials from it. To sustain high security for the long haul at an affordable price, the hundreds of buildings and bunkers where Russia's nuclear weapons and materials are now stored should be drastically reduced.<sup>4</sup> Both DOE and the Department of Defense have talked to their Russian counterparts about consolidating nuclear warhead and material sites, but progress has been painfully slow—indeed, Russia's Federal Agency for Atomic Energy (FAAE) has failed to come up with a consolidation plan, and has effectively prohibited DOE from offering incentives to FAAE sites to give up their nuclear material. Here, too, a serious push from the presidential level is likely to be needed to achieve consolidation on the scale that is needed. At the same time, a fast-paced "global cleanout" effort should be put in place to remove material from the most vulnerable sites worldwide.

### **Resources, Incentives, and Organizations**

The most critical elements of achieving sustainable security are putting in place the resources, incentives, and organization needed to do the job. Resources include money, appropriately trained personnel, equipment, and industrial infrastructure. DOE has programs in place working in all of these areas: training programs to build up an adequate cadre of Russian experts trained in modern security and accounting techniques (with at least the beginnings of training in the importance of these efforts to Russia's security and to the global effort to stem the spread of nuclear weapons); upgrade designs that focus on "inherently sustainable" upgrades that cost no money to maintain (the classic example being the large concrete blocks placed on top of thousands of potentially vulnerable plutonium canisters at Mayak); agreements at many sites to cover the first few years of maintenance costs for installed equipment; and contracting designed to strengthen Russia's indigenous infrastructure for producing modern security and accounting equipment, operating and maintaining it, doing vulnerability assessments, designing security systems, and installing security upgrades. But ultimately, a greater commitment of Russia's own resources will be essential.

Managers will always be tempted to cut spending on security—which brings in no revenue—unless strong incentives not to do so are put in place. Regulations are crucial: if managers know they are going to be inspected, and fined or shut down if their facility does not meet stringent requirements, they will invest in security. Hence the United States should increase its efforts to work with Russia to strengthen nuclear security and accounting regulation, including not only cooperation with GAN, Russia's civilian nuclear regulatory agency, but also efforts to strengthen the FAAE's internal ability to regulate its facilities, and the regulatory effectiveness of the Ministry of Defense group charged with regulating military stockpiles. As part of such a regulatory effort, the United States and Russia should work together to put in place a regular system of performance testing, which would demonstrate the performance of sites with strong security, while identifying weaknesses requiring correction at others. In addition, the two sides should cooperate to

expand the use of cameras to monitor actual security operations at key locations, providing another check on the day-to-day performance of the systems being put in place—now in place at only a few sites.<sup>5</sup>

The United States should also send the message that high standards of security and accounting for nuclear material were part of the “price of admission” for any facility to get lucrative contracts from the United States—and work to convince other leading nuclear states to do the same. Finally, the United States should make it will only support new projects involving transport and processing of weapons-usable nuclear materials if very high levels of security are maintained throughout these processes.

Experience with past international assistance efforts suggests that efforts to improve the way a foreign government carries out a governmental task (such as providing nuclear security) only provide long-term benefits if they focus on modifying the entire *system* in which the function is performed (from the power and budgets of the agencies doing the work, to the regulations specifying what work should be done, to the way the people doing the work are recruited, hired, trained, paid, and promoted). Simply adding security and accounting to the work load of people who have other “regular” jobs is not likely to be effective.

DOE is now planning to provide support for a “security culture coordinator” at each site, intended to help identify and fix the most important weaknesses in prevailing security practices—a useful first step. The United States should work with Russia and the other former Soviet states on a systemic program of reform of the organizations involved in security and accounting for nuclear material, designed to ensure that each facility with nuclear weapons or weapons-usable nuclear material has a designated office charged with securing and accounting for these stockpiles, with appropriate personnel and authority; that each agency or ministry controlling such facilities has an appropriate office to oversee security and accounting, with procedures and regulations in place; that there is regular sharing of information and experience within and between sites, and between sites and the national authorities; that there are clear and authoritative laws and regulations in place which, if complied with in their entirety, would ensure an effective system; that the regulatory bodies have what they need to enforce these laws and regulations; that there are recruitment, compensation, promotion, and training procedures in place to ensure that highly qualified people are available for all aspects of the security and accounting task, with incentives for good performance; that there are effective mechanisms in place for interagency coordination, joint action, and resolution of disputes related to securing and accounting for these stockpiles; and that a body of non-governmental organizations, journalists, and legislators is built up that can monitor progress independently.

### ***The Need for a Partnership Approach***

If new security and accounting measures are seen as imposed by Americans, they are unlikely to be sustained. Only if the experts in each country participating in such upgrades see the new approaches as in substantial part their own idea are they likely to “buy in” to the need for scrupulous implementation, day in, and day out. Thus a genuine partnership approach is needed: the United States should involve experts from the states where upgrades are taking place in every aspect of the conception, design, implementation, and operation of these upgraded systems. Plans should be developed jointly (including both U.S. funds and the state’s own funds), not in Washington alone; criteria for what kinds of upgrades should be done, to what standards of security, should be discussed and agreed wherever possible; progress should be reviewed by experts from both sides, working together, not solely by U.S. experts; and the same key personnel should lead the effort at particular sites for extended periods of time, so they can build the site-level relationships needed for a real partnership to grow.<sup>6</sup> Sustainable security will not be easy to achieve—but achieving it is essential, and worth the effort that will be required.

<sup>1</sup> For a list of incidents of this general kind, see Matthew Bunn et al., “Anecdotes of Nuclear Insecurity,” *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, January 16, 2004 (available at [http://www.nti.org/e\\_research/cnwm/threat/anecdote.asp](http://www.nti.org/e_research/cnwm/threat/anecdote.asp) as of April 26, 2004).

<sup>2</sup> Personal communication, April 2003.

<sup>3</sup> The discussion here is drawn from Oleg Bukharin, Matthew Bunn, and Kenneth N. Luongo, *Renewing the Partnership: Recommendations for Accelerated Action to Secure Nuclear Material in the Former Soviet Union* (Princeton, N.J.: Russian American Nuclear Security Advisory Council, August 2000), and references cited therein. See also Igor Khripunov and James Holmes, ed., *The Human Factor and Security Culture: Challenges to Safeguarding Fissile Materials in Russia* (Athens, Georgia: Center for International Trade and Security, University of Georgia, November 2002; available at <http://www.uga.edu/cits/documents/pdf/Humanfactor.pdf> as of May 13, 2004).

<sup>4</sup> For an excellent discussion of this point as it applies to warheads, see Harold P. Smith, Jr., “Consolidating Threat Reduction,” *Arms Control Today*, November 2003 (available at [http://www.armscontrol.org/act/2003\\_11/Smith.asp](http://www.armscontrol.org/act/2003_11/Smith.asp) as of May 13, 2004).

<sup>5</sup> Office of International Material Protection and Cooperation, *MPC&A Operations Monitoring (MOM) Project* (Washington, D.C.: U.S. Department of Energy, February 2002).

<sup>6</sup> For an extended discussion, see Bukharin, Bunn, and Luongo, *Renewing the Partnership*, op. cit.

- Security must be raised to *a high enough level*, to make sure that the threats terrorists and criminals have shown they can pose to such sites can be defeated.
- Security must be improved *in a way that will last*, including after foreign assistance phases out, so that these sites do not become vulnerable again in a few years' time.

There are clearly tensions among these three goals: putting in place security systems to defeat larger threats, and security systems that will stand the test of time, inevitably takes longer than slapping together less capable and long-lasting systems. Yet meeting all three goals is essential if the objective of keeping nuclear weapons and materials out of terrorist hands is to be met. The metrics discussed in this section really focus only on the first goal, and hence are inevitably incomplete.

Moreover, even for assessing whether security is improving fast enough, looking only at how many sites, or how much material, is equipped with modern security and accounting equipment tells only part of the story. General Eugene Habiger, former "security czar" at DOE's nuclear weapons complex and former commander of U.S. strategic nuclear forces, has said that "good security is 20% equipment and 80% culture."<sup>41</sup> Assessing how well programs are doing in changing the crucial "security culture" at these facilities—that is, the degree to which all of the personnel at the site are trained and motivated to maintain high security at all times—is extremely difficult to do, but extremely important.

Because of these underlying factors, several key caveats should be kept in mind when considering the above figures:

<sup>41</sup> Interview by author, April 2003.

<sup>42</sup> As just one simple example, see the picture of a security gate left open and unattended by GAO investigators, in GAO, *Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; Further Enhancements Needed*, GAO-01-312 (Washington, D.C.: GAO, February 28, 2001; available at <http://www.gao.gov/new.items/d01312.pdf> as of April 22, 2004), p. 14.

<sup>43</sup> For a description of the upgrades completed in 1996, see DOE, Russia/NIS Nuclear Material Security Task Force, *Improving Nuclear Materials Security at the Institute of Nuclear Physics—Tashkent, Uzbekistan* (Washington, D.C.: DOE, June 1997); for the upgrades completed in 2002, see DOE, "Secretary Abraham Announces Completion of Upgrades at Uzbekistan Nuclear Facility" (Washington, D.C., October 21, 2002; available at <http://www.nnsa.doe.gov/default.htm> as of April 12, 2004); the continuing presence of the Uzbek facility near the top of the priority list of facilities from which material is to be removed entirely is from interviews with U.S. and Russian officials, September–October 2003.

- First, sites that have had comprehensive upgrades of their security and accounting equipment installed are not necessarily secure. Only if the equipment is effectively used to provide high security by the personnel at the site, and is maintained and improved over time, is the material likely to be reasonably secure. Reports of guards turning off intrusion detectors because they generated an annoying number of false alarms, workers leaving armored doors open and unattended, and equipment breaking and not being fixed or maintained are not unusual, unfortunately.<sup>42</sup>

Even where the systems now being installed are used and maintained appropriately, these systems are simply not designed to deal with attacks on the scale of some of those of recent years, such as 41 heavily armed, suicidal terrorists striking without warning (as occurred in the Moscow theater seizure in October 2002), or four independent, coordinated teams of 4–5 well-trained, suicidal individuals each, from a group with access to large quantities of heavy infantry weapons and explosives, striking without warning (the September 11 threat). (See "Demonstrated Terrorist and Criminal Threats," p. 14.) Thus, when some one says a site is "secured," the appropriate questions are: "against what?" and "how do we know?" The degree of confidence that program officials themselves have in "completed" security upgrades can perhaps be judged by the fact that security upgrades for the HEU-fueled research reactor in Uzbekistan were declared "completed" in 1996, and then a second round of upgrades was declared "completed" in 2002—yet this facility is still high on the U.S. and Russian list of facilities from which to remove HEU entirely.<sup>43</sup>



- Second, just because a facility has not received completed upgrades funded by the United States does not necessarily mean that it is *not* secure, as Russia has carried out a number of rounds of security upgrades without U.S. help, including at buildings to which U.S. personnel do not yet have access. Other members of the G-8 Global Partnership are also beginning to support security and accounting upgrades for nuclear material. Most of the material that has not received U.S.-sponsored upgrades is at nuclear weapons complex facilities protected by armed troops and multiple layers of fences; they would not be easy targets for terrorist teams attempting to shoot their way in (though how well protected they are against insiders carrying material out may be another story). Yet at every facility where U.S. and Russian experts have cooperated on MPC&A to date, including nuclear weapons complex facilities and nuclear weapon storage facilities, they have agreed that major upgrades were needed, suggesting that the remaining vulnerabilities at these sites are substantial.<sup>44</sup>
- Third, a substantial amount of work has been done that is crucially important but is not reflected in these figures on the fraction of materials covered. This includes an extensive training program to provide qualified personnel for all aspects of nuclear material security, control, and accounting, work with Russian regulators to put in place an effective regulatory program that will give facility managers strong incentives to provide good security, investments to ensure that nuclear material is secure during transport, and more.

In 2001, DOE's MPC&A program took a first cut at the complex task of developing appropriate metrics to assess the real state of progress toward achieving sustainable security at these sites for the long term.<sup>45</sup> The program is now putting a substantial focus on progress toward strong security cultures and long-term sustainability as part of developing a new strategic plan. (See "Achieving Sustainable Security," p. 48.) But there is still more to be done to develop performance measures that adequately reflect the real state of progress, but are simple enough to be useful to policymakers.

### **Securing Metric 2: Security Upgrades on Russian Sites Containing Warheads**

**Fraction accomplished.** While Russia has never declared how many warheads it has, and there are large uncertainties in both official and unofficial U.S. estimates, the best recent unclassified estimates are in the range of 18,000 warheads still in assembled form (with a much smaller number actually operational).<sup>46</sup> By some unclassified estimates, these warheads exist at some 150–210 sites (counting each bunker at a facility as a separate site)—50–70 of which are national stockpile sites, 60–80 are deployed, service-level storage sites, and 40–60 of which are temporary sites (such as rail transfer points and warhead handling areas at operational bases).<sup>47</sup>

The Department of Defense (DOD) and DOE are both working with Russian counterparts to install modern security systems at many of these sites.<sup>48</sup> It is important to understand, however, that as of early 2004, there is

<sup>44</sup> Interviews with DOE and laboratory officials.

<sup>45</sup> DOE, *MPC&A Program Strategic Plan* (Washington, D.C.: DOE, July 2001; available at [http://www.nti.org/db/nisprofs/russia/full-text/doe\\_mpca/doe2001/mpca2001.pdf](http://www.nti.org/db/nisprofs/russia/full-text/doe_mpca/doe2001/mpca2001.pdf) as of May 3, 2004). For assessing progress toward sustainable security over time, plausible metrics might include the fraction of sites with MPC&A systems that are performing effectively (as judged by performance tests, regulatory inspections, or other forms of expert review); the fraction of sites with long-term plans in place for sustaining their MPC&A systems, and resources budgeted to fulfill those plans; the priority the Russian government assigns to the task (measured by senior leadership attention and resources assigned to the effort); the presence of stringent MPC&A regulations that were effectively enforced (assessed by expert reviews); and the presence of an effective infrastructure of personnel, equipment, organizations, and incentives to sustain MPC&A (again assessed by expert reviews, given the difficulty of quantification).

<sup>46</sup> Robert S. Norris and Hans M. Kristensen, "NRDC Nuclear Notebook: Russian Nuclear Forces, 2003," *Bulletin of the Atomic Scientists* 59, no. 4 (July/August 2003; available at <http://www.thebulletin.org/issues/nukenotes/ja03nukenote.html> as of May 3, 2004).

<sup>47</sup> Charles Thornton, presentation, Harvard University, October 24, 2003.

<sup>48</sup> For a more detailed account of these warhead security programs, see Matthew Bunn, "Nuclear Warhead Security Upgrades," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, August 2002 (available at [http://www.nti.org/e\\_research/cnwm/securing/warhead.asp](http://www.nti.org/e_research/cnwm/securing/warhead.asp) as of May 3, 2004).

## WARHEAD SECURITY: THE SAGA OF THE SLOW “QUICK FIX”

The fate of the effort to provide a “quick fix” to improve security at Russian nuclear warhead storage sites is emblematic of the obstacles—and lack of top-level attention to overcoming them—that have slowed progress to a crawl in so many of the efforts to secure nuclear warheads and materials.

In the mid-1990s, U.S. and Russian experts agreed that the sites where Russia stores nuclear warheads themselves needed extensive security improvements. The fences and intrusion detectors at these sites were old, and in some cases broken; trees had been allowed to grow up around the fences, making it hard to see attackers coming; troops guarding the sites were not equipped with body armor or hardened fighting positions, potentially making them sitting ducks in the event of an attack on the sites by well-armed intruders.

The U.S. and Russian experts agreed to proceed in two phases. They would install an initial set of “quick fix” security upgrades—consisting of several layers of security fencing with intrusion detectors—at each of the sites, which would allow enough time for a second round of more comprehensive and time-consuming security upgrades that would need to be designed for the specific characteristics of each site. The 12th Main Directorate of Russia’s Ministry of Defense, the force that guards Russia’s nuclear warheads, initially ordered 50 one-kilometer sets of quick fix fencing. The U.S. Department of Defense purchased these 50 sets and delivered them by the first quarter of 1998—six years ago.<sup>1</sup> The 12th Main Directorate quickly asked for 73 more, for a total of 123—thought to correspond to roughly 123 warhead storage bunkers under the 12th Main Directorate’s control. The last of this second set was delivered to Russia in the 3rd quarter of 2000—nearly four years ago at this writing (spring of 2004).

The original idea was that the 12th Main Directorate would install these sets themselves, with their own funds, so that there would be no need for U.S. experts to go to these very secret sites. But the first equipment arrived just as the ruble crisis of 1998 was unfolding, and no money was available—the 12th Main Directorate’s forces, like the rest of Russia’s military, were not even receiving their salaries for months at a time. As a result, only a handful of these quick fix sets were installed each year.

Finally, the 12th Main Directorate asked if the United States could pay for the installations, as well as for the equipment itself. U.S. officials agreed, but insisted that under U.S. procurement laws, if U.S. taxpayers were footing the bill, U.S. officials would have to be able to actually go to the sites and see that the installations had been done, and done to the quality standards that would be specified in a contract. Russian officials said this was impossible, as the locations of the warhead storage facilities were a state secret, and no foreigners were allowed to visit them. (There was clearly some flexibility to this prohibition, as then-commander of U.S. Strategic Command Gen. Eugene Habiger had been allowed to visit a warhead storage facility in 1997, Senator Richard Lugar was allowed to visit one in 2000, and U.S. Department of Energy experts, after completing security upgrades at several of the Russian navy’s fuel sites, by 1999 had begun carrying out security upgrades at Navy warhead sites as well.) This access issue stymied progress for a substantial period.

In 2001, the 12th Directorate of the Ministry of Defense allowed a “pilot project” to go forward in which U.S. experts were allowed access to one site, so that security equipment could be installed there.<sup>2</sup> Then, in early 2002, the Russian Ministry of Defense got permission from the Russian Prime Minister to allow U.S. access for these security upgrades—

no plan to upgrade security for *all* the warhead sites in Russia: in January 2003, the administration took an interagency decision not to provide support for upgrading warhead handling areas in most cases,<sup>49</sup> and from the beginning of the cooperation, there have been some sites that Russian officials have not put on the table as subjects for cooperation—particularly some forward-deployed tactical nuclear warhead sites.<sup>50</sup> Thus, unless there are policy changes in Wash-

ington and Moscow, even when current programs are “completed,” there will remain some warhead facilities in Russia that have not had U.S.-funded security upgrades.

Of the 150–210 total sites, DOE currently plans to perform some level of upgrade on 39 Navy sites and 25 Strategic Rocket Forces sites,<sup>51</sup> and it appears that DOD plans to upgrade some 90–95 additional

<sup>49</sup> GAO, *Additional Russian Cooperation Needed to Facilitate U.S. Efforts to Improve Security at Russian Sites*, op. cit., pp. 33–34.

<sup>50</sup> Interview with U.S. defense contractor expert, February 2004.

<sup>51</sup> For the 39 Navy and 25 SRF figures, see DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 446. Of the 39 Navy warhead sites, 21 are sites where DOE completed initial “rapid” upgrades, and then did not pursue further upgrades after the interagency decision that in most cases support would not be provided for upgrading warhead-handling sites. DOE’s bud-

but just as Department of Defense officials were preparing to go to Moscow to sign modified agreements to get the work going, the Bush administration decided not to certify that Russia was complying with Congressional requirements for threat reduction assistance. Another year would pass, until early 2003, before the modified agreements were signed.<sup>3</sup> Finally, in the summer of 2003, U.S. experts visited nine of these sites, in preparation for installation of both quick fix upgrades and more comprehensive upgrades. With Russia now expecting that the United States will pay for the installations, Russia's installation efforts paid for with its own money have slowed almost to a standstill.<sup>4</sup>

Today, almost four years after the last quick fix equipment was delivered, more than two years after the September 11 attacks, and two years after the commander of the 12th Main Directorate acknowledged that terrorists had carried out reconnaissance on these very warhead sites twice in 2001, roughly half of this equipment is still sitting in warehouses, uninstalled.<sup>5</sup> The quick fix has been anything but quick. Yet the fact that the Department of Energy has been successfully upgrading security at the Russian Navy's warhead sites since 1999 makes clear that when there is flexibility on both sides, the job can get done.

This story reflects a fundamental problem in identifying and fixing high-priority problems in both the U.S. and the Russian governments. While the roughly \$1 million per site estimated to be needed to install this equipment might be more than the regular budget of the 12<sup>th</sup> Main Directorate can easily afford, it would not be especially expensive for the Ministry of Defense as a whole—and still less for the Russian government, which for years has been running budget surpluses of billions of dollars a year. Surely if some one had said to the Russian President, "terrorists are carrying out reconnaissance at our warhead sites, and the Americans have given us a lot of useful equipment to secure them, but we need \$60 million to finish installing it," he would have directed that this money be allocated immediately—but that did not happen. Similarly, if the U.S. President had been told that access disputes were preventing the installation of urgently needed equipment to secure Russian nuclear warheads, one would hope that he would have taken action immediately to resolve the dispute—but that did not happen either. In the absence of sustained high-level attention on either side, obstacles such as these are allowed to fester for years at a time—putting the security of the United States, Russia, and the world at risk.

<sup>1</sup> See U.S. Department of Defense, Defense Threat Reduction Agency (DTRA), "Site Security Enhancements: Quick Fix," 2003 (available at [http://www.dtra.mil/ctr/project/projrus/ctr\\_quickfix.html](http://www.dtra.mil/ctr/project/projrus/ctr_quickfix.html) as of May 13, 2004). For an extensive discussion of warhead security upgrades, see Matthew Bunn, "Nuclear Warhead Security Upgrades," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, August 2002 (available at [http://www.nti.org/e\\_research/cnwm/securing/warhead.asp](http://www.nti.org/e_research/cnwm/securing/warhead.asp) as of May 3, 2004).

<sup>2</sup> DTRA, "Site Security Enhancements: Quick Fix," op. cit., reports that this site was completed in 2001.

<sup>3</sup> Signature of this agreement was reported, for example, in testimony of J.D. Crouch III, Assistant Secretary of Defense for International Security Policy, House Armed Services Committee, March 4, 2003.

<sup>4</sup> Interviews with U.S. Defense Department officials, February 2004.

<sup>5</sup> Interviews with U.S. Defense Department officials, February 2004.

sites,<sup>52</sup> for a total in the range of 155–160 sites to be upgraded. This figure suggests that beyond the warhead-handling areas for which the United States will generally not provide assistance under current policy,

get justifications used to refer to 42 naval warhead sites; DOE has declined to offer assistance for three of these (apparently because there should not be warheads there if Russia is fulfilling its pledges under the 1991–1992 Presidential Nuclear Initiatives), leaving the remaining total for which upgrades are planned at 39. Russian requests for assistance at sites of which that was true provoked considerable concern and suspicion within the U.S. government. Interviews with DOE, DOD, and national laboratory officials, 2003 and February–March 2004.

<sup>52</sup> DOD's initial workplan called for upgrades at 123 sites, matching the Russian request for 123 sets of "quick fix" equipment. (Each set represents 1 kilometer of multiple-layer fencing, with sensors—there is no precise one-to-one correspondence between sets and sites, but it was expected that the number of sites would be similar to the number of sets requested.) Five of the Navy sites where DOE is upgrading security are within the original DOD list, as are the 25 SRF sites; if these are subtracted from 123, this leaves 93 for the Department of Defense. In its 2003 report to Congress on threat reduction, DOD indicated that the Russian Ministry of Defense had provided a list of 52 facilities requiring upgrades, including 15 large facilities with an average of 5 bunkers each (for a total of 75 bunkers at large facilities), and 37 smaller facilities with 1–2 bunkers each; this is quite consistent with a total of 123 sites. See U.S. Department of Defense, Defense Threat Reduction Agency (DTRA), *Cooperative Threat Reduction: Annual Report to Congress, Fiscal Year 2004* (Washington, D.C.: DOD, January 2003; available <http://armedservices.house.gov/reports/2003exereports/03-01-01ctr.pdf>

most other sites are planned to be covered.<sup>53</sup> (Ultimately, more security could be purchased, probably at lower costs, through consolidating this vast warhead infrastructure into just a few facilities, but U.S. officials have so far made little progress with Russia on the warhead consolidation issue.<sup>54</sup>)

To date, initial rapid upgrades have been completed for all 39 of the Navy sites where DOE is working,<sup>55</sup> and it appears that “quick fix” sets—similar in some respects to these initial “rapid upgrades”—have been installed for roughly an additional 50–60 sites,<sup>56</sup> for a total in the range of 90–100 sites with rapid upgrades installed. This represents roughly 50% of the total number of warhead sites, or approximately 60% of the sites where U.S.-funded upgrades are currently planned. More elaborate “comprehensive” upgrades have been completed for nine Russian Navy sites, and no other warhead sites—representing roughly 5% of the total number of sites.<sup>57</sup> There are 21 other naval sites where the U.S. government has concluded that only rapid upgrades are required, and those rapid

upgrades are completed, so DOE counts these sites under its total of “secured” sites.<sup>58</sup>

**Rate of progress.** During FY 2003, rapid upgrades on the final one or two Navy warhead sites were completed; it appears that some 10–15 sets of “quick fix” equipment were installed as well, either with Russian funding in most cases or with U.S. funding in a small number of cases. Thus a reasonable estimate is that some 10% of the Russian warhead sites received initial rapid upgrades during the year. Comprehensive upgrades were completed for just two more sites during FY 2003,<sup>59</sup> increasing the fraction of the total number of sites covered by just 1%. Obviously, at that rate it would take many years to finish the job.

Fortunately, however, the year 2003 laid the groundwork for a substantial increase in the pace of upgrades at warhead sites. DOE is now working at 9 remaining Russian Navy warhead sites where comprehensive upgrades are planned, and 12 of the estimated 25 Strategic Rocket Forces warhead sites (the Russian Ministry of Defense is making additional SRF sites available as work progresses on the first SRF sites).

as of May 3, 2004), p. 27. In the following year’s report, DOD indicated that of the 52 storage facilities, when one subtracted out the Navy and SRF facilities that DOE will address, the sites that will not be upgraded because of the interagency decision on warhead-handling sites, and sites that were no longer in use because of Russian consolidation efforts, the latest DOD plan included only 32 facilities. See DTRA, *Cooperative Threat Reduction: Annual Report to Congress, Fiscal Year 2005* (Washington, D.C.: DOD, January 2004; available at <http://www.house.gov/hasc/issues/FY05CTR.pdf> as of May 3, 2004), p. 57.

<sup>53</sup> The 39 Navy warhead sites that DOE has upgraded or plans to upgrade include more than 20 of the estimated 40–60 temporary sites within the estimated total of 150–210 warhead sites. Some of the sites DOD is upgrading or plans to upgrade are also temporary sites, such as rail transfer points. Hence, of the estimated 110–150 permanent sites, it appears likely that either DOE or DOD upgrades are planned for something in the range of 90–110 sites.

<sup>54</sup> For an analysis of the warhead consolidation issue, see Harold Smith, “Consolidating Threat Reduction,” *Arms Control Today*, November 2003 (available at [http://www.armscontrol.org/act/2003\\_11/Smith.asp](http://www.armscontrol.org/act/2003_11/Smith.asp) as of May 3, 2004).

<sup>55</sup> Personal communication from DOE program official, February 2004.

<sup>56</sup> The Russian Ministry of Defense has informally indicated that roughly half of the 123 sets of quick fix equipment have been installed, though they have only specifically certified the installation of 47 of them. (Personal communication with DTRA official, February 2004.) If half are installed, this would be 61–62 sets, five of which were for Navy sites already covered in the 39 figure mentioned in the text. Hence this suggests that these quick fix sets are installed for roughly 50–60 non-Navy sites.

<sup>57</sup> Personal communication from DOE program official, February 2004. This year, because government data has shifted to focusing on the number of sites, rather than the number of warheads covered, we are doing the same with our metric, assessing the fraction of warhead sites covered, as opposed to the fraction of warheads covered. This somewhat reduces the percentages compared to last year’s estimate, as DOE had been estimating that the Navy sites at which it was conducting upgrades held 4,000 warheads (a figure that is probably too high), and that they had already succeeded in completing rapid upgrades for sites holding nearly all of them, and comprehensive upgrades for some 40% of them. Given how little data is available to support estimates of the number of warheads at particular sites (Russia provides no data on that subject to U.S. experts), it makes sense for both the government data and our metric to shift toward a site-based system rather than a warhead-based system.

<sup>58</sup> Personal communication from DOE program official, February 2004.

<sup>59</sup> As of the end of FY 2002, 7 sites had comprehensive upgrades completed. See DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 634. As noted earlier in the text, by the end of FY 2003, this was up to 9 sites.

Following a breakthrough on DOD access to warhead sites in 2002, in 2003 initial upgrade designs were developed for nine sites in the DOD-sponsored program, but as of the end of FY 2003, implementation of major upgrades was not yet underway.<sup>60</sup> Thus work of one kind or another was underway at 30 sites that were not yet completed at the end of FY 2003, some 17% of the total number of sites. DOE expects to have the nine remaining Navy sites where it is implementing comprehensive upgrades finished in 2006, and all of the Strategic Rocket Forces sites completed in 2008.<sup>61</sup> Based on past performance and their success in gaining access to the relevant sites, this appears to be realistic.

DOD managers believe that the pace at which they can complete the sites they are planning to upgrade depends on the rate at which Russia will provide access, and the number of Russian teams with the appropriate expertise and security clearances to do the installation work. At the current rate, they estimate it might take until 2009–2011 to complete the sites DOD plans to upgrade, though they hope to increase the pace by adding more Russian teams, and hence finish sooner—perhaps at roughly the same time DOE expects to finish.<sup>62</sup> DOD work is also being held up by delays in gaining Russian approval for an amendment to the warhead security implementing agreement that would commit Russia not to request DOD assistance for securing warhead sites that will be closed within 5 years—one of DOD’s responses to the episode of the heptyl fuel destruction facility with no heptyl fuel to destroy. Because of this dispute, DOD is not yet able to obligate FY 2003 or FY 2004 appropriations, and if the dispute is not resolved soon, some FY 2002 appropriations may expire.<sup>63</sup>

*If* these obstacles can be overcome, and the pace can be increased, there is some hope that during 2008 it will be possible to say that all the warhead sites the

United States and Russia have been cooperating to secure are secured—but as noted above, this will not mean that *all* the warhead sites in Russia have been secured. If Russia continues to limit work in DOD’s effort to only a few sites per year, even securing those sites for which upgrades are planned could take much longer.

**Caveats and uncertainties.** The issues that should be kept in mind in considering these percentages are similar to those described above for nuclear materials:

- the numbers of warheads and sites themselves are uncertain;
- even sites that have had comprehensive upgrades may not be secure against the severe threats that terrorists and criminals have shown they are able to pose;
- on the other hand, sites without U.S.-funded upgrades should not necessarily be considered insecure, as in some cases Russia may have provided effective security without U.S. help; and
- whether improved security will be maintained for the long haul remains very much an open question. A number of experts involved in these efforts suggest that the systems now being installed at Russian warhead sites will cost hundreds of millions of dollars a year to operate and maintain—a budget substantially larger than the current budget of the force in charge of securing Russia’s nuclear warheads.<sup>64</sup>

But as in the case of nuclear materials, there is also an enormous amount of work that has been done that is not reflected in these figures on the fraction of sites equipped with upgrades—including extensive

<sup>60</sup> Interview with DTRA official, February 2004.

<sup>61</sup> See DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 446.

<sup>62</sup> Interview with DTRA official, February 2004.

<sup>63</sup> Interview with DTRA official, April 2004.

<sup>64</sup> Interviews with DTRA and contractor officials. The kinds of systems being installed at many warhead sites—including perimeter fencing and various types of intrusion detectors (microwave, taut-wire, etc.) require continuing maintenance in many cases costing 10% or more of the initial capital cost annually.

programs focused on improving security during warhead transport (and funding transports to centralized storage or dismantlement facilities); the establishment of a national training and equipment testing center; the provision of equipment and training for personnel screening, real-time computerized accounting of warheads, and emergency response; and more.<sup>65</sup> Nevertheless, the fraction of warheads provided with security upgrades offers as good a metric of overall progress as is currently available.

### **Securing Metric 3: Vulnerable Non-Russian Sites with Material Removed or Secured**

**Fraction accomplished.** The problem of nuclear warheads and materials that may be vulnerable to theft, given today's terrorist and criminal threats, is not just a former Soviet Union problem, it is a global problem. The essential ingredients of nuclear weapons exist in more than forty countries around the world. In some cases they are well secured, in other cases (such as at civilian research reactors fueled with HEU) they may have no more security than a night watchman and a chain-link fence.<sup>66</sup> Given that the world community is dealing with terrorists who have demonstrated global reach, and an ability to find and strike weak points on a global basis, the goal should be to make sure that every nuclear warhead and every kilogram of nuclear material is secure and accounted for, to a level adequate to defeat demonstrated terrorist and criminal capabilities. There has been no global assessment of how much work would need to be done, and where, to reach that goal. With the size of the overall task undefined, it is particularly difficult to develop metrics for assessing progress in completing the task. Moreover, these other facilities are being addressed

by a wide range of separate programs, some of which focus on reviewing and if necessary upgrading security at such facilities, while others focus on removing nuclear material from them entirely. Moreover, while some countries have been very open to U.S. or international assistance in improving security for their facilities, some key countries—particularly those with nuclear weapons programs shrouded in substantial secrecy, such as Pakistan, India, and Israel—have not been enthusiastic about intensive cooperation in this area.<sup>67</sup>

One metric that may be useful is the fraction of the sites identified by the U.S. government as high priorities for removing nuclear material entirely, from which the material has in fact been removed. In 2002, after the removal of 48 kilograms of 80% enriched HEU fuel from the Vinca facility in the Yugoslavia, the U.S. State Department indicated that there were two dozen other sites around the world from which similar removal operations were planned.<sup>68</sup> Later discussions clarified that these were not necessarily the highest-priority sites in the world, but simply the sites with HEU that was Soviet-supplied, for which Russia, the United States, and the International Atomic Energy Agency (IAEA) had established a tripartite initiative to move the material back to Russia for secure storage and destruction.<sup>69</sup> Three such Soviet-supplied sites had been addressed before the 2002 statement was made—Vinca; the Ulba facility in Kazakhstan (from which nearly 600 kilograms of HEU was airlifted in 1994); and a facility in Tbilisi, Georgia, whose HEU was airlifted to the United Kingdom in 1998.<sup>70</sup> Thus the original total was 27 such facilities.

During 2003, HEU was removed from two more of these facilities, one in Romania and one in Bulgaria;<sup>71</sup>

<sup>65</sup> See discussion of these efforts in Bunn, "Nuclear Warhead Security Upgrades," op. cit., and references therein.

<sup>66</sup> For a discussion, see Matthew Bunn and Anthony Wier, "The Global Threat," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, November 2002 (available at [http://www.nti.org/e\\_research/cnwm/threat/global.asp](http://www.nti.org/e_research/cnwm/threat/global.asp) as of May 3, 2004).

<sup>67</sup> See discussions in Bunn, "Removing Material From Vulnerable Sites," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, January 2004 (available at [http://www.nti.org/e\\_research/cnwm/securing/vulnerable.asp](http://www.nti.org/e_research/cnwm/securing/vulnerable.asp) as of May 3, 2004); and Bunn, "International Nuclear Security Upgrades," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, October 2002 (available at [http://www.nti.org/e\\_research/cnwm/securing/secure.asp](http://www.nti.org/e_research/cnwm/securing/secure.asp) as of May 3, 2004).

<sup>68</sup> Robert Schlesinger, "24 Sites Eyed for Uranium Seizure," *Boston Globe*, August 24, 2002.

<sup>69</sup> Interviews with U.S. State Department and IAEA officials, 2003.

<sup>70</sup> See discussion of these cases in Bunn, "Removing Nuclear Material From Vulnerable Sites," op. cit.

<sup>71</sup> See discussion of these cases in Bunn, "Removing Nuclear Material From Vulnerable Sites," op. cit.

all HEU was removed from another facility, in Libya, in March 2004.<sup>72</sup> Thus, by this metric, six out of 27 facilities had been addressed as of the spring of 2004, or roughly 22% of the total. This is an overly generous assessment, in that three of these facilities (Vinca, Romania, and Bulgaria) still have substantial quantities of HEU in irradiated fuel on-site, which is not radioactive enough to be self-protecting and continues to pose a significant proliferation hazard,<sup>73</sup> and one more (Ulba, in Kazakhstan) has had HEU moved back into the facility from another site, in preparation for blending the HEU to low-enriched reactor fuel that cannot sustain an explosive nuclear chain reaction.<sup>74</sup> Moreover, two of the six removals counted here were from facilities within the former Soviet Union (and hence perhaps should be counted in the previous measures rather than in this one).

**Rate of progress.** During 2003, the Bush administration succeeded in substantially increasing the rate at which HEU was being removed from vulnerable sites. From 1994 to 2002, removals of Soviet-supplied HEU were occurring at the rate of one every four years. In 2003, two removals occurred in a single year, and another occurred in March 2004 (so that three had occurred over the seven-month period from September 2003 through March 2004). In addition, in November 2003, Secretary of Energy Spencer Abraham and then-Russian Minister of Atomic Energy Alexander Rumiantsev signed a joint statement indicating that a government-to-government agreement to facilitate these removals had been completed and would soon be signed.<sup>75</sup> After the Bulgaria removal, Deputy

Administrator for Defense Nuclear Nonproliferation Paul Longworth told reporters that the U.S. goal was to remove all the HEU from Soviet-supplied sites outside Russia by 2005.<sup>76</sup> Later discussions clarified that this referred to all of the fresh, unirradiated HEU (believed to exist at only a half a dozen Russian-supplied sites)—dealing with the irradiated HEU (which also poses proliferation risks) will take substantially longer.<sup>77</sup> As noted earlier, the Bush administration is now preparing an initiative to accelerate these removals further and close some of the gaps in current efforts (see “Gaps in Current Programs to Remove HEU From Vulnerable Sites,” p. 58). While the administration clearly hopes to maintain or even increase the pace of these removals over the next several years, there remain substantial bureaucratic obstacles that are likely to require high-level leadership to overcome (particularly in Russia, having to do with the process for completing required environmental assessments for bringing back irradiated HEU fuels).<sup>78</sup>

**Caveats and uncertainties.** There are other potential metrics that could be used to assess progress in this area. The facilities in the metric described above are only the Soviet-supplied facilities; most other facilities were supplied by the United States (and a few by other countries). Over the years, there has been an ongoing effort to bring back to the United States U.S.-supplied HEU. As of the end of FY 2003, 1,100 kilograms of HEU had been returned to the United States since its HEU take-back program was restarted in 1996, roughly 6% of the 17,500 kilograms of HEU the United States had exported to dozens of

<sup>72</sup> German Solomatin, “Uranium from Libyan research reactor shipped to Russia,” *ITAR-TASS*, March 9, 2004; “Nuclear Fuel from Libya to be Processed in Dimitrovgrad,” *RIA Novosti*, March 9, 2004; Steve Gutterman, “Libya Returns Nuclear Fuel to Russia,” *Associated Press*, March 8, 2004. Also, see the IAEA, “Removal of High-Enriched Uranium in Libyan Arab Jamahiriya,” March 8, 2004 (available at [http://www.iaea.or.at/NewsCenter/News/2004/libya\\_uranium0803.html](http://www.iaea.or.at/NewsCenter/News/2004/libya_uranium0803.html) as of April 8, 2004).

<sup>73</sup> See “The Threat From Research Reactor Fuel,” p. 36.

<sup>74</sup> “Research Reactors – Terrorist Fears Bring HEU Up the Agenda,” *Nuclear Engineering International*, December 19, 2002; Ann MacLachlan and Daniel Horner, “Romanian HEU moved to Russia in Multilateral Nonproliferation Deal,” *Nuclear Fuel*, September 29, 2003; Ann MacLachlan and Daniel Horner, “HEU Airlifted from Bulgaria and Russia,” *Nuclear Fuel*, January 5, 2004.

<sup>75</sup> DOE, “Secretary Abraham and Minister Rumyantsev Sign Joint Statement on the Return of Russian Research Reactor Fuel” (Washington, D.C., November 7, 2003; available at <http://www.energy.gov> as of May 3, 2004).

<sup>76</sup> Peter Baker, “U.S.-Russia Team Seizes Uranium at Bulgaria Plant; Material was Potent Enough for Bomb,” *Washington Post*, December 24, 2003.

<sup>77</sup> Interviews with DOE officials, February 2004, and communications with Philipp Bleek, based on his interviews with DOE officials, December 2003 and January 2004.

<sup>78</sup> Interview with Russian officials, September 2003.

## GAPS IN CURRENT PROGRAMS TO REMOVE HEU FROM VULNERABLE SITES

The United States has several programs focused on reducing the number of vulnerable sites where highly enriched uranium (HEU) is present—but significant gaps remain, both in the coverage of these efforts and in their focus on providing the targeted incentives needed to convince states and facilities to give up their vulnerable HEU.<sup>1</sup>

**U.S. RERTR and Russian RERTR.** The Reduced Enrichment for Research and Test Reactors (RERTR) program has been working since 1978 to convert U.S.-supplied HEU-fueled research reactors to non-weapons-usable low-enriched uranium (LEU) fuels, and has converted dozens of reactors. In recent years, the program has added an effort to work with Russia to convert Soviet-supplied reactors as well. But significant gaps remain. The new strategic plan for RERTR developed after the 9/11 attacks calls for converting 60 U.S. or Russian-supplied reactors by 2012—less than half of the 135 remaining HEU-fueled research reactors worldwide.<sup>2</sup> The program has traditionally not focused on fast-neutron reactors, reactors with one-of-a-kind specialty fuels, reactors that are neither U.S.-supplied nor Russian-supplied,<sup>3</sup> icebreaker reactors, tritium production reactors, and more. And the offer of fresh fuel supply and spent fuel take-back that has been the primary RERTR “carrot” for conversion provides little incentive to convert for facilities that have a single life-time fuel supply (representing the majority of the world’s HEU-fueled reactors). Many of these life-time core reactors have only small amounts of HEU, or in-core HEU that would be difficult to remove—but some (such as some critical assemblies) have large amounts of HEU that is not very radioactive. What is more, the focus of the RERTR effort has always been on conversion, not on helping aging, outmoded, and underutilized reactors to shut down (an approach that is probably the better answer for the majority of the world’s research reactors). And reactors that use HEU for medical isotope production are not yet even moving to conversion, contributing to a continuing commerce in weapons-usable HEU.<sup>4</sup>

**U.S. HEU Take-back.** Formally known as the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program, this effort focuses on taking U.S.-supplied HEU fuel (and LEU, for reactors that agreed to convert to LEU, or agreed to start with LEU in the first place) back to the United States. But as a recent DOE Inspector General report pointed out, two-thirds of the 17 tons of U.S.-supplied HEU that was still abroad when the take-back effort was renewed in 1996 is not covered under the current take-back plan, and the incentives offered for states to send their HEU back to the United States are so slim that the current effort only expects to succeed in getting back half of the material that is covered, or some 15% of the total.<sup>5</sup> Since then, DOE has moved the program from its office for environmental management to its nonproliferation office, to focus it better on reducing the highest priority proliferation threats, and indicated that the take-back offer will be extended beyond its current 2009 end-point.<sup>6</sup> Much more remains to be done, however, to make sure that the effort is transformed into the kind of fast-paced effort to eliminate the most urgent proliferation threats posed by U.S.-supplied HEU that is now needed.

**Russian HEU Take-back.** The United States is supporting Russian take-back of Soviet-supplied HEU, in a tripartite initiative with the IAEA. To date, Soviet-supplied HEU has been airlifted out of Yugoslavia, Romania, Bulgaria, and Libya. This initiative focuses on HEU at some 20 facilities in 17 countries,<sup>7</sup> and DOE officials have set a target of removing all fresh, unirradiated HEU from these facilities by the end of 2005 (while acknowledging that irradiated HEU, which also poses a proliferation threat, is likely to take longer).<sup>8</sup> Essentially all of the relevant Soviet-supplied facilities appear to be covered in this effort, and this effort *has* focused on providing flexible incentives to facilities to give up their HEU—which was crucial for both the Yugoslavia operation (managed as a separate effort) and the Romanian removal. For the Yugoslavia case, key U.S. officials believed that U.S. agencies did not have appropriate authority to spend money helping Yugoslavia manage the spent fuel at the site, which was crucial to Yugoslav agreement to removal of the HEU—so the non-government Nuclear Threat Initiative stepped in with a \$5 million contribution to resolve that problem. But both signature of a U.S.-Russian agreement to provide the overall structure for the effort, and the environmental impact assessments required under Russian law before any of the irradiated HEU can be brought back, appear mired in bureaucratic disputes and lethargy in Moscow—which U.S. officials at the level at which the issue is being addressed have been unable to break through.<sup>9</sup>

**Material Consolidation and Conversion.** This effort is focused on reducing the number of buildings and sites with HEU *within* Russia, and blending down consolidated HEU to non-weapons-usable form. Unfortunately, Russian facilities have strong incentives to keep their HEU (workers at facilities with HEU or plutonium reportedly receive higher pay and other benefits), and Russia’s Federal Agency for Atomic Energy has not allowed DOE to provide incentives directly to the agency’s sites to convince them to give up their material. Few research reactors within Russia appear interested in shutting down or converting to LEU fuels under the RERTR program, and the Russian government does not appear to be pressuring them to do so.<sup>10</sup>



**Nonproliferation and Disarmament Fund.** The State Department's Nonproliferation and Disarmament Fund (NDF) was created to provide speedy support to unanticipated, time-sensitive nonproliferation opportunities. It has helped finance HEU removals from vulnerable sites in some previous cases, and may do again in the future. But it has limited staff and expertise, and does not appear likely to take the leading role in removing HEU from sites around the globe.

In short, there remains an urgent need to consolidate these efforts in a single task force with all the responsibility, expertise, and resources needed to remove nuclear materials entirely from the world's most vulnerable sites—regardless of who supplied them—as rapidly as possible. As of April 2004, DOE was considering the establishment of such a task force, and Senator Diane Feinstein (D-CA) had introduced legislation intended to create one, as an amendment to the defense authorization bill.<sup>11</sup>

<sup>1</sup> For a discussion and links to additional references, see Matthew Bunn, "Converting Research Reactors" and "Removing Material From Vulnerable Sites," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, January 2004 (available at [http://www.nti.org/e\\_research/cnwm/securing/index.asp](http://www.nti.org/e_research/cnwm/securing/index.asp) as of May 3, 2004). This portion of this report does not describe efforts focused on improving security for HEU stocks without removing them, such as U.S. bilateral programs to review security for U.S.-supplied HEU, security reviews coordinated by the International Atomic Energy Agency (IAEA), or the Global Research Reactor Security Initiative, part of a radiological materials task force established in November 2003, which is charged with assessing security at research reactors and developing plans to address the threats they pose. As of this writing (spring 2004), this initiative does not appear to be principally focused on HEU removals.

<sup>2</sup> The 60 reactors to be converted figure comes from the slides used in Armando Travelli, "Status and Progress of the RERTR Program in the Year 2003," presented to the 25th International Meeting on Reduced Enrichment for Research and Test Reactors (RERTR 2003), Chicago, Illinois, October 5-10, 2003. The figure of roughly 135 reactors worldwide still operating with HEU comes from IAEA, *Nuclear Research Reactors of the World* (Vienna, Austria: IAEA, September 2000), supplemented with personal communications with James Matos, Argonne National Laboratory, and Iain Ritchie, IAEA, 2002.

<sup>3</sup> RERTR program officials have sought Chinese support for converting Chinese-supplied research reactors in countries such as Syria and Ghana (which would be technically straightforward, as these reactors are based on the Canadian "Slowpoke" design, for which LEU fuels have already been developed), but so far these discussions have not borne fruit. (Interview with Argonne National Laboratory expert, 2003). These Chinese-supplied reactors use very small amounts of HEU (typically about a kilogram of HEU in the reactor core).

<sup>4</sup> The world's largest medical isotope producer, MDS Nordion of Canada, reportedly ceased cooperation with U.S.-funded LEU conversion efforts in 2003, and has backed legislation (incorporated in the comprehensive energy bill being debated as of the spring of 2004) that would eliminate current legal restrictions that allow export of HEU only to those facilities that pledge to convert to LEU when appropriate targets and processes are available, and cooperate in their development. See, for example, Daniel Horner, "Nordion Headed For 'Showdown' With U.S.?" *Nuclear Fuel*, March 15, 2004.

<sup>5</sup> U.S. Department of Energy, Office of the Inspector General, *Audit Report: Recovery of Highly Enriched Uranium Provided to Foreign Countries*, DOE/IG-O638 (Washington, D.C.: DOE, February 2004; available at <http://www.ig.doe.gov/pdf/ig-0638.pdf> as of May 13, 2004). The 17-ton figure represents the amount of HEU exported minus the amount returned, and thus does not take into account the fact that irradiation in reactors will have consumed a portion of the HEU, and reprocessing and recovery as LEU may have destroyed an additional quantity. It seems likely that the amount of U.S.-supplied HEU that actually still existed abroad as of when the take-back program started again was in the range of 12-13 tons. See David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities, and Policies* (Oxford: Oxford University Press for the Stockholm International Peace Research Institute, 1997), p. 253.

<sup>6</sup> See DOE, "Department Refocuses Threat Reduction Efforts to Return Nuclear Research Reactor Fuel" (Washington, D.C., April 14, 2004).

<sup>7</sup> See DOE's summary of its efforts, "Russian Research Reactor Fuel Return," no date (available at <http://www.nnsa.doe.gov/na-20/rrrfr.shtml> as of May 13, 2004).

<sup>8</sup> See Peter Baker, "U.S.-Russia Team Seizes Uranium at Bulgaria Plant," *Washington Post*, December 24, 2003.

<sup>9</sup> Interviews with Russian and U.S. officials, September 2003 and April 2004.

<sup>10</sup> Interviews with DOE officials, April 2004.

<sup>11</sup> Interviews with DOE officials, April 2004; for the text of Feinstein's bill, and her remarks introducing it, see *Congressional Record*, Senate, April 8, 2004.

countries over the years that was still abroad in 1996. The current take-back program does not apply at all to roughly two-thirds of that 17.5 tons of HEU, and is currently expected to succeed in recovering only about half of the material it does cover—some 15% of the 17,500 kilograms that remained abroad in 1996—by 2009.<sup>79</sup> Some of this U.S.-supplied HEU has been fissioned during irradiation in research reactors, and an additional fraction has been reprocessed and recovered as LEU, so the total that now exists abroad is actually less than 16,400 kilograms. By one unclassified estimate, when these factors are taken into account, the amount of U.S.-supplied material that still existed abroad as of the restart of the take-back program, taking these factors into account, was in the range of 12–13 tons, rather than 17.5 tons.<sup>80</sup> Unfortunately, data on the fraction of sites to which U.S. HEU was exported from which HEU has been entirely removed is not publicly available.

Another factor to consider is that some material that has not been removed has had its security significantly improved. U.S. law requires, for example, that U.S. personnel carry out occasional reviews of the security arrangements for U.S.-supplied material, and these have been ongoing for many years. When significant weaknesses are found at a particular site, the United States sometimes provides assistance in fixing them. In addition, the IAEA's International Physical Protection Advisory Service (IPPAS) provides international peer reviews of security arrangements at the request of member states. If the reviewers find significant weaknesses, the IAEA often helps coordinate with donor states to fund needed security upgrades. The

pace of such bilateral and multilateral efforts has increased in recent years, but remains modest: as of late 2003, the IAEA planned IPPAS missions to nine countries in 2004; U.S. bilateral visits to check on security of U.S.-supplied material continue at the rate of roughly five per year.<sup>81</sup> The entire U.S. budget devoted to what is now dubbed the "Global Nuclear Security" effort, which is focused on improving "nuclear security systems in all non-weapons states," including continued support for MPC&A in the non-Russian states of the former Soviet Union, U.S. bilateral reviews and upgrades for U.S.-supplied material, and U.S. support for the IAEA's IPPAS effort, is just over \$7 million in FY 2004.<sup>82</sup> This total is less than the average cost of security upgrades at a single site in the former Soviet Union. Nevertheless, the effort is currently providing security upgrade assistance to 15 countries (suggesting that the amount of assistance provided at each site is quite modest).<sup>83</sup>

## INTERDICTING NUCLEAR SMUGGLING

Key developments related to interdicting nuclear smuggling over the past year included:

- A series of steps were taken to strengthen the Proliferation Security Initiative and its ability to interdict illicit WMD-related shipments, including an accord on interdiction principles, additional interdiction exercises, the addition of more countries to the effort, and the signing, in February 2004, of an agreement with Liberia, a key flag-of-convenience state, to allow Liberian-flagged vessels suspected

<sup>79</sup> See DOE, Office of Inspector General, *Audit Report: Recovery of Highly Enriched Uranium Provided to Foreign Countries*, DOE/IG-O638 (Washington, D.C.: DOE, February 2004; available at <http://www.fas.org/irp/agency/doe/ig-heu.pdf> as of May 3, 2004).

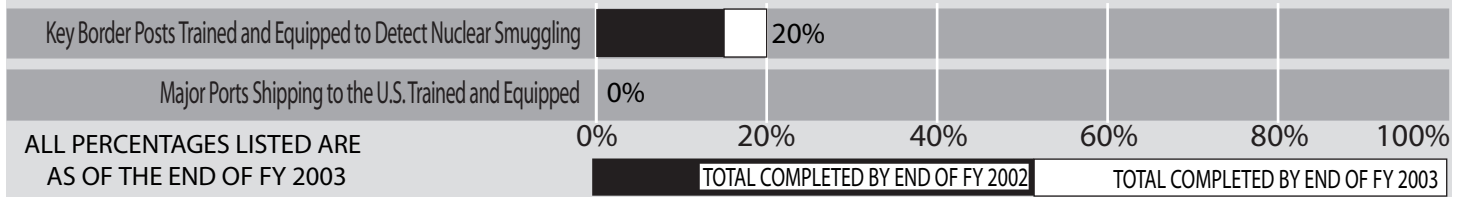
<sup>80</sup> David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities, and Policies* (Oxford, UK: Oxford University Press for the Stockholm International Peace Research Institute, 1997), p. 253. It is interesting to note that although the DOE-IG report was greeted with great concern, the basic outlines of the situation it describes were described already in Albright, Walker, and Berkhout's book, and in official reports from the early 1990s on which it draws. The DOE-IG report estimates that of 17.5 tons of U.S.-supplied HEU abroad when the take-back program was restarted, some 14.9 tons will remain abroad; Albright, Walker, and Berkhout had already put the figure in the range of 12.9 tons when the new take-back program began (p. 251). Note that the reduction in quantity of HEU as a result of irradiation would have to be applied to the material to be returned as well as to the stock abroad—the 1,100 kilograms figure for amount returned is based on the original amount of HEU in those fuel elements, not the amount that remains after irradiation.

<sup>81</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 438.

<sup>82</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 438.

<sup>83</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 438.

**Figure 3-3**  
**How Much Interdicting Work Have U.S.-Funded Programs Completed?**



of carrying such shipments to be stopped and searched. Following President Bush's suggestion in February 2004, the PSI participants have agreed to expand the cooperation to include intelligence and law-enforcement cooperation related to identifying and shutting down WMD trafficking networks.<sup>84</sup>

- The UN Security Council passed a resolution requiring all states, among other things, to "develop and maintain appropriate effective border controls and law enforcement efforts to detect, deter, prevent and combat, including through international cooperation when necessary, the illicit trafficking and brokering" in weapons, materials, and technologies of mass destruction.<sup>85</sup>
- Under the "Megaports" initiative, the United States continued to work out agreements with states where megaports are located to install nuclear material detection equipment to inspect containers being shipped to the United States.
- Nuclear material detection capabilities were installed at additional border crossing points in and near the former Soviet Union.
- At the same time, the revelation of the success of the global nuclear black market network led by Pakistan's Abdul Qadeer Khan in supplying everything from centrifuge and bomb designs to full scale centrifuges and canisters of uranium hexafluoride over a period of two decades starkly highlighted

the weaknesses of the existing systems to control such illicit trafficking.

Developing metrics for the goal of interdicting nuclear smuggling is difficult, as many different elements are essential to accomplishing the overall goal. These include, among other steps, providing adequate capabilities to detect nuclear materials being smuggled across borders; establishing appropriate police and intelligence units in the relevant countries that are trained and equipped to deal with nuclear smuggling cases; creating stronger legal infrastructures so that nuclear thieves and smugglers face a greater chance of a larger punishment; expanding international intelligence and police cooperation focused on finding and arresting those involved in nuclear smuggling; and carrying out stings and other operations designed to break up nuclear smuggling rings and make it more difficult for thieves and buyers to reliably connect with each other.<sup>86</sup>

Two steps that are necessary but not sufficient to accomplishing the goal are to ensure that:

- at least the most critical border crossings in the key source and transit states for nuclear material have personnel trained, and equipment designed, to detect smuggled nuclear materials; and
- major ports and other locations shipping cargo to the United States, and major ports and other entry points into the United States, are equipped to be

<sup>84</sup> See U.S. Department of State, "Proliferation Security Initiative" no date (available at <http://www.state.gov/t/np/c10390.htm> as of May 6, 2004).

<sup>85</sup> UN Security Council, Resolution 1540, op. cit.

<sup>86</sup> For a discussion, see, for example, Bunn and Wier, "Interdicting Nuclear Smuggling," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, August 2002 (available at [http://www.nti.org/e\\_research/cnwm/interdicting/index.asp](http://www.nti.org/e_research/cnwm/interdicting/index.asp) as of May 3, 2004).

able to detect smuggled nuclear weapons or materials.

Measuring progress in these two areas provides a rough guide as to how much of at least the initial steps in addressing nuclear smuggling has been accomplished.

### ***Interdicting Metric 1: Key Border Posts Trained and Equipped to Detect Nuclear Smuggling***

**Fraction accomplished.** Understanding how many sites should be considered high priorities for installing nuclear detection equipment is itself a difficult task. Originally, DOE's Second Line of Defense program targeted nearly 60 border crossings in Russia alone. The Departments of Defense and State were providing funding for installation of similar equipment in other countries judged to be key source or transit states for nuclear smuggling.<sup>87</sup> When the Second Line of Defense effort expanded geographically, and went further down the priority list, they concluded that 393 sites in Russia and 21 nearby countries would ultimately require installation of equipment to detect nuclear smuggling, a figure that was later reduced to 293.<sup>88</sup> Of these 293 sites, DOE had completed providing equipment and training for 39 sites, representing 13% of the total, by the end of FY 2003.<sup>89</sup> Additional nuclear detection equipment at a number of other sites, along with training and other support for interdicting nuclear smuggling, has been provided by programs sponsored by the Departments of Defense and State. DOE has taken over maintenance of equipment installed in State Department-sponsored efforts in 22 countries. Data is not publicly available on precisely how many sites were provided with effective capabilities to detect smuggled nuclear materials in either the Defense and State sponsored programs,

or how many of those are within DOE's current target list of 293 sites. Overall, it appears likely that the fraction of the identified set of border crossings that have been provided with appropriate equipment and trained personnel is in the range of 20%.

**Rate of progress.** In most cases, U.S. nuclear smuggling interdiction programs have had excellent cooperation with recipient states, and have therefore been providing training and installing equipment as fast as they had the funding to do so. DOE's Second Line of Defense program equipped 19 additional sites in FY 2003, representing some 6% of the total, but intends to complete 31 sites in FY 2004, a substantial increase in pace. DOE does not expect to complete installation at all 293 sites until 2012.<sup>90</sup> Data on the pace at which programs sponsored by Defense and State have installed such equipment and plan to do so in the future is not publicly available, but it appears that these other programs are increasingly focusing on other aspects of interdicting nuclear smuggling, leaving DOE to take a larger and larger share of the job of installing nuclear detection equipment at border crossings. Within the U.S. government, an interagency plan that outlines which agencies will be responsible for specific types of assistance at particular locations is reportedly complete or nearly so.<sup>91</sup>

**Caveats and uncertainties.** Several important caveats should be kept in mind:

- As noted above, interdicting nuclear smuggling requires a broad complex of activities, many of which are not included in a metric focused on the fraction of key border sites trained and equipped to detect nuclear contraband. In particular, official border crossings are only a tiny fraction of the thousands

<sup>87</sup> See GAO, *Nuclear Nonproliferation: U.S. Assistance Efforts to Help Other Countries Combat Nuclear Smuggling Need Strengthened Coordination and Planning*, GAO-02-426 (Washington, D.C.: GAO, May 2002; available at <http://www.gao.gov/new.items/d02426.pdf> as of May 3, 2004), p. 6.

<sup>88</sup> See DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 658. This figure represents the total set of sites that are to be equipped with radiation detection equipment—though there are some additional border crossings in these key countries that are not included. Interviews with DOE officials, February 2003. For the later figure, see DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 447.

<sup>89</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 447.

<sup>90</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 447.

<sup>91</sup> Interview with DOE official, 2003.

of miles of border across which nuclear material might be smuggled.

- As with securing weapons or materials, just because a site has U.S.-provided equipment and training does not mean that it is necessarily invulnerable to nuclear smuggling. Equipment must be maintained and used effectively, and border officials must be honest and alert, for illicit nuclear shipments to be stopped. In many countries, for example, corruption among customs officials is widespread (though many nuclear detector installations attempt to address this problem, for example by having the sensors give their readings not only to an on-site official who might be easily bribed, but to a central station as well).
- On the other hand, just because a site does not yet have U.S.-supplied equipment and training does not necessarily mean it has no equipment and training. A number of countries around the world are initiating nuclear smuggling interdiction efforts of their own, and donors other than the United States are funding at least limited assistance programs.

### ***Interdicting Metric 2: Major Ports Shipping to the United States Trained and Equipped to Detect Nuclear Smuggling***

**Fraction accomplished.** The United States, in the aftermath of the September 11 attacks, has attempted to “push the borders out” with programs designed to make sure that cargo is examined appropriately before it ever reaches U.S. shores. This is particularly important in the case of possible smuggling of a crude nuclear bomb: inspections after the ship holding the bomb has already arrived at the port in New York or Los Angeles or other U.S. cities could be too late, with the bomb detonating before the inspection occurred and causing horrifying damage. Hence, the U.S. government has identified 20 “megaports” that together ship over two-thirds of the cargo that reaches the

United States every year, and has launched a “Megaports Initiative,” in support of the broader “Container Security Initiative,” to equip these 20 megaports with radiation detection equipment.<sup>92</sup> Additional smaller ports in regions of proliferation or terrorist concern may be added to the effort in the future. To date, however, the fraction of these sites with operational arrangements to inspect large fractions of these containers for nuclear contraband remains zero. The first of these ports where the nuclear detection equipment is expected to be fully operational is Rotterdam, expected in the summer of 2004.<sup>93</sup>

**Rate of progress.** DOE is expecting to have nuclear detection at 3 of the 20 megaports (15% of the total) operational by the end of FY 2004, and to add another 3 during FY 2005. If no additional sites are added, the total effort is expected to be completed by 2012.<sup>94</sup>

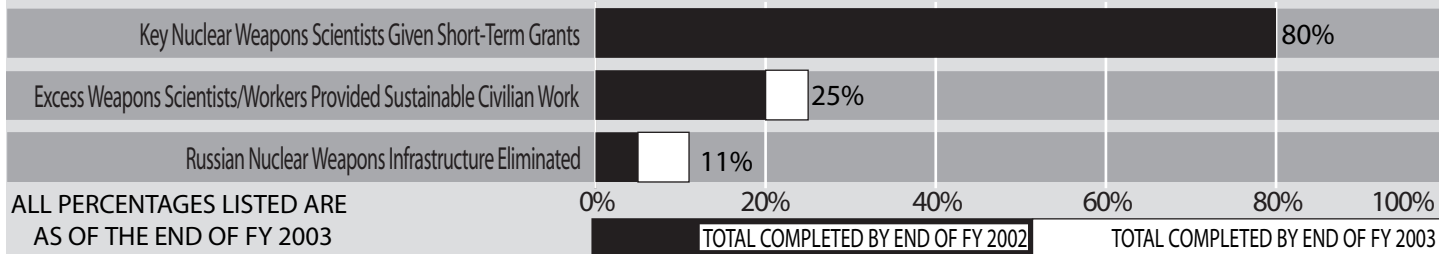
**Caveats and uncertainties.** Many of the same caveats and uncertainties described above for the sites in key source and transit states apply here as well. There is far more to stopping nuclear smuggling than simply providing nuclear detection equipment and training at identified high-priority sites; there are far more than 20 ports that ship cargo to the United States, and some of these other sites may also pose significant risks; sites with such equipment and training provided are still not necessarily proof against nuclear smuggling; and sites without U.S.-funded equipment and training may well have at least a modest level of equipment and training already available (for example hand-held detectors that can be used in searching a container identified as suspicious for other reasons). Ultimately, a full system of container security is needed, from where the containers are first loaded to when they reach customers in the United States—and even with such a system in place, there are many other pathways into the United States that may be even more difficult to address (as evidenced by the thousands of illegal aliens and thousands of

<sup>92</sup> U.S. Department of Homeland Security, “Protecting America’s Ports” (Washington, D.C., June 12, 2003; available at [http://www.dhs.gov/interweb/assetlibrary/DHS\\_Port\\_Security\\_Press\\_Kit.pdf](http://www.dhs.gov/interweb/assetlibrary/DHS_Port_Security_Press_Kit.pdf) as of May 3, 2004).

<sup>93</sup> Personal communication from DOE program official, February 2004.

<sup>94</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 447.

**Figure 3-4**  
**How Much Stabilizing Work Have U.S.-Funded Programs Completed?**



tons of illegal drugs that cross U.S. borders every year).<sup>95</sup>

### STABILIZING EMPLOYMENT FOR NUCLEAR PERSONNEL

Key developments in this area in the past year included:

- The revelation of the global black market supply network established by Pakistan's Abdul Qadeer Khan and his many associates made clear that the problem of leakage of nuclear expertise, like the problem of insecure nuclear materials, is a global one. The activities of the network put both complete centrifuge designs and actual nuclear bomb designs into the hands of shadowy middlemen; whether all the branches of this network, and all the copies of this deadly information can be found and recovered remains very much an open question. The information this network was providing is so comprehensive that, if it again becomes readily available on a global black market, this could significantly reduce the importance of potential leakage of nuclear expertise from other sources.
- In Iraq, for reasons that remain somewhat mysterious, the United States seems to have gone to war with no plan in place for securing even the known

WMD sites in Iraq, and no plan for dealing with the many scientists in Iraq with deadly knowledge, including knowledge of techniques for enriching uranium, producing and separating plutonium, and designing nuclear weapons. One key participant in Iraq's uranium enrichment program, for example, went into hiding after the U.S. invasion and finally made contact with the U.S. government through a U.S. non-government expert, David Albright, who the Iraqi expert had come to know when Albright had served as a UN inspector in Iraq.<sup>96</sup> The United States did not put in place a serious effort to engage the Iraqi scientists until months after the invasion.<sup>97</sup>

- Similarly, during the past year, the United States began working to engage Libyan WMD scientists. But this effort too seems to have had a delayed start. Libya announced its renunciation of all of its weapons of mass destruction programs in December 2003, after months of secret negotiations that gave the United States considerable time to prepare to follow up on the announcement immediately—but a State Department team did not arrive until March 2004 to begin assessing needs for engaging Libya's WMD scientists.<sup>98</sup>
- In Russia, which remains the focus of the largest efforts focused on stabilizing employment for nuclear personnel, the United States allowed the

<sup>95</sup> For more, see Stanford Study Center for International Security and Arms Control (CISAC), Stanford University, *CISAC Report: Container Security Report* (March 2003; available at [http://iis-db.stanford.edu/pubs/20127/container\\_sec\\_03.pdf](http://iis-db.stanford.edu/pubs/20127/container_sec_03.pdf) as of April 9, 2004).

<sup>96</sup> See, for example, David Albright, "Here's the Way to Find the Weapons," *Washington Post*, May 11, 2003.

<sup>97</sup> For a summary of this effort, see Michael Roston, "Redirection of WMD Scientists in Iraq and Libya: A Status Report" (Washington, D.C.: Russian-American Nuclear Security Advisory Council, April 2004; available at <http://www.ransac.org> as of May 6, 2004)

<sup>98</sup> See Roston, "Redirection of WMD Scientists in Iraq and Libya: A Status Report," *op. cit.*

Nuclear Cities Initiative (NCI) agreement to expire in September 2003 rather than compromise on liability provisions. Projects already begun under the initiative will continue, however, and both sides have expressed interest in a new NCI agreement if the liability issue can be resolved.

- Other international programs, such as the U.S.-funded Initiatives for Proliferation Prevention (IPP) and the International Science and Technology Centers (ISTC) continued to make some progress toward reemploying Russian nuclear weapon scientists. Under the aegis of the Global Partnership, Britain in particular planned to focus significant efforts on redirecting Russian nuclear scientists.<sup>99</sup>

As we discussed in our previous report, developing metrics for assessing how much of the job of stabilizing the personnel with access to nuclear weapons, materials, and expertise has been done is complicated by the wide range of different conceptions of the threat such programs are designed to address, and therefore the specifics of the job to be done.<sup>100</sup> Boiled down to their essence, there are four conceptions of the threat to be addressed:

- **Leakage of nuclear expertise and technologies by nuclear scientists.** The classic “brain drain” concern was that desperate, underemployed nuclear scientists might be tempted to sell their knowledge to terrorists or hostile states. To address this problem, the idea of the U.S.-funded programs was that if these scientists received a living wage and useful civilian research to do, desperation would be prevented, and this temptation would

be greatly reduced. (As the world has seen in the case of the Pakistani scientist A. Q. Khan and his colleagues, however, some scientists may be motivated by the prospect of making millions of dollars, and by ideological affinity with the recipients of their knowledge, even if they are not economically desperate; programs like the International Science and Technology Centers (ISTC) or Initiatives for Proliferation Prevention (IPP) would not solve that problem.) Such a living wage might come either through short-term grants designed to tide them over until economic conditions improved enough for either the Russian government or Russian firms to support their work (the original concept behind the ISTC), or through the creation of sustainable civilian jobs for them.

A critical question here is: how many people have knowledge that would pose a serious risk? Current estimates suggest that there are perhaps 2,000–3,000 individuals in Russia who could design a nuclear bomb or make a critical contribution to doing so, and perhaps 10,000–15,000 that have critical knowledge of some particular aspect of nuclear weapon design or manufacture or fissile material production.<sup>101</sup> Presumably most of these individuals would be employed at the nuclear weapons complex facilities, rather than civilian nuclear facilities, and particularly at the nuclear weapons design laboratories.<sup>102</sup> (In the case of uranium enrichment centrifuges, however, nearly all of the design and manufacturing knowledge in Russia exists *outside* the major nuclear weapons complex facilities.)<sup>103</sup> Unfortunately, for security reasons Russia has never

<sup>99</sup> For more on the latest plans of the United Kingdom under the Global Partnership, see UK Foreign and Commonwealth Office, et al., *The G8 Global Partnership: Progress Report on the UK's Programme to Address Nuclear, Chemical and Biological Legacies in the Former Soviet Union*, Annual Report, 2003 (available at [http://www.dti.gov.uk/energy/nuclear/fsu/news/First\\_annual\\_report.pdf](http://www.dti.gov.uk/energy/nuclear/fsu/news/First_annual_report.pdf) as of May 12, 2004).

<sup>100</sup> Bunn, Wier, and Holdren, *Controlling Nuclear Warheads and Materials*, op. cit., p. 75.

<sup>101</sup> Estimates provided by Oleg Bukharin, Princeton University, personal communication, March 2004.

<sup>102</sup> For a useful discussion distinguishing between “first tier” and “second tier” workers and their likely locations, see Bukharin, presentation to Russian-American Nuclear Security Advisory Council (RANSAC) workshop on “Strategies for Russian Nuclear Complex Downsizing and Redirection: Options for New Directions,” Washington, D.C., March 25, 2003 (available at <http://www.ransac.org> as of May 3, 2004).

<sup>103</sup> For a discussion of the centrifuge complex, see Bukharin, *Russia's Gaseous Centrifuge Technology and Uranium Enrichment Complex* (Princeton, N.J.: Program on Science and Global Security, Woodrow Wilson School of Public and International Affairs, Princeton University, January 2004).

been willing to provide a list of those scientists and engineers whose knowledge poses the highest proliferation risks. Hence, these programs have tended to focus on all scientists and engineers who worked on weapons of mass destruction, without attempting to systematically identify those posing the highest risks. The events of the past year have made it painfully clear that the danger of leakage of nuclear expertise from scientists elsewhere in the world—for example in Pakistan, Libya, and Iraq—must also be addressed.

- **Theft of nuclear material by nuclear scientists or workers.** Others argue that the threat that needs to be addressed is not just leakage of expertise, but also theft of nuclear weapons and materials themselves. No matter what kind of modern security and accounting equipment is installed, if the personnel at a facility with large quantities of weapons-usable nuclear material are underpaid and desperate, a serious danger of theft will remain. (Here, too, relieving desperation will not completely solve the problem—there are many documented cases around the world of insiders stealing from the firms where they worked because they were greedy, not because they were desperate.) In this case, the target is not just scientists, but all personnel who have access to nuclear weapons or materials, or who could provide substantial assistance in an effort to steal them (including particularly guards). This group includes a far larger number than the scientists and engineers with the most critical knowledge, and includes not only employees in the nuclear weapons complex but employees of civilian nuclear facilities as well.

Total employment at the large nuclear facilities in Russia's ten closed nuclear cities is estimated to be in the range of 120,000–130,000 people,<sup>104</sup> of whom approximately 75,000 (as of 2000) were employed on nuclear weapons-related work as opposed to civilian production.<sup>105</sup> Figures for how many of these defense complex employees have access to either weapons-usable nuclear materials or critical nuclear secrets are not known outside of Russia (if they have even been compiled there). It may be that if the thousands of janitors, accountants, and other support personnel in the nuclear weapons complex who do not have such access (and therefore pose less proliferation risk) were subtracted from this total, while the thousands of personnel employed in civilian roles (either within the ten closed cities or outside them) who *do* have access to weapons-usable nuclear materials or critical nuclear secrets were added, one might arrive at a similar total for the number of people of concern. It is clearly not practical for the United States or other countries outside Russia to offer employment or short-term grants to this entire group, even if they could all be identified; in any case those with stable employment at reasonable wages presumably already pose only modest theft risks.

But for many, the employment may not be stable: as of 2000, the number of defense employees in Russia's nuclear weapons complex was expected to shrink by some 35,000, nearly half of total defense employment in the complex, by 2005.<sup>106</sup> It appears that at least some of these reductions have been delayed, and remain in the future. Part of this reduction may be achieved through retirement—particularly if adequate pensions are provided and buy-outs are offered to encourage employees

<sup>104</sup> See Bunn, "The Nuclear Cities Initiative," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, November 2002 (available at [http://www.nti.org/e\\_research/cnwm/stabilizing/nci.asp](http://www.nti.org/e_research/cnwm/stabilizing/nci.asp) as of May 3, 2004), including a "Nuclear Cities Table" prepared by Dmitry Kovchegin. See also Oleg Bukharin, Frank von Hippel, and Sharon K. Weiner, *Conversion and Job Creation in Russia's Closed Nuclear Cities: An Update Based on a Workshop Held in Obninsk, Russia, June 27–29, 2000* (Princeton, N.J.: Princeton University, November 2000; available at <http://www.princeton.edu/~globsec/publications/pdf/obninsk1.pdf> as of January 21, 2003); for a recent statement from a Russian official putting the figure at 127,000, see Gethin Chamberlain, "Cold War Nuclear Scientists Warm to Scotland," *The Scotsman*, March 30, 2004.

<sup>105</sup> Estimate from then-First Deputy Minister of Atomic Energy Lev Ryabev, discussed in Bukharin, von Hippel, and Weiner, *Conversion and Job Creation in Russia's Closed Nuclear Cities*, op. cit.

<sup>106</sup> This reduction was included in the plan for restructuring the nuclear weapons complex approved in Russia in 1998. See discussion in Bukharin, von Hippel, and Weiner, *Conversion and Job Creation in Russia's Closed Nuclear Cities*, op. cit.



to retire—but for the rest, if desperation is to be avoided, civilian jobs will have to be created. While reducing the number of people with access to nuclear secrets and materials is highly desirable for the long term, in the immediate term the planned reduction and the limited availability of alternative jobs mean that there are many thousands of people who still have access to nuclear material and nuclear secrets today, but expect to lose their jobs soon. This could create a period of particular danger, as people may be tempted to steal material or sell information while they still can, to provide for what may be a prolonged period of unemployment after their jobs come to an end.

- **Leakage of nuclear expertise and technologies by nuclear facilities.** Another danger posed by an oversized and underfunded nuclear complex is the possibility that if nuclear facilities have inadequate government support, and insufficient revenue from the West or from commercial activities, the facilities' management may feel compelled to enter into contracts with other states that could lead to the proliferation of sensitive knowledge and technologies. In this conception, it is as much the facility as a whole that must be stabilized as it is the individuals who work there, and therefore civilian projects that engage substantial parts of entire facilities, not just individual personnel from them, are what is called for—and indeed, the ISTC is now referring to graduating entire facilities from any further need for assistance as one of its key performance measures.<sup>107</sup>
- **Reconstruction of a Cold War nuclear threat by large production facilities.** Finally, there remains the possibility that if political and economic circumstances changed radically, an oversized nuclear weapons complex could return to mass

production of nuclear warheads targeted on the United States and its allies. Shrinking the weapons production complex can limit this possibility and contribute to the “irreversibility” of nuclear arms reductions.<sup>108</sup> For this threat, the key targets would be demonstrable elimination or conversion to non-weapons uses of the nuclear weapons production facilities themselves.

Developing metrics in this area is particularly difficult given that there is little agreement as to which of these four dangers is the most important to address. Just as important, Russia today is a very different country from the Russia that existed in the early to mid-1990s when programs like the ISTC and IPP were first established. In general, scientists and workers at Russia's nuclear facilities are now paid a living wage, on time. The chaos and loss of central government control of the 1990s has been substantially reversed, and the economy is growing. Thus the remaining dangers are less from desperate people still in place than from people who have lost their jobs or see they are about to—or people who are not desperate but who seize opportunities for greater wealth.

These changed circumstances require a rethinking of approaches to these programs, and this is taking place. Overall, there is an increasing shift away from short-term grants to tide individuals over until better times, toward efforts to build toward sustainable commercial employment for former nuclear weapons scientists and workers. Yet the creation of sustainable commercial jobs remains a difficult and slow enterprise, particularly in locations as remote, and with as little experience competing in the global economy, as Russia's closed nuclear cities.

In the discussion below, we will focus on three simple measures: the fraction of the key nuclear weapon

<sup>107</sup> U.S. State Department, “Strategic Goal 4: Weapons of Mass Destruction - Performance Results for Performance Goal 1,” in *FY 2003 Performance and Accountability Report* (Washington, D.C.: State Department, December 2003; available at <http://www.state.gov/m/rm/rls/perfrpt/2003/html/29011.htm> as of May 3, 2004); others have stated this view: see, for instance, Siegfried S. Hecker, “Thoughts About an Integrated Strategy for Nuclear Cooperation with Russia,” *Nonproliferation Review* 8, no. 2 (Summer 2001; available at <http://cns.miis.edu/pubs/npr/vol08/82/82heck.pdf> as of May 3, 2004).

<sup>108</sup> For a useful analysis of which facilities are most important in this respect, see Bukharin, “A Breakdown of Breakout: U.S. and Russian Warhead Production Capabilities,” *Arms Control Today*, October 2002 (available at [http://www.armscontrol.org/act/2002\\_10/bukharinoct02.asp](http://www.armscontrol.org/act/2002_10/bukharinoct02.asp) as of May 3, 2004).

scientists who received short-term grants to tide them over the worst times; the fraction of excess nuclear weapon scientists and workers provided with sustainable civilian employment for the long haul; and the fraction of Russia's nuclear weapons infrastructure eliminated. (Our measures continue to focus exclusively on Russia, as the new programs focused on Iraq and Libya are still at such early stages that it is too early to begin assessing what fraction of the nuclear scientists from those countries those efforts are successfully engaging.) Here, as elsewhere, it is important to distinguish between the fraction of whatever has been accomplished that U.S.-funded programs can take credit for, and the fraction that is been accomplished through Russia's own efforts or those of others.

### ***Stabilizing Metric 1: Key Nuclear Weapons Scientists Given Short-Term Grants***

**Fraction accomplished.** Initially, the idea was to provide short-term grants on an emergency basis to make sure that key weapons scientists did not become desperate enough to sell their knowledge during what was expected to be a short-term crisis before Russia got back on its feet—while funding important civilian research in the process. Although it took some time for key programs such as the ISTC to get up and running on a large scale, the mission of easing desperation for key nuclear weapons scientists was largely accomplished in the mid- and late-1990s. There is no data publicly available concerning how many of the scientists and engineers with the most proliferation-sensitive knowledge received grants (since there is no accepted list of which people those were). Nevertheless, as we argued last year, from the anecdotal information that is available, it seems plausible that in the nuclear sector at least, the ISTC or similar projects may have provided grants to a large fraction—perhaps 70–80%—of those most in need of them.<sup>109</sup> Our estimate this year is the same, as the programs focused on short-term grants are focusing less on ex-

panding their reach to additional individuals than on making the transition to long-term sustainability.

This may be an overestimate of the fraction of the problem successfully addressed, however, as there are two important categories of individuals that ISTC and related programs do not reach. First, as the grants go only to individuals affiliated with particular facilities or institutes, those nuclear weapons experts who have retired, or who left their facilities for civilian jobs that have since disappeared, are not typically within the pool of people who can get support from these programs. This may be important, as the likelihood of economic desperation among these individuals may be higher than it is for those individuals still employed at institutes, and controls or monitoring of their travel and meetings with foreigners may be much weaker—yet they may still retain in their memories critical knowledge related to nuclear weapons. Second, experts associated with those facilities that remain completely off-limits to foreigners—such as Russia's nuclear weapons assembly and disassembly facilities—are not generally eligible for such grants, which require a certain level of transparency from the facility where the recipients work. Here, too, this may be an important gap, as some of these facilities reportedly continue to face severe economic challenges, and some of the experts who work at such plants may have critical knowledge related to nuclear weapons manufacture.

**Rate of progress.** On this metric (if not on others) the effort in the nuclear sector has more or less stabilized. No clear target for ending the effort has been identified. Today, in any case, Russian nuclear weapons scientists are being paid on time, and paid enough to live on.<sup>110</sup> As just noted, programs in this area are focusing less on expanding the number of grantees they reach than on helping grantees made the transition to civilian employment that does not require foreign assistance.

<sup>109</sup>The fraction is likely much less in the chemical and (especially) biological areas, where the sensitivities were even higher; some key biological facilities have not yet been opened to the West, and therefore the scientists who still work at these facilities have not been eligible to participate in programs such as ISTC.

<sup>110</sup>For discussion, see Bunn, "The Threat in Russia and the NIS," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, October 2002 (available at [http://www.nti.org/e\\_research/cnwm/threat/russia.asp](http://www.nti.org/e_research/cnwm/threat/russia.asp) as of May 3, 2004).

## **Stabilizing Metric 2: Excess Nuclear Weapon Scientists and Workers Provided Sustainable Civilian Work**

**Fraction accomplished.** As noted above, Russia plans to reduce the workforce in its nuclear weapons programs by 35,000 people, nearly half of the total, over the next several years. As DOE put it, these “35,000 nuclear experts represent a knowledge base that terrorist groups and proliferant countries could target for clandestine nuclear programs.”<sup>111</sup> The goal for U.S.-funded job-creation programs need not be as high as this 35,000 figure, however. Thousands of these nuclear weapons scientists and workers are likely to retire, thousands more are likely to find other work without help, and thousands more are likely to be re-employed in civilian nuclear projects or other conversion projects sponsored by FAAE. The remaining need may be in the range of 15,000–20,000 jobs.<sup>112</sup> The task of creating thousands of civilian jobs in Russia—and of measuring how many jobs have in fact been created—is so daunting that U.S.-funded programs have been trying to move away from job-creation as a measure of their performance. But ultimately if jobs are not created, and many thousands of nuclear weapons workers find themselves facing imminent unemployment as Russia’s nuclear weapons complex contracts, these programs will not have fulfilled their mission. Job creation, therefore, remains an important measure of success.

In last year’s report, we pointed out that while programs such as ISTC, IPP, and the Nuclear Cities Initiative (NCI) have helped foster the establishment of a substantial number of high-tech firms based in part on technologies drawn from the nuclear weapons com-

plex, it remains very difficult to estimate how many of the jobs in these firms are in fact held by former nuclear complex personnel. Moreover, it is difficult to estimate how many of the businesses and jobs created with support from these programs will be able to sustain themselves for the long haul.

Through the end of 2003, DOE estimates that its Russia Transition Initiatives have supported the commercialization of 20 technologies into sustainable businesses employing former nuclear, chemical, biological, or missile scientists and engineers.<sup>113</sup> Related programs such as ISTC and the Civilian Research and Development Foundation have also supported the establishment of new businesses that are employing some nuclear weapons complex scientists and experts. Moreover, as noted in last year’s report, the European Bank for Reconstruction and Development (EBRD) loan programs in the nuclear cities, established with assistance from NCI, have made over a thousand small-business loans in these cities, which have presumably supported the creation of thousands of new jobs in these towns, some of which may be held by former employees of the nuclear weapons complex. In last year’s report, we estimated, that if the jobs created by the EBRD loans are included, these programs might have created as many as 4,000 jobs that could have gone to former nuclear weapons scientists and workers, representing some 20% of the overall need.<sup>114</sup> We acknowledged, however, that this was likely an overestimate.

With the expiration of the NCI agreement, FY 2003 was a difficult year for these efforts. Some additional projects were commercialized, however, and the EBRD continued to make new loans. A rough (and

<sup>111</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 459.

<sup>112</sup> DOE’s Russian Transition Initiatives program (combining IPP and NCI) has set a goal of providing 15,000 civilian jobs for these personnel. DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 459.

<sup>113</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 458. DOE estimates that during 2003, some 7,600 scientists, engineers, and technicians from Russia, Ukraine, Kazakhstan, Armenia, and Georgia were working on IPP projects; this figure, however, represents the number of individuals supported by short-term grants, not the number in sustainable jobs. DOE estimates that by the end of FY 2003, IPP had created 585 private sector jobs in Russia—a very small fraction of the total potential need, even if all of these jobs were held by former WMD scientists, which seems unlikely. See DOE Moscow Office, *Summary of DOE Programs in Russia*, op. cit., pp 26-27.

<sup>114</sup> See discussion in Bunn, Wier, and Holdren, *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan*, op. cit., pp. 76–77. For a similar (though even more pessimistic) assessment of the degree of success to date in job creation, see J. Raphael della Ratta, “A Strategy for the Redirection of the Russian Nuclear Complex,” in *Reshaping U.S.-Russian Threat Reduction*, op. cit.

again probably over-optimistic) estimate might be that the fraction of this mission accomplished has risen to 25%.

Other U.S.-funded programs not directly focused on job creation have also led to the creation of large numbers of jobs. The most important of these is the U.S.-Russian HEU Purchase Agreement. Several thousand Russian nuclear experts and workers are directly employed on the various steps of fulfilling this contract, and are therefore not included among those for whom other U.S., Russian, or international programs have to provide other employment. The total number of jobs specifically for nuclear experts and workers created by this agreement is probably larger than the combined total from all the programs specifically focused on job creation. Moreover, FAAE officials have indicated that the funding for FAAE's own roughly \$50 million per year conversion program in its nuclear weapons complex comes primarily from the HEU purchase—as does funding for dealing with nuclear waste from dismantled submarines, and for cleanup in FAAE's nuclear complex.<sup>115</sup> One FAAE official recently claimed that this FAAE-sponsored conversion effort, in combination with efforts supported by Western countries, had created some 15,000 jobs.<sup>116</sup> If true, this could further reduce the overall number of jobs that Russia needs U.S. support to help create. Since Russia has funded this program itself—choosing to use revenue from the HEU purchase for that purpose—we have not counted these jobs toward the total created by U.S.-funded programs, but to the extent that they turn out to be sustainable, long-term jobs, they substantially reduce the total requirement for jobs to be created by U.S. or other internationally funded efforts.

Other U.S.-funded programs, such as the MPC&A program and programs to develop new monitoring

technologies and procedures, are also employing hundreds, if not thousands, of Russian nuclear experts and workers, at least for now, and if regulations, procedures, and other approaches are put in place that result in Russia maintaining a substantial level of effort in these areas after U.S.-funded programs phase out, some of these jobs will be sustainable ones. No data on the number of these jobs, or the fraction judged likely to be continued after U.S. funding phases out, is publicly available. Privately financed initiatives have also created substantial numbers of jobs for former nuclear workers: one former uranium enrichment facility, for example, now produces video and audiotapes under license to the German firm BASF; Intel employs dozens of former nuclear weapons scientists doing software at a facility in Sarov; and a South Korean firm has financed a diamond-cutting company, also in Sarov.<sup>117</sup> The Nuclear Threat Initiative has made a \$1 million contribution to revolving economic development fund in the closed nuclear city of Sarov, which they believe has so far led to the creation of over 70 permanent civilian jobs for former nuclear weapon scientists.<sup>118</sup>

Jobs directly created in projects sponsored by U.S.-funded programs may not be the most accurate metric. If U.S. programs assist, for example, in improving the business climate and promoting general economic development in Russia's nuclear cities, this may lead to natural growth of jobs that will absorb large numbers of former nuclear weapons workers. For example, the International Development Centers established in Zheleznogorsk and Snezhinsk are helping with local and regional economic planning, business training, matching of businesses to foreign partners, and a wide range of services for new or expanding businesses. But these centers employ very few people themselves, and their impact on other job

<sup>115</sup> See, for example, remarks by then-First Deputy Minister of Atomic Energy Lev Ryabev, quoted and discussed in Bukharin, von Hippel, and Weiner, *Conversion and Job Creation in Russia's Closed Nuclear Cities*, op. cit.

<sup>116</sup> Chamberlain, "Cold War Nuclear Scientists Warm to Scotland," op. cit. Russia's Ministry of Atomic Energy had estimated that its conversion programs had created roughly half this number of jobs through 2001. See Ministry of Atomic Energy, *Major Results of Conversion in Defense Complex Enterprises of MINATOM, Russia in 1998–2001* (Moscow: MINATOM, Summer 2002, translated from the original Russian). This represented somewhat more than half the planned figure.

<sup>117</sup> For discussions of these projects and others, see Bukharin, von Hippel, and Weiner, *Conversion and Job Creation in Russia's Closed Nuclear Cities*, op. cit.

<sup>118</sup> Personal communication from Laura Holgate, May 2004.

creation is difficult to assess quantitatively. Appropriate metrics have not been developed for measuring the contribution of U.S. programs to the business climate in the areas where nuclear workers and experts must be re-employed; moreover, beyond these development centers, U.S.-funded programs focused on improving the general business climate in these locations have been extremely modest, and have had limited impact.

**Rate of progress.** As just noted, 2003 was a difficult year for these efforts. Nevertheless, some programs, such as IPP, are now reaching the time when past investments in pre-commercial projects are reaching the point of commercialization, increasing the number of jobs created. No data is publicly available on the total number of jobs provided for former nuclear weapons scientists and workers in the last year or two years, but it appears unlikely to have been more than 5% of the total need per year. DOE now expects that only one new technology supported by its initiatives will be commercialized each year for the next several years.<sup>119</sup>

### ***Stabilizing Metric 3: Russian Nuclear Weapons Infrastructure Eliminated***

**Fraction accomplished.** Only one U.S. program, NCI, is specifically focused on closing down excess nuclear weapons infrastructure in Russia, and this initiative's intergovernmental agreement has expired. NCI supported the transition of roughly 40% of the "Avangard" nuclear weapons assembly and disassembly facility (the smallest of Russia's four such facilities) from weapons work to open civilian work. Even if Avangard had been as large as the other facilities, 40% of it would amount to some 10% of Russia's total nuclear weapons assembly and disassembly floor space—and a much smaller fraction of the total floor space of all the different facilities in Russia's nuclear weapons complex. Russia subsequently closed the entire Avangard

facility. Russia has also closed its next-smallest nuclear weapons assembly and disassembly facility, at Zarechnyy (formerly Penza-19), without U.S. help.<sup>120</sup> Only the two largest weapons assembly-disassembly plants remain in operation. If one subtracts Zarechnyy from the total mission remaining to be accomplished, and assumes that the capacity of these four facilities is roughly proportional to the estimated employment there, then by contributing to the closure of Avangard, NCI contributed to shutting down roughly 11% of the non-Zarechnyy capacity of Russia's warhead assembly-disassembly complex.<sup>121</sup>

In addition, Russia appears to have closed one of its two facilities for manufacturing HEU and plutonium components for nuclear weapons (the one located at Seversk).<sup>122</sup> This closure, if it is irreversible, is likely to constrain the rate at which Russia could mass produce new warheads more than the assembly plant closures. This closure occurred without U.S. help, however, and with no measures in place to confirm the closure and ensure that it would be irreversible. The remaining employees at Avangard were absorbed into the weapons-design institute that is also located in the city of Sarov. The Zarechnyy plant reportedly still does some conventional weapons work, but the ultimate fate of the thousands of employees there is unclear. Most of the thousands of employees at Seversk who once worked manufacturing weapons components are reportedly now involved in dismantling these components and blending the HEU down for sale to the United States as commercial reactor fuel.<sup>123</sup>

The Russian Transition Initiatives program reports that it has set nuclear weapons complex reduction targets for six Russian nuclear weapons complex sites, including two nuclear weapons assembly-disassembly facilities (Avangard and Zarechnyy), two plutonium production facilities (Seversk and Zheleznogorsk, where another U.S.-sponsored program is working to shut down Russia's remaining

<sup>119</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 458.

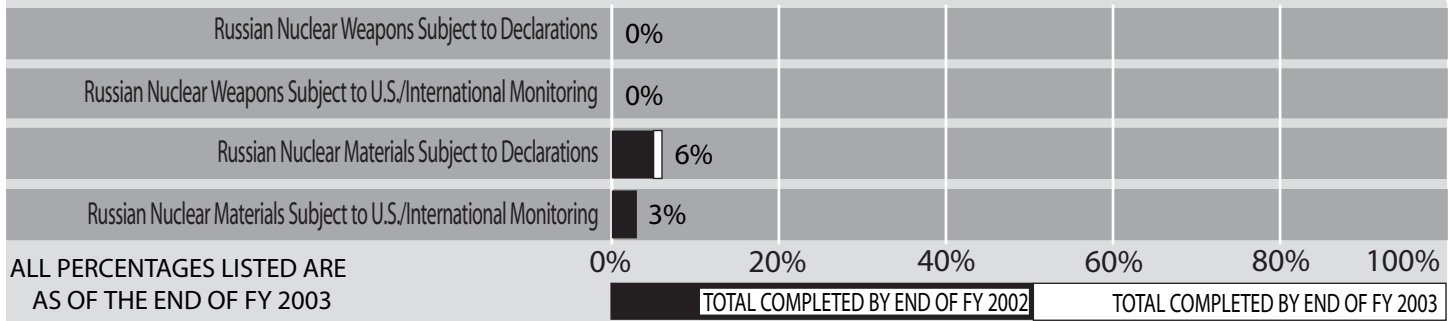
<sup>120</sup> Interview with former First Deputy Minister of Atomic Energy Lev Ryabev, September 2003.

<sup>121</sup> Avangard is believed to have had roughly 3,000 employees, while Lesnoy and Trekghornyy combined are thought to have some 16,400 employees. See Kovchegin, "Nuclear Cities Table," op. cit.

<sup>122</sup> Personal communication from Oleg Bukharin, Princeton University, March 2004.

<sup>123</sup> Personal communication from Oleg Bukharin, Princeton University, March 2004.

**Figure 3-5**  
**How Much Monitoring Work Have U.S.-Funded Programs Completed?**



plutonium production reactors), and two weapons design institutes (Sarov and Snezhinsk). These targets apparently include both “workforce reduction and facility closure.”<sup>124</sup> The degree to which achieving these targets would meet the overall objective of reducing Russia’s ability to rapidly restart mass production of warheads should circumstances change is difficult to judge, since the specific targets have not been made public.

**Rate of progress.** There is as yet no agreement for the United States and Russia to cooperate on closing down more of Russia’s nuclear weapons complex (though Russia plans to close other facilities on its own). DOE projects that it will only accomplish a few percent of its “nuclear complex reduction targets” each year over the next several years.<sup>125</sup> DOE has not made the specifics of these targets public, and does not expect to complete them until 2015.<sup>126</sup>

## MONITORING NUCLEAR STOCKPILES AND REDUCTIONS

Ultimately, measures to declare the size and composition of nuclear stockpiles, and to allow bilateral or international monitoring of key stocks, could contribute substantially to ensuring that these stockpiles remain safe and secure.<sup>127</sup> The current administration, however, has so far preferred to maintain secrecy concerning U.S. nuclear stockpiles and plans, and not press Russia to change its own long-held policies of secrecy. Hence the administration is not pursuing previous initiatives focused on measures such as stockpile data exchanges or verified dismantlement of nuclear warheads, except for limited discussions of transparency measures to build confidence in the implementation of the Strategic Offensive Reductions Treaty (SORT). Thus progress in this area has been minimal, and the rate of additional progress essentially zero. The only key development for the past year was the continuing failure to reach agreement on transparency measures for the Mayak Fissile Material Storage Facility, even as the facility was completed.<sup>128</sup> As metrics for judging

<sup>124</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 459.

<sup>125</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 458. The fact that DOE has established targets for six of the ten closed nuclear cities in Russia is somewhat mysterious given that the Nuclear Cities Initiative focused on only three of these cities, and there is no U.S.-Russian agreement to cooperate on closure of additional sites. Nonetheless, DOE projects that it will have completely met its reduction targets at four of the six sites by FY 2009.

<sup>126</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 458. Although the only major facility whose closure the United States has substantially contributed to is Avangard, DOE reports that as of the end of FY 2003 it had already achieved 49% of the combined total of the reduction targets for the six sites, suggesting that the targets for the other five may be modest.

<sup>127</sup> See discussion in Bunn, Wier, and Holdren, *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan*, op. cit. pp. 147–150.

<sup>128</sup> See Bunn, “Mayak Fissile Material Storage Facility,” op. cit.

progress in this area, we use the fraction of Russia's nuclear warheads and materials that have been the subject of detailed declarations, and the fraction that are subject to actual monitoring.

### ***Monitoring Metric 1: Russian Nuclear Weapons and Materials Subject to Declarations***

**Fraction accomplished.** Remarkably, the United States and Russia have never told each other how many nuclear weapons or how many tons of plutonium and HEU they have. Nor has either country ever allowed the other to verify the dismantlement of a single nuclear warhead. Therefore the fraction of nuclear warheads subject to detailed declarations is zero. In the case of nuclear materials, every year another 30 tons of HEU is blended down, and becomes subject to declarations (and monitoring, as described below) as part of that process (while also removing that HEU from the total of material remaining to declare or monitor). In addition, Russia makes declarations every year on its stockpiles of separated civilian plutonium (a category in which Russia has chosen to include the plutonium produced in the reactors built to produce plutonium for weapons, since that material stopped being used in new weapons). As of the end of 2002, Russia's civil plutonium declaration included 37.2 tons of material.<sup>129</sup> Hence, the total amount of nuclear material subject to declarations is in the range of 67 tons, just under 6% of the approximately 1195 tons of weapons-usable nuclear material in Russia as of the end of 2003,<sup>130</sup> or 11% of the 600

tons of that total stockpile that is believed to be outside of nuclear weapons themselves.

**Rate of progress.** As material is loaded into the now nearly completed Mayak Fissile Material Storage Facility, it will effectively come under declarations, since, if transparency arrangements for the facility are eventually agreed, the United States will be informed of roughly how much material is present in the facility. Thus, over the next few years, some 25 tons of plutonium should be added to the amounts just described—or more, if the United States and Russia agree on policy changes that would allow more material to be stored there.<sup>131</sup> Beyond that, progress in bringing additional weapons or materials under declarations is minimal.

### ***Monitoring Metric 2: Nuclear Weapons and Materials Subject to U.S. or International Monitoring***

**Fraction accomplished.** As with declarations, no warheads are currently subject to monitoring. In the case of nuclear materials, the 30 tons of HEU being downblended each year are subject to limited monitoring during that process (and are removed from the total stockpile). It is worth noting that in February 2003, continuous monitoring equipment to monitor the point at which the HEU and blendstock are actually blended to LEU was installed at the second of three facilities in Russia where this work is done, so that some 75% of the LEU being delivered is now subject to such continuous blend monitoring;

<sup>129</sup> IAEA, "Communication received from the Russian Federation Concerning its Policies regarding the Management of Plutonium," INFCIRC/549/Add.9/5, September 15, 2003 (available at <http://www.iaea.org/Publications/Documents/Infcircs/2003/infcirc549a9-5.pdf> as of April 9, 2004).

<sup>130</sup> For a discussion and update of unclassified estimates on this stockpile, see Bunn, "Unclassified Estimates of Russia's Plutonium and HEU Stockpiles—And World Civil Separated Plutonium Stockpiles: A Summary and Update," Rev. 1, July 23, 2003 (unpublished).

<sup>131</sup> Currently, the United States takes the view that only weapons plutonium or weapons HEU which will never be returned to weapons can be stored in this facility. Russia takes the view that the HEU in this category is already being blended for sale to the United States under the HEU purchase agreement and does not require storage at Mayak, and the only plutonium in this category is the 34 tons covered by the 2000 U.S.-Russian Plutonium Disposition and Management Agreement, of which 9 tons is material produced in the plutonium production reactors in recent years and stored there, leaving only 25 tons of plutonium eligible for placement in the Mayak storage facility—enough to fill one-quarter of the facility. The United States is considering approaches that would allow additional material to be stored at Mayak, such as having one portion of the facility limited to excess plutonium that would never be returned to weapons and would be subject to monitoring, and another portion where Russia could store a portion of the plutonium still reserved for support of its military stockpile. See Bunn, "Mayak Fissile Material Storage Facility," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, January 2004 (available at [http://www.nti.org/e\\_research/cnwm/securing/mayak.asp](http://www.nti.org/e_research/cnwm/securing/mayak.asp) as of May 3, 2004).

## WHAT ARE THE MAIN IMPEDIMENTS TO ACTION?

Despite more than a decade of work, and the oft-expressed intentions of senior U.S. and Russian officials, much less than half of the job of securing the former Soviet nuclear stockpiles is done. Today, neither lack of money nor lack of technology is the primary obstacle to faster progress—the primary obstacles are political and bureaucratic, and could be overcome with sufficient political will and sustained leadership from the highest levels of governments.<sup>1</sup>

**Lingering distrust and lack of partnership.** Whatever the relationship at senior political levels, distrust and suspicion remain in substantial sections of the U.S. and Russian nuclear establishments, and these attitudes are the most fundamental and deep-rooted obstacles to faster progress. Since President Putin's rise to power, the Russian security services, a hotbed of this distrust, have gained in power and extended their reach. Russian officials suspect U.S. experts are out to spy on sensitive facilities; U.S. officials suspect that Russia will misuse threat reduction assistance, or that assistance for threat reduction projects will free up resources for Russia to spend on its own military forces. Across a wide range of programs, there is often a lack of real partnership to move these joint efforts forward—including a U.S. tendency toward “made in America” approaches designed with only modest consultation with Russian experts, and a Russian tendency to allow delays to continue, and to rely on the United States to pay virtually the entire cost of these joint efforts.<sup>2</sup> There are exceptions, of course, where personal relationships built through successful joint work have allowed mutual confidence to bloom—and those are the areas where progress is the most rapid.

**Secrecy.** Secrecy is one critical result of lingering distrust. Keeping some nuclear information secret is essential to preventing the spread of nuclear weapons. But the scale of secrecy, particularly in Russia, frequently slows or stops ongoing threat reduction cooperation. Cooperation to secure nuclear warheads, materials, and expertise is invariably hampered when experts on both sides can not evaluate together where the most dangerous vulnerabilities lie because they are prohibited from exchanging information on how big the nuclear stockpiles are, where they are located, and the like. Other countries with which the United States might cooperate on security, such as China and Pakistan, are likely to be even more sensitive about the details of their nuclear weapons programs. (See “The Challenges of Adapting Threat Reduction to New Contexts,” p. 104.)

**Disputes over access to sensitive sites.** One particular manifestation of secrecy has been the extended disputes over access to sensitive sites. To ensure that a particular site really holds dangerous materials, to assess the kinds of upgrades needed at that site, and to ensure that installation work is done to contract specifications, U.S. officials have often demanded direct access by U.S. personnel, even at highly sensitive locations. Russian officials have often rejected these demands, arguing in some cases that Russian law does not permit such foreign access. Work at most of Russia's nuclear warhead storage sites and several of its most important nuclear material sites has been delayed for years over such disputes—though recent agreements have led to expanded access at both warhead sites and some sensitive nuclear material sites. Different programs in the former Soviet Union have pursued a patchwork of different approaches to resolving them. In many cases, non-access approaches such as photographs and videotapes of the installed equipment in use, or the use of “trusted agents” (Russian citizens with Russian security clearances in the employ of a U.S. contractor who are allowed to the secret location to confirm that the work was done as agreed) can provide the needed assurances that U.S. taxpayer's money is being spent appropriately, without requiring direct access by U.S. personnel. Accelerating the pace of security upgrades, and especially providing security at some of the largest—and most sensitive—remaining material and warhead storage sites will likely require the use of such creative approaches. Access will likely prove an even greater challenge to overcome if security cooperation is expanded to other nuclear weapons states.

**Unnecessary political linkages.** The U.S. Congress has long tied threat reduction assistance to presidential certification that recipient states were meeting a variety of goals, from complying with their arms control obligations to not spending more on their military forces than needed for their own defense. From time to time, there have been proposals to tie such threat reduction assistance to other issues as well, particularly Russian nuclear cooperation with Iran. All new threat reduction projects—including critical work on securing nuclear warhead sites—were held up for some six months when the Bush administration refused to certify Russia's compliance with the Congressional conditions. The logjam was temporarily broken when Congress passed legislation giving the President the authority to waive the certification requirements in the interests of national security—but that authority only lasts until 2005, when the issue will have to be fought through again. Meanwhile, progress in destroying Russia's chemical stockpiles was held up for some three years over additional Congressional certification requirements. While there is little doubt that threat reduction cooperation is affected by the overall political relationships between the United States and Russia (or between other donor and recipient states), it makes little sense to formally link investments the United States makes in the interests of its own security to Russian behavior in other areas: if we are concerned about Russian cooperation with Iran, does that make it less urgent to ensure that Russian nuclear warheads and materials do not fall into hostile hands? Russia, to its credit, has continued threat reduction cooperation even during some of the lowest points of U.S.-Russian relations, such as during the NATO intervention in Kosovo, or after the U.S.-led bombing of Iraq in 1998. Both sides should avoid unnecessary political linkages in the future, and Congress should grant the President the permanent waiver authority he has sought.<sup>3</sup>

**Liability protection.** Given the serious safety hazards in working with these dangerous materials, before being willing to start work, U.S. and international companies have wanted to be sure that they would not be responsible for billions of dollars in damage if an accident occurred during the course of threat reduction cooperation. While the original Cooperative Threat Reduction umbrella agreement included blanket liability protection—absolving the American government or any contractor of any responsibility even if they deliberately caused a mishap—Russian officials have often balked at providing such blanket protection in subsequent agreements. Officials from the United States have refused to accept anything less. The United States allowed two key threat reduction



agreements (one on technical cooperation on plutonium disposition, and the other the Nuclear Cities Initiative) to expire in 2003, rather than compromise on the liability issue. In Russia, U.S. demands that Russia accept liability even if U.S. personnel carry out deliberate sabotage are seen as patently unreasonable. (Every other participant in the G-8 Global Partnership has been able to work out compromise language with Russia.) Even when liability protection agreements have been strong, most firms have still asked their national government for indemnification. For over a year, the Bush administration has allowed a large fraction of what little high-level political attention is devoted to these issues to be sucked into the liability dispute.

**Travel restraints.** Travel restrictions have been an area where bureaucratic logjams have had a particularly severe effect. In the case of an expert from a Department of Energy laboratory, a typical trip to a Russian facility requires laboratory approval, DOE headquarters approval, State Department approval, a Russian visa, and Russian permission to visit a closed area (which typically requires at least 45 days advance notice). These approvals usually take at least two months to arrange, and can often fall through at the last moment. Participants from former Soviet countries coming to visit the United States face similar problems, which have been severely exacerbated by the intensity of post-9/11 visa application reviews, which have routinely delayed visits for months at a time. The restraints on travel take up the time of scientists and officials on both sides that should be spent improving nuclear security, and undermine good will on both sides.<sup>4</sup>

**Taxes.** Countries providing their taxpayers' money for programs to dismantle or secure weapons of mass destruction want the money to go for that purpose, and not into the general coffers of the recipient state—and hence have insisted that their assistance be tax free. Most recipient countries, including Russia, have agreed to this in principle, but in many countries projects face a complex set of local, regional, and national tax collection agencies which have sometimes been reluctant to implement such exemptions. While the taxation issue has been largely resolved in principle, in practice actually getting the tax exemptions implemented has taken up an enormous amount of energy that could otherwise have been devoted to the work at hand.

**Bureaucracy.** As one senior U.S. official joked: "if there were an Olympics for bureaucracy, Russia would take home most of the medals." The United States would not be far behind. There are myriad cases—continuing to the present day—of threat reduction cooperation being bogged down for months or years by the slow pace of business-as-usual bureaucratic procedures, interagency infighting, and the like. In both Washington and Moscow, for example, reviews of contracts for security upgrades, and demands for revisions in those contracts, often go on for months at a time, drastically slowing the pace of work. Fundamentally, no one in Moscow or Washington was ever fired for failing to get these programs moving faster—but many perceive that they might be fired if they allowed a project to go forward on a basis that was later judged to be questionable.

In their statement launching the Global Partnership Against the Spread of Weapons and Materials of Mass Destruction, the leaders of Russia and the other members of the G-8 agreed on a set of implementation principles designed to overcome some of these logjams—including access, tax exemption, and liability protection, among others. Two years after those pronouncements, taxes are largely resolved in principle (though often with difficulties in practice), the access issue has moved forward significantly (while being by no means fully resolved), and the United States and Russia are still fighting over the liability issue.

Most of these impediments to accelerated progress cut across agency boundaries. No matter how energetic and well-intentioned one U.S. Cabinet member or one Russian minister may be, there are limits to what they can do to overcome these obstacles. Sweeping aside these obstacles and achieving the accelerated progress that is so urgently needed will require sustained leadership from the presidential level, where power cuts across interagency boundaries.

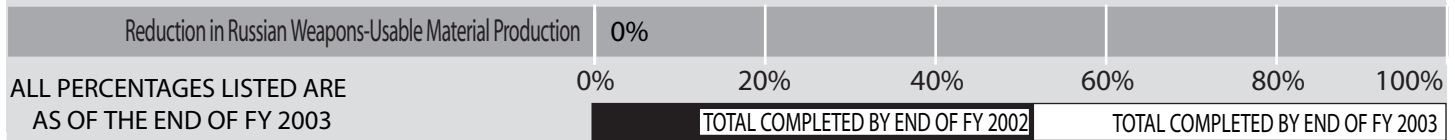
<sup>1</sup> See U.S. National Academies Committee on U.S.-Russian Cooperation on Nuclear Non-Proliferation and Russian Academy of Sciences Committee on U.S.-Russian Cooperation on Nuclear Non-Proliferation, *Overcoming Impediments to U.S.-Russian Cooperation on Nuclear Non-Proliferation: Report of a Joint Workshop* (Washington, D.C.: National Academies Press, 2004; available at <http://books.nap.edu/catalog/10928.html> as of May 5, 2004).

<sup>2</sup> In some of the programs to secure nuclear material, for example, the United States prepared strategic plans for the efforts without consulting with the Russian side; developed guidelines for what levels of security should be achieved at each site, without consulting with the Russian side and without being willing to show the guidelines to Russian experts; and reviewed progress in meeting the guidelines with the use of a U.S. team with no Russian input. Russia, meanwhile, has taken countless actions that have had the effect of slowing this cooperation or making it more complex, and in some cases has unexpectedly changed policies in ways that left large U.S. threat reduction investments as expensive white elephants. See, for example, U.S. Department of Defense, Office of the Inspector General, *Cooperative Threat Reduction: Cooperative Threat Reduction Program Liquid Propellant Disposition Project* (Arlington, VA: DOD, September 30, 2002; available at <http://www.dodig.osd.mil/audit/reports/02report.htm> as of May 5, 2004).

<sup>3</sup> For discussion, see Senator Richard Lugar, "Eliminating the Obstacles to Nunn-Lugar," *Arms Control Today*, March 2004 (available at [http://www.armscontrol.org/act/2004\\_03/Lugar.asp](http://www.armscontrol.org/act/2004_03/Lugar.asp) as of May 3, 2004).

<sup>4</sup> For a discussion of the importance of resolving this impediment, see John P. Holdren and Nikolai P. Laverov, "Letter Report From the Co-Chairs of the Joint Committee on U.S.-Russian Cooperation on Nuclear Non-Proliferation" (Washington, D.C.: The National Academies, December 4, 2002; available at <http://www4.nationalacademies.org/news.nsf/isbn/s02052003?OpenDocument> as of May 13, 2004). The House International Relations Committee included strong language on resolving this issue in its foreign relations authorization bill in 2003, but the bill never became law, as the Senate never passed its comparable version.

**Figure 3-6**  
**How Much Ending Production Work Have U.S.-Funded Programs Completed?**



similar equipment is to be installed at the third facility in 2004.<sup>132</sup> Limited monitoring of the plutonium produced in Russia's plutonium production reactors since 1994 (amounting to some 8–11 tons of plutonium) is now occurring, although as of early 2004 the United States and Russia were still debating the specifics of what kind of equipment could be used to take measurements on the canisters containing the plutonium at these sites.<sup>133</sup> Together, the plutonium and HEU being monitored represents some 3% of Russia's total nuclear material stockpile, or nearly 7% of the estimated 600 tons outside of weapons.

**Rate of progress.** As noted earlier, there are no current plans for monitoring or declarations on warhead stockpiles. For material stockpiles, the rate of increase in the amounts of materials subject to monitoring has been painfully slow. As just noted, 25 tons or more of plutonium is slated to be loaded into the Mayak Fissile Material Storage Facility over the next few years, and if all goes well, this will be subject to some form of transparency. Over the longer term, monitoring of plutonium being burned as fuel in the plutonium disposition effort would begin, but all of this material would be either from the plutonium stored at Mayak (which, if transparency arrangements are agreed, will already be subject to monitoring), or plutonium from the stocks at Russia's plutonium production reactors (also already subject to monitoring). No date for completing monitoring arrangements for warheads and materials has been established.

<sup>132</sup> DOE Moscow Office, *Summary of DOE Programs in Russia*, op. cit., p. 20.

<sup>133</sup> These monitoring visits finally began to occur in 2002. See, for example, National Nuclear Security Administration, "Warhead and Fissile Material Transparency (WMFT) Program," no date (available at <http://www.nnsa.doe.gov/na-20/wfmt.shtml> as of May 6, 2004). See also DOE Moscow Office, *Summary of DOE Programs in Russia*, op. cit., pp. 31–33.

<sup>134</sup> See Bunn, "Plutonium Production Reactor Shutdown," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, July 2003 (available at [http://www.nti.org/e\\_research/cnwm/ending/plutonium.asp](http://www.nti.org/e_research/cnwm/ending/plutonium.asp) as of May 3, 2004).

<sup>135</sup> See Bunn "Fissile Material Cutoff Treaty," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, February 2003 (available at [http://www.nti.org/e\\_research/cnwm/ending/fmct.asp](http://www.nti.org/e_research/cnwm/ending/fmct.asp) as of May 3, 2004).

## ENDING PRODUCTION

The United States and Russia already have far more nuclear weapons and far more plutonium and HEU than they need for any conceivable military purpose. Hence, it makes sense to stop further production. Both the United States and Russia reserve the right to assemble additional nuclear warheads (for example, to replace warheads disassembled because of age or other problems), so there have been no discussions focused on a verifiable end to warhead production. With respect to weapons-usable nuclear material, the United States is providing assistance to Russia to replace the heat and power provided by Russia's three remaining plutonium production reactors, so that they can be shut down.<sup>134</sup> There are also multilateral discussions of a fissile cutoff treaty that would prohibit additional production of HEU and plutonium outside of safeguards, but these have gone nowhere for years.<sup>135</sup>

Key developments in this area in the last year included:

- The Department of Energy granted contracts to two U.S. integrating contractors to oversee construction of fossil power plants to replace Russia's plutonium production reactors, and the United States and Russia reached agreement on access to the sites where the fossil plants will be built. However, new cost estimates in the winter of 2003–2004

were substantially higher than previous estimates. As of early 2004, the United States and Russia were still debating access arrangements necessary to carry out interim nuclear safety improvements for the period until the plutonium production reactors are shut down.<sup>136</sup>

- In the discussions of a fissile cutoff treaty, in August 2003 China relaxed its position linking the start of negotiations on a cutoff to the start of negotiations on space weaponry—but the United States, rather than seizing this potential opportunity to get negotiations going, announced an extended interagency review of its position on the fissile cutoff, which, as of early 2004, was still ongoing.<sup>137</sup>

### **Ending Metric 1: Reduction in Russian Weapons-Usable Material Production**

**Fraction accomplished.** The metric here is very simple: the reduction in the rate of fissile material production resulting from U.S. sponsored programs. So far, this is zero, as U.S.-funded programs have not affected this production rate. Russian production of HEU for weapons ended, and most of Russia's plutonium production reactors were shut, before cooperative threat reduction programs began. The plutonium production rate at the last three production reactors has been reduced because of reductions in their permitted peak power imposed by Russia's nuclear safety regulatory agency, but this was not the result of U.S. programs intended to reduce plutonium production. Currently these reactors are expected to operate, producing some 1.2 tons of plutonium per year, through 2008–2011.<sup>138</sup> The administration has dropped Clinton-era efforts to negotiate an end to Russia's continuing separation of civilian weapons-usable plutonium, so roughly an additional ton of

separated plutonium is added to Russia's stockpile each year from this source as well.

**Rate of progress.** The program to shut Russia's plutonium production reactors has made progress in awarding contracts, negotiating access arrangements, and the like. But construction is not yet underway on a substantial scale. DOE estimates that as of the end of FY 2003, only 1% of the construction work required to shut the two plutonium production reactors at Seversk had been completed, and only 0.5% of the construction work required to shut the one plutonium production reactor at Zheleznogorsk had been completed. However, having laid the groundwork in previous years, they expect to complete an additional 15% of the Seversk work in FY 2004, and an additional 32% in FY 2005, with a slower pace of work at Zheleznogorsk.<sup>139</sup> The slow planned pace for the Zheleznogorsk work is primarily driven by budget constraints.

In recent months, cost estimates for this effort have risen substantially.<sup>140</sup> Efforts are underway to streamline the effort and reduce costs. The schedule could be accelerated and the total cost reduced by providing sufficient funding at the outset to proceed as a commercial power plant project would, rather than assuming that funding will be limited to \$50 million per year. The longer the project takes, the closer the end of plutonium production comes to when these reactors would have used up their useful lives and would need to shut down without U.S. help. If cost increases and schedule delays cannot be addressed, they could ultimately make the cost per ton of plutonium whose production is avoided too high for the effort to be worthwhile.

<sup>136</sup> DOE Moscow Office, *Summary of DOE Programs in Russia*, op. cit., pp. 22–25. Increased cost estimates are from interviews with DOE officials, April 2004.

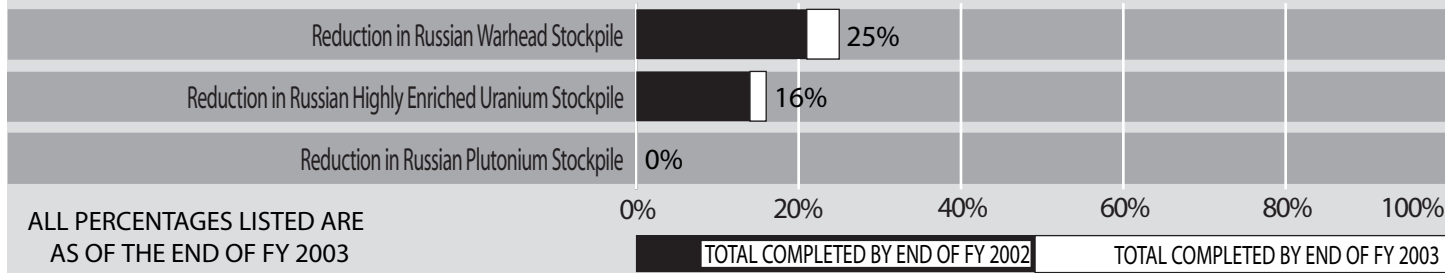
<sup>137</sup> See, for example, "Conference on Disarmament Adopts Programme of Talk," *Disarmament Diplomacy*, no. 76, (March/April 2004; available at <http://www.acronym.org.uk/dd/dd76/76news02.htm> as of May 6, 2004).

<sup>138</sup> See Bunn, "Plutonium Production Reactor Shutdown," op. cit. The current planned shutdown dates are in See DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 713.

<sup>139</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 469.

<sup>140</sup> Interviews with Department of Energy officials, March and April 2004.

**Figure 3-7**  
**How Much Reducing Work Have U.S.-Funded Programs Completed?**



## REDUCING NUCLEAR STOCKPILES

Key developments in this area included:

- The United States decided to allow the U.S.-Russian agreement on technical cooperation on plutonium disposition to expire in July 2003, rather than reaching a compromise on liability provisions. The liability dispute delayed the start of industrial-scale disposition of excess weapons plutonium in the United States and Russia by at least a year, and as of the spring of 2004, the expectation was that another year would be lost if agreement was not reached by June or July of 2004.
- No agreement on a multilateral approach to managing and financing plutonium disposition was concluded, despite continuing efforts.
- An additional 30 tons of HEU from Russian dismantled nuclear weapons was blended to LEU and shipped to the United States.

The metrics in this area are very simple—the fractions of the relevant stockpiles that have been reduced.

### **Reducing Metric 1: Reduction in Russian Warhead Stockpile**

**Fraction accomplished.** Although Nunn-Lugar is often thought of as a weapons dismantlement effort, the fact is that the United States has never paid for

the dismantlement of a single Russian nuclear warhead—because Russia and the United States have never been able to agree on the kind of monitoring measures the United States would require to ensure that the dismantlements it was paying for were really occurring. Nunn-Lugar does pay for shipments of warheads to dismantlement sites, and it routinely pays for the dismantlement of nuclear missiles, bombers, and submarines, but not for dismantlement of the warheads themselves.

Nevertheless, Russia has dismantled thousands of nuclear warheads since the collapse of the former Soviet Union. Under the Department of Defense’s nuclear warhead transportation program, the United States has paid for over 200 nuclear warhead shipments, typically carrying some 20–30 warheads each, either to central storage facilities or to dismantlement facilities.<sup>141</sup> The U.S.-Russian HEU Purchase Agreement has also provided a financial incentive to dismantle warheads, by arranging for the commercial sale of uranium blended from the HEU warheads contain. By the end of 2003, 200 tons of HEU had been blended down under this agreement; if we assume that, on average, Russian warheads contain 25 kilograms of HEU, this is the equivalent of more than 8,000 nuclear warheads.<sup>142</sup> Presumably a large fraction of the warheads transported to dismantlement facilities with U.S. assistance were the same as warheads dismantled to provide HEU for the HEU Purchase Agreement, and hence these figures should not be added together. What is unknown, however, is (a) how much of the

<sup>141</sup> Interview with DOD official, January 2004. See DTRA, “Nuclear Weapons Transportation,” no date (available at [http://www.dtra.mil/ctr/project/projrur/ctr\\_nuke\\_transportation.html](http://www.dtra.mil/ctr/project/projrur/ctr_nuke_transportation.html) as of May 3, 2004).

<sup>142</sup> U.S. Enrichment Corporation (USEC), “Status Report: U.S.-Russian Megawatts to Megatons Program” (Bethesda, Md.: USEC, September 2002; available at [http://www.usec.com/v2001\\_02/HTML/Megatons\\_status.asp](http://www.usec.com/v2001_02/HTML/Megatons_status.asp) as of May 3, 2004).

HEU blended down to date was from warheads dismantled even before the HEU Purchase Agreement was negotiated (whose dismantlement the agreement therefore could not take credit for), and (b) how many warheads Russia had when the agreement began. By some public estimates, Russia had some 32,000 warheads in 1993, when the HEU Purchase Agreement began, and has since reduced this figure to some 18,000.<sup>143</sup> If all of the HEU blended to date came from warheads dismantled in part as a result of this HEU deal (a generous assumption), then it could be argued that U.S. programs have contributed to the dismantlement of more than a quarter of the total stockpile of nuclear warheads that Russia had when the agreement began.

**Rate of progress.** Today, some 30 tons a year of HEU is being blended down under the HEU Purchase Agreement, representing the equivalent of some 1,200 warheads per year, roughly an additional 4% each year of the warheads Russia had when the HEU Purchase Agreement began. The HEU Purchase Agreement is currently scheduled to end in 2013. As there is no program in place to directly fund Russian warhead dismantlement, there is no planned completion date for such an effort.

### ***Reducing Metric 2: Reduction in Russian Highly Enriched Uranium Stockpile***

**Fraction accomplished.** As just noted, by the end of 2003, 201.5 metric tons of HEU had been destroyed (by blending it to low enriched uranium reactor fuel) as part of the U.S.-Russian HEU Purchase Agreement. In addition, by the end of FY 2003 some 4.3 tons of HEU had been destroyed as part of the Material Consolidation and Conversion (MCC) effort in DOE's MPC&A program.<sup>144</sup> This represents some 16% of the

over 1,200 tons of weapons-grade HEU equivalent Russia was believed to possess when the HEU deal began.<sup>145</sup>

**Rate of progress.** As already described, an additional 30 tons of HEU is currently being destroyed each year, representing roughly an additional 2% of the original Russian HEU stockpile. The program is currently scheduled to end in 2013, after 500 tons—some 40% of the original stockpile—has been blended. In addition, DOE plans to blend down 4 more tons in the MCC effort during FY 2004–2005.<sup>146</sup> Russia is also consuming some of its HEU stockpile as fuel for naval, icebreaker, research, and plutonium production reactors, and is using some for commercial production of LEU fuel from European reprocessed uranium.<sup>147</sup> To address a larger fraction of the stockpile more quickly, the blend-down of HEU should be substantially accelerated, and expanded well beyond the 500 tons initially agreed.

### ***Reducing Metric 3: Reduction in Russian Plutonium Stockpile***

**Fraction accomplished.** Years of effort and hundreds of millions of dollars of investment have been focused on laying the groundwork for disposition of excess weapons plutonium. But the program is not yet at the point where any substantial amounts of excess weapons plutonium have been used as reactor fuel or otherwise transformed into forms unsuitable for weapons use. Hence, the fraction accomplished to date in actually reducing the stockpile is zero.

**Rate of progress.** To date, the annual rate of progress in reducing excess plutonium stockpiles is also zero. The year 2003 was a difficult one for this effort as well, with the liability dispute leading to the

<sup>143</sup> See, for example, Robert S. Norris and William M. Arkin, "NRDC Nuclear Notebook: Global Nuclear Stockpiles, 1945–2000," *Bulletin of the Atomic Scientists* 56, no. 2 (March/April 2000; available at <http://www.thebulletin.org/issues/nukenotes/ma00nukenote.html> as of April 2, 2004); and Norris and Kristensen, "NRDC Nuclear Notebook: Russian Nuclear Forces 2003," *op. cit.*

<sup>144</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, *op. cit.*, p 446.

<sup>145</sup> This includes both HEU for weapons and HEU for naval fuel, research reactor fuel, and other purposes. See discussion in Bunn, "Unclassified Estimates of Russia's Plutonium and HEU Stockpiles—And World Civil Separated Plutonium Stockpiles: A Summary and Update," *op. cit.*

<sup>146</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, *op. cit.*, p 446.

<sup>147</sup> See discussion in Bunn, "Unclassified Estimates of Russia's Plutonium and HEU Stockpiles—And World Civil Separated Plutonium Stockpiles: A Summary and Update," *op. cit.*

expiration of the 1998 U.S.-Russian technical cooperation agreement, and blocking efforts to move toward construction of U.S. and Russian facilities to make reactor fuel from excess weapons plutonium. Since the 2000 Plutonium Disposition and Management Agreement has no liability provisions, the technical cooperation agreement was only agreement in force that provided the liability provisions and other details necessary for contracts for joint research and development of plutonium disposition technologies. Work can continue under contracts signed before the technical cooperation agreement expired, but no new contracts can be placed until the liability issue is resolved. The U.S. government is seeking a multilateral agreement on funding Russian plutonium disposition that would include liability and other relevant provisions, and could provide the basis for actual construction and operation of the large facilities required—but progress toward resolving these issues in that negotiation have been slow. The liability dispute has blocked even early steps that could be taken before an overall financing and management arrangement for Russian plutonium disposition is in place—including the transfer to Russia of the key design information for the plutonium fuel fabrication facility, which is to be a Russianized version of the U.S. design. As a result, construction of the U.S. and Russian plutonium fuel fabrication facilities has been pushed back by a year; in early 2004 DOE predicted that if the result was not resolved by April 2004, another year would be lost—but program officials now believe that they can avoid losing another year if the dispute is resolved by June or July of 2004.<sup>148</sup>

Efforts are still underway to pull together an international financing package. Despite the inclusion of plutonium disposition as one of the priorities in the \$20 billion G-8 Global Partnership, total pledges for the effort are still far below the roughly \$2 billion estimated cost of disposition of the 34 tons of Russian weapons plutonium covered by the 2000 agreement (let alone the larger cost of disposition of a much larger fraction of Russia's weapons plutonium, which

would be necessary if the effort was to make a significant difference in reducing the nuclear theft and rearmament threats this material poses) It seems clear that the decision to rely on an international funding approach, rather than paying for this effort with U.S. funds and allowing other nations to fund other priorities, has already delayed progress and will likely result in a more complex and less responsive management structure, reporting to multiple governments, in the future. Because of the uncertainties in international financing, DOE does not now even project a target date when the Russian plutonium disposition program might be finished.<sup>149</sup>

If both the liability problem and the international financing and management issues can be resolved quickly, DOE hopes that construction of the needed plutonium fuel facilities could begin in 2005, and be completed 3–4 years later.<sup>150</sup> Actual loading of substantial quantities of fuel made from excess weapons plutonium will probably not occur until 2009–2010. At the initial stage, current plans are to begin destroying approximately two tons per year of Russian excess weapons plutonium at that time, and then to attempt to increase this rate to four tons per year. Russia will carry out disposition of approximately 38 tons of separated plutonium under the U.S.-Russian Plutonium Disposition and Management agreement, including 34 tons of excess weapons plutonium and 4 tons of reactor-grade plutonium with which it will be blended, to maintain the confidentiality of the precise isotopic mix in Russia's weapons plutonium. If operations in fact began in 2010, and the four ton per year rate were achieved quickly, disposition of the material covered by this initial agreement could be completed in 2020–2021; if the program remained at two tons per year, disposition of this material would not be completed until 2029.

The 38 tons of material covered in this agreement, however, represents less than one-quarter of Russia's total stockpile of roughly 170 tons of separated plutonium (counting both weapons plutonium and

<sup>148</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., pp. 478–487, and interviews with DOE officials, March 2004.

<sup>149</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 480.

<sup>150</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., pp. 479–480.

weapons-usable civil plutonium).<sup>151</sup> Indeed, as Russia's plutonium production reactors continue to produce plutonium, and Russia continues to separate weapons-usable civilian plutonium as well, if these are not stopped in a timely way, a two-ton-per-year disposition program would effectively be running in place—eliminating as much plutonium every year as is produced every year.<sup>152</sup> If production were stopped, but disposition of all 170 tons of Russia's stockpile except the amount needed to sustain a stockpile of 10,000 warheads were included in the program, at four tons a year, completion of the plutonium disposition effort would stretch to 2040 (or beyond 2070 at two tons per year).

### **SUMMARY: HOW MUCH OF THE JOB IS DONE?**

Figure 3-8 summarizes what fraction of the job has been accomplished, when judged by the metrics described above for each of the six categories of effort. Also shown is the fraction of the job that was accomplished during FY 2003, to give an impression of the current rate of progress when judged by these metrics. There are substantial uncertainties in all of these estimates—even those based on official government data, since that data itself is uncertain.

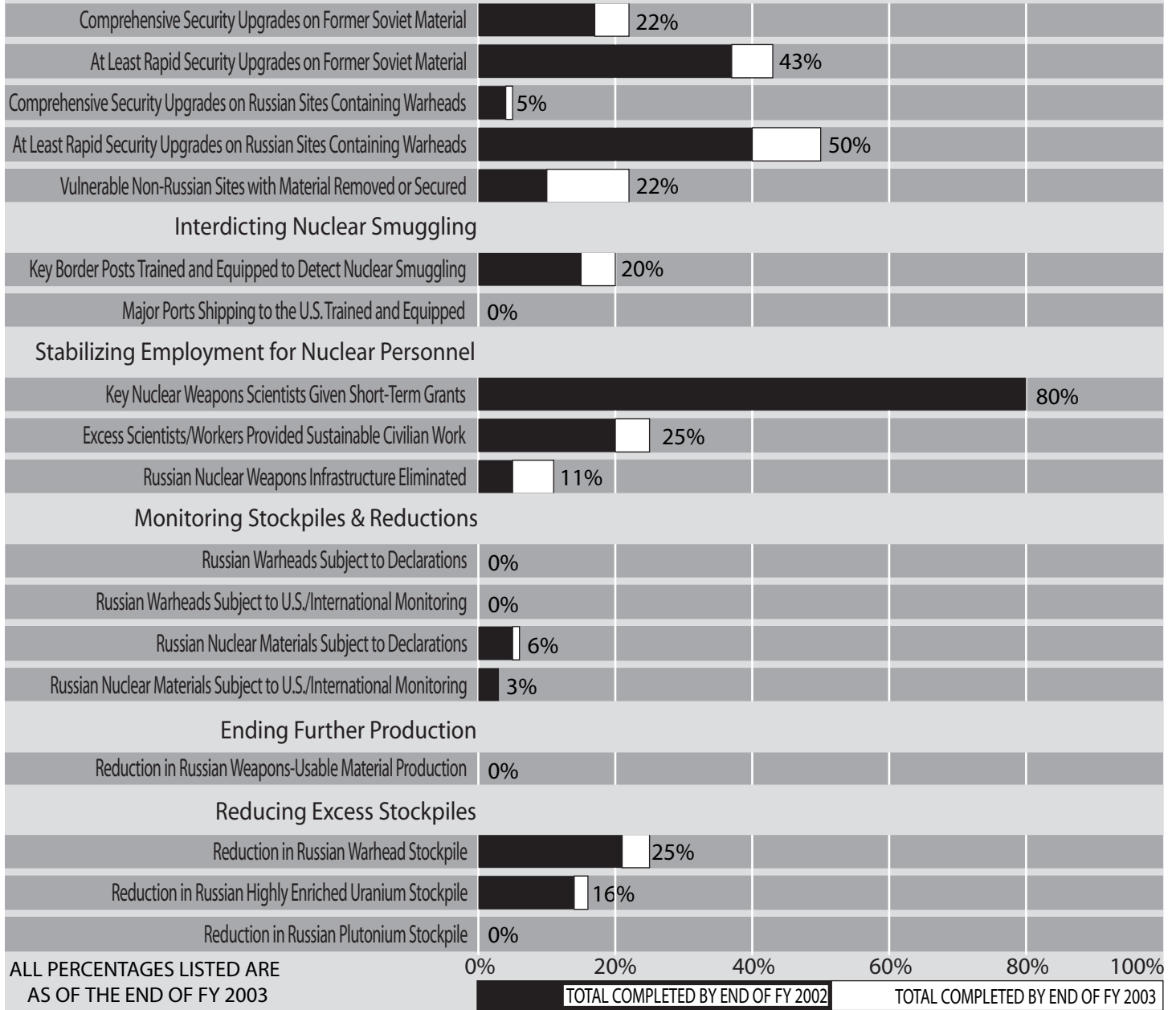
<sup>151</sup> Bunn, "Unclassified Estimates of Russia's Plutonium and HEU Stockpiles—And World Civil Separated Plutonium Stockpiles: A Summary and Update," *op. cit.*

<sup>152</sup> The plutonium production reactors continue to produce in the range of a ton of plutonium per year, and Russia's declarations of separated civilian plutonium have increased, on average, by 1.3 tons per year for the past several years. Thus, the total increase in separated plutonium stocks is in the range of 2.0–2.5 tons per year.

Overall, it is clear that while much has been accomplished in these efforts, across a broad range of metrics, much less than half of the job has yet been done, after more than a decade of threat reduction efforts. There remains too much grey space on this chart—grey space that represents thousands of insufficiently secure warheads, enough insecure nuclear material for tens of thousands more, and thousands of excess nuclear weapons scientists and workers not yet permanently redirected to civilian work. Most of the bars are only inching across that grey space. In most cases, the rate of progress even two years after the September 11 attacks remains so slow that if the current rate were continued, it would still be a decade or more before the job is done. Terrorists and thieves may not give the world the luxury of that much time.

In short, there remains a potentially deadly gap between the urgency of the threat and the scope and pace of U.S. efforts to address it. If nuclear weapons, materials, and expertise are to be prevented from falling into the hands of terrorist groups or hostile states, a substantially accelerated effort will be needed, focused on addressing the highest security priorities first.

**Figure 3-8**  
**Controlling Nuclear Warheads, Material, and Expertise:**  
**How Much Work Have U.S.-Funded Programs Completed?**





# 4 THE BUDGET PICTURE

Security for nuclear stockpiles around the globe is not a problem that can be solved solely by throwing more money at it. Unless sustained high-level political leadership succeeds in overcoming the other obstacles to progress, even large increases in budgets for many of these programs would not make much difference (with some important exceptions, discussed below). But if the non-monetary obstacles could be overcome, more money would surely be needed to carry out an expanded, strengthened, and accelerated effort.

Budgets, nonetheless, are one important signal about priorities. The budget changes over the last four years since the end of the Clinton administration offer important information about the real priority that the Bush administration and the Congress place on cooperative efforts to keep terrorists from getting their hands on the vast stockpiles of nuclear warheads, materials, and expertise that already exist around the world.

## TOTAL THREAT REDUCTION FUNDING

For the thirteen-year period from Fiscal Year (FY) 1992 through FY 2004, the United States Government budgeted approximately \$9.2 billion to the task of working cooperatively with other countries to dismantle and secure their weapons of mass destruction (WMD). Of that amount, roughly \$5.5 billion has been

for programs with a significant focus on reducing the threat posed by insecure nuclear warheads, material, and expertise.<sup>1</sup> The remainder has gone toward activities such as eliminating Russian chemical weapons stockpiles, destroying former Soviet weapons delivery systems, and dismantling the former Soviet biological weapons complex.

By comparison, the Department of Defense is requesting roughly the same total—\$9.2 billion—for FY 2005 alone to fund the Missile Defense Agency and its efforts to build a national missile defense system.<sup>2</sup> Beyond the accomplishments in nuclear security and threat reduction discussed elsewhere in this report, the \$9.2 billion budgeted for cooperative threat reduction efforts has been responsible for the destruction of some 500-plus intercontinental ballistic missiles, nearly 500 submarine-launched ballistic missiles, roughly 125 bombers, and over 25 strategic submarines.<sup>3</sup> After years of work and tens of billions of investment, Defense officials plan that this latest budget installment for the missile defense program will allow fielding an initial capability of 10–15 interceptors by late 2004.<sup>4</sup>

The Department of Defense (DOD) has accounted for \$4.8 billion of the \$9.2 billion in threat reduction funds. The Department of Energy (DOE) has set aside nearly \$3.4 billion for such work. The Department of

<sup>1</sup> The budget figures in this report come from data compiled for the “Interactive Budget Database,” *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, February 2004 (available at [http://www.nti.org/e\\_research/cnwm/overview/funding.asp](http://www.nti.org/e_research/cnwm/overview/funding.asp) as of April 29, 2004). Users can use this database to compile custom charts on the cooperative threat reduction goals, agencies, and programs of their choice. It is important to understand that these are the funds appropriated for the Departments of Defense, Energy and State to spend, not necessarily the total amount actually spent already. These totals might be thought of as the amounts Congress and the President have agreed to transfer from the government’s general fund to the checking accounts of these particular programs. These totals do not represent the total amount of checks written by these programs, nor the total of checks that have cleared the account.

<sup>2</sup> U.S. Department of Defense (DOD), “Under Secretary of Defense, Dov Zakheim Fiscal 2005 Briefing” (Washington, D.C., January 30, 2004; available at <http://www.defenselink.mil/transcripts/2004/tr20040130-0407.html> as of April 29, 2004).

<sup>3</sup> U.S. Defense Threat Reduction Agency (DTRA), “Cooperative Threat Reduction Scorecard” (Washington, D.C., December 31, 2003; available at [http://www.dtra.mil/ctr/ctr\\_score.html](http://www.dtra.mil/ctr/ctr_score.html) as of April 29, 2004).

<sup>4</sup> DOD, “Under Secretary of Defense, Dov Zakheim Fiscal 2005 Briefing,” op. cit.

**Table 4-1**  
**Proposed and Approved Funding Levels for All U.S. Cooperative Threat Reduction Efforts**

(US\$ in millions, by fiscal year)	FY 1992– FY 2002 Enacted	FY 2003 Final Enacted	FY 2004 President’s Budget	FY 2004 Final Enacted	FY 2005 President’s Budget	Change from FY 2004 Final	% Change from FY 2004 Final
Department of Energy <sup>1</sup>	2,377.7	536.2	464.4	442.0	484.9	42.9	9.7%
Department of Defense <sup>2</sup>	3,930.4	425.1	462.3	462.6	423.1	-39.5	-8.5%
Department of State <sup>3</sup>	751.4	131.7	164.0	145.8	153.0	7.2	4.9%
<b>Total</b>	<b>7,059.4</b>	<b>1,092.9</b>	<b>1,090.7</b>	<b>1,050.4</b>	<b>1,061.0</b>	<b>10.6</b>	<b>1.0%</b>

<sup>1</sup> In its own documents, the administration reports that it is requesting \$919 million in FY 2005 for cooperative nonproliferation programs as part the G-8 Global Partnership Against the Spread of Weapons of Mass Destruction, with \$439 million of that coming out of the Department of Energy. Our figure includes all programs with a cooperative threat reduction component for which information is available, regardless of whether that program is acting only in the former Soviet Union or elsewhere.

<sup>2</sup>The administration’s count for the Pentagon’s contribution in FY 2005 to the Global Partnership is \$409 million, though that estimate does not include, as we do, an estimated \$10 million for the International Counterproliferation program, or an estimated \$3.9 million for the Arctic Military Environmental Cooperation program.

<sup>3</sup>The administration also reports that it is requesting \$71 million for the State Department in FY 2005 for cooperative nonproliferation programs as part the G-8 Global Partnership. This figure includes only the parts of the Export Control and Related Border Security Assistance program and the Nonproliferation and Disarmament Fund expected to go towards work in the former Soviet Union, while our figure includes the entirety of these programs’ funding. The government figure also does not include, as we do, an estimated \$15 million for the Georgia Border Security and Law Enforcement program (which has some nonproliferation benefits), and an estimated \$14 million for the Civilian Research and Development Foundation.

State has been responsible for the remaining \$1 billion.

As Table 4-1 shows, the United States allocated nearly \$1.1 billion to fund cooperative threat reduction programs in FY 2004 (using a broad definition of threat reduction funds that includes some funds spent outside the former Soviet Union that the administration does not count toward its Global Partnership contribution). That level was a slight reduction from both the final FY 2003 level and the budget request submitted by the administration. As Table 4-1 also shows, the overall funding the administration is requesting for FY 2005 for all WMD cooperative threat reduction efforts is largely unchanged from the previous year. Beyond the funding shifts among programs focused on nuclear material and expertise (discussed below), the main shifts within this topline figure are a \$40 million reduction in new funding for the effort to build and operate a facility to destroy Russian chemical weapons, and an increase in DOE’s budgets that reflects an assumption that they will no longer use prior-year balances to finance FY 2005 activities.

Given its nuclear expertise, it is not surprising that DOE has budgeted the most for programs focused on controlling and securing other countries’ nuclear warheads, materials, and expertise. As Table 4-1 reveals, DOE has accounted for \$3.4 of the \$5.5 billion devoted to these activities. DOD has contributed \$1.4 billion (largely to help Russia secure its nuclear warheads and for construction of the Mayak Fissile Material Storage Facility), while the State Department has devoted around \$650 million (geared primarily toward improving other countries’ capacity to interdict nuclear and other WMD smuggling, and toward redirecting former Soviet WMD scientists to peaceful work).

For FY 2004 the administration received almost exactly the cumulative budget it requested for programs primarily focused on working with other countries to reduce the threat of unsecured nuclear warheads, material, and expertise. The budget being requested for FY 2005 is in turn only slightly changed from the final level of FY 2004, differing by just over \$8 million, or 1%.

**Table 4-2**

**Proposed and Approved U.S. Budgets for Controlling Nuclear Warheads, Material, and Expertise**

(US\$ in millions, by fiscal year)	FY 1992– FY 2002 Enacted	FY 2003 Final Enacted	FY 2004 President’s Budget	FY 2004 Final Enacted	FY 2005 President’s Budget	Change from FY 2004 Final	% Change from FY 2004 Final
Securing Warheads and Materials	2,254.5	280.0	309.4	317.7	310.0	-7.8	-2.5%
Interdicting Nuclear Smuggling	247.1	221.3	113.5	127.3	127.0	-0.3	-0.2%
Stabilizing Employment for Nuclear Personnel	616.3	105.1	114.0	105.0	106.5	1.5	1.5%
Monitoring Stockpiles and Reductions	124.1	34.8	35.6	35.2	38.9	3.7	10.4%
Ending Further Production	106.9	49.2	50.0	65.0	50.1	-14.9	-23.0%
Reducing Excess Stockpiles	666.1	47.1	73.1	48.0	74.0	26.0	54.2%
<b>Total<sup>1</sup></b>	<b>4,014.9</b>	<b>737.5</b>	<b>695.7</b>	<b>698.2</b>	<b>706.5</b>	<b>8.3</b>	<b>1.2%</b>

<sup>1</sup>The totals in this table are different from those in last year’s comparable Table 4.2 for two main reasons. First, supplemental funding for FY 2003 was added for the Second Line of Defense program in the Interdicting Nuclear Smuggling line after last year’s report went to print. Second, we have recalculated funding for programs in the Interdicting Nuclear Smuggling and Stabilizing Employment categories to capture the full amount of funding going to these programs anywhere in the world (not just the parts for the former Soviet Union) and to fully reflect the budget information that is publicly available.

Reflecting only a one percent increase over the FY 2004 level (meaning a slight decrease when inflation is taken into account), the administration’s budget proposal is a clear statement that it believes that the scope of efforts to control the threat posed by unsecured nuclear warheads, material, and expertise should not expand. The consistency in the budget for these activities contrasts with the continued budgetary increases for other national defense and homeland security endeavors, as will be discussed in a moment. For instance, the administration’s budget highlights as one of its top priorities its proposal to increase national defense funding by seven percent over last year, even excluding the money being devoted to military operations in Iraq and Afghanistan. The administration also touts its proposed 10 per-

cent increase in discretionary funding for homeland security.<sup>5</sup>

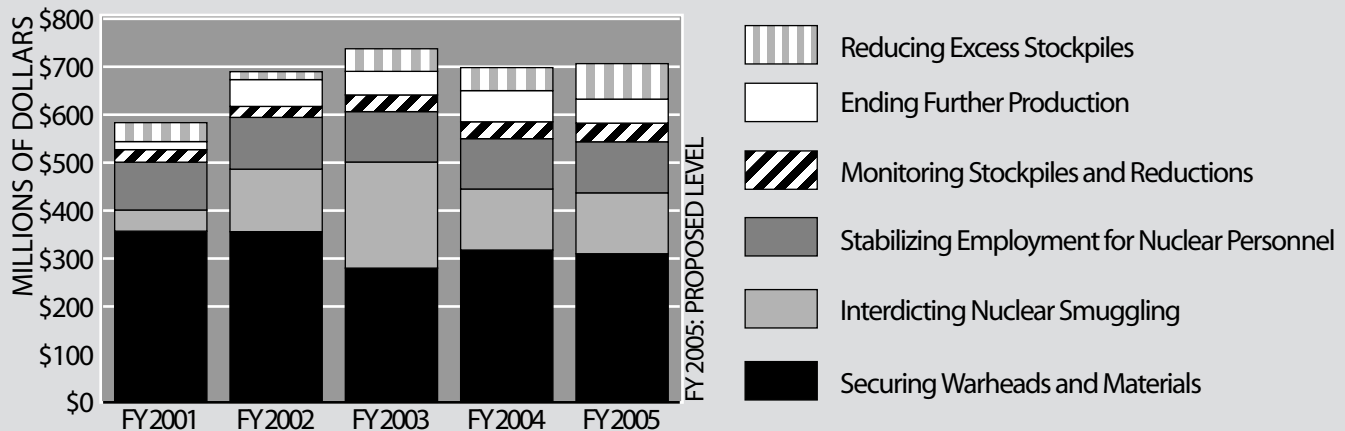
In fact, the increase that the administration is seeking for efforts to help other countries keep their vast stockpiles of existing nuclear weaponry, material, and expertise out of the hands of terrorists and other states is more in line with the 0.5 percent growth rate the administration wants for discretionary funding not related to defense and homeland security.<sup>6</sup> The administration’s FY 2005 budget proposal puts a clear priority on expanding and accelerating national defense and homeland security activities—but somehow does not include efforts to secure nuclear stockpiles and expertise around the world as part of those priorities.

<sup>5</sup>U.S. Office of Management and Budget (OMB), “Overview of the President’s FY 2005 Budget,” in *Budget of the United States Government, Fiscal Year 2005* (Washington, D.C.: OMB, February 2, 2004; available at <http://www.whitehouse.gov/omb/budget/fy2005/overview.html> as of February 17, 2004).

<sup>6</sup>OMB, “Overview of the President’s FY 2005 Budget,” *op. cit.*

**Figure 4-1**

**Shifts among Priorities for Controlling Nuclear Warheads, Materials, and Expertise since FY 2001**



Source: Authors' calculations, based on data in "Interactive Budget Database," Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials, February 2004 (available at [http://www.nti.org/e\\_research/cnwm/overview/funding.asp](http://www.nti.org/e_research/cnwm/overview/funding.asp) as of May 6, 2004).

**PROPOSED FY 2005 FUNDING FOR CONTROLLING NUCLEAR WARHEADS, MATERIALS, AND EXPERTISE**

The administration submitted a request for FY 2005 for programs focused on countering the threat posed by unsecured nuclear warheads, material, and expertise that in the aggregate increased by only \$8 million, or just over one percent. The most significant program changes include:

- A \$17 million increase in new funding for the Russian Plutonium Disposition program, reflecting a hope that the liability issue will soon be resolved and the program can begin moving toward construction;
- A decline in new funding for the program for the Elimination of Weapons Grade Plutonium Production, because in FY 2004 an extra \$15 million in old DOD funds became available to DOE, which

can be used to fund some of the planned FY 2005 activities;<sup>7</sup>

- An increase of \$10 million over the FY 2004 level approved by Congress for DOD's WMD Proliferation Prevention Initiative, which returns the funding level originally sought by the administration in FY 2004;
- A \$9 million increase, to \$10 million, for the DOE program to purchase HEU fuel from Russia for use in U.S. research reactors (and thereby reduce excess stockpiles of material in Russia);
- A proposed reduction of \$7 million to the portion of the Material Protection, Control, & Accounting (MPC&A) program that does not include the Second Line of Defense interdiction program; and,
- A \$6 million decline in new funding for the program to provide security for spent fuel from Kazakhstan's BN-350 reactor.<sup>8</sup>

<sup>7</sup>In essence, \$15 million had previously been appropriated to DOD years before, but its time limit had expired; Congress re-awarded the funds to DOE in FY 2004.

<sup>8</sup>The best sources for FY 2005 budget information are: OMB, *Budget of the United States Government, Fiscal Year 2005* (Washington, D.C.: OMB, February 2, 2004; available at <http://www.whitehouse.gov/omb/budget/fy2005/> as of April 29, 2004); Department of Energy, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, D.C.: DOE, February 2, 2004; available at <http://www.mbe.doe.gov/budget/05budget/content/defnn/nn.pdf> as of April 29, 2004); DTRA, *Cooperative Threat Reduction: Annual Report to Congress, Fiscal Year 2004* (DOD: Arlington, Va., January 2003; available at <http://armedservices.house.gov/reports/>

As Figure 4-1 shows, the FY 2005 budget continues a trend over the last four years, in which there has been a shift in the priorities among the various goals collectively aimed at reducing the threat of unsecured nuclear weapons, raw ingredients, and know-how. A somewhat smaller share of the budget resources have been directed away from the formerly dominant activity, that of securing the vast existing stockpiles of nuclear warheads and materials at their source, with a larger share going toward efforts to help other countries police in and around their borders to interdict the smuggling of nuclear (and other WMD) material, as well as toward programs aimed at reducing excess nuclear material stockpiles (largely with the program to dispose of Russia's excess weapons plutonium, but also through DOE efforts to reduce Russia's HEU stockpile beyond the commercial U.S.-Russian HEU Purchase Agreement).

### ***Securing Nuclear Warheads and Materials***

For this most critical part of the mission to control nuclear weapons and materials, the administration is requesting less new funding for FY 2005 than it received in FY 2004. Funding for this area in the FY 2005 request is at almost exactly the same level as in the FY 2004 request, before subsequent add-ons. The proposed FY 2005 funding is an increase from FY 2003, but is far below the roughly \$350 million provided in FY 2002, when Congress added supplemental funds in the immediate aftermath of the 9/11 terrorist attacks.<sup>9</sup>

Given the other constraints—particularly slow-downs caused by access disputes, bureaucratization on both sides, and other obstacles—more money alone would not be likely to lead to a substantial acceleration or

strengthening of the effort. But if intensive leadership succeeded in overcoming the non-monetary impediments to progress, more money *would* be needed to implement the accelerated effort we recommend.

Additional funds will also be needed to secure nuclear stockpiles not just in the former Soviet Union but around the world, as President Bush called for in his February 2004 speech on WMD policy to National Defense University.<sup>10</sup> The President gave this speech a week after his administration released a budget proposal that hardly increased available funds for securing nuclear warheads and materials—so significantly expanding to the rest of the world while staying within the administration's budget proposal would require reducing funds going to the ongoing efforts in the former Soviet Union.

There are four programs that collectively comprise the bulk of what DOE is currently doing to remove nuclear material from the most vulnerable sites around the world: the U.S. Reduced Enrichment for Research and Test Reactors (RERTR) program, the Russian Research Reactor Fuel Return program, the Global Nuclear Security program (a new DOE name for on-going efforts to help countries whose nuclear material is U.S.-supplied or who request review and assistance through the IAEA to improve security for their nuclear material), and the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program (which takes back some U.S.-origin HEU fuel provided to research reactors). To substantially accelerate the pace of such a "global cleanout" effort, additional funds for these separate programs—or for a single program subsuming each of these efforts, as we recommend—would be needed.

2003exereports/03-01-01ctr.pdf as of April 29, 2004); and U.S. Department of State, "Request by Appropriation Account: Bilateral Economic Assistance - Department of State (part 2)," in *FY 2005 Congressional Budget Justification for Foreign Operations* (Washington, D.C.: State Department, February 10, 2004; available at <http://www.state.gov/documents/organization/28971.pdf> as of April 29, 2004).

<sup>9</sup> For FY 2002 figures, see Table 4.3 from Matthew Bunn, Anthony Wier, and John Holdren, *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan* (Washington, D.C.: Nuclear Threat Initiative and Project on Managing the Atom, Harvard University, March 2003; available at [http://www.nti.org/e\\_research/cnwm/overview/report.asp](http://www.nti.org/e_research/cnwm/overview/report.asp) as of April 29, 2004), p. 52.

<sup>10</sup> President Bush, "Remarks by the President on Weapons of Mass Destruction, Fort Lesley J. McNair, National Defense University, Washington, D.C.," op. cit.

**Table 4-3**  
**U.S. Funding for Securing Nuclear Warheads and Materials**

(US\$ in millions, by fiscal year)	Dep't.	FY 2003 Final Enacted	FY 2004 President's Budget	FY 2004 Final Enacted	FY 2005 President's Budget	Change from FY 2004 Final	% Change from FY 2004 Final
Material Protection, Control, & Accounting	DOE	193.885 <sup>1</sup>	203.000 <sup>2</sup>	206.487 <sup>2</sup>	199.000 <sup>1</sup>	-7.487	-3.6%
Nuclear Weapons Storage Security - Russia	DOD	39.800	48.000	48.000	48.672	0.672	1.4%
Nuclear Weapons Trans- portation Security - Russia	DOD	19.600	23.200	23.200	26.300	3.100	13.4%
Reduced Enrichment for Research and Test Reactors (RERTR)	DOE	6.352	8.860 <sup>3</sup>	8.860 <sup>3</sup>	9.965	1.105	12.5%
Russian Research Reactor Fuel Return	DOE	9.520	9.691	9.691	9.866	0.175	1.8%
Global Nuclear Security	DOE	2.319 <sup>4</sup>	2.361 <sup>4</sup>	7.167 <sup>4</sup>	9.230	2.063	28.8%
Foreign Research Reactor Spent Nuclear Fuel Acceptance Program	DOE	0.440	6.062 <sup>5</sup>	6.062	4.918	-1.144	-18.9%
BN-350 Fuel Security	DOE	8.124	8.270	8.270	2.000	-6.270	-75.8%
Russia/NIS Safeguards Sustainability	DOE	0.000 <sup>6</sup>	0.000 <sup>6</sup>	0.000 <sup>6</sup>	0.000 <sup>6</sup>	0.000	N/A
<b>Total, Securing Nuclear Warheads and Materials</b>		<b>280.040</b>	<b>309.444</b>	<b>317.737</b>	<b>309.951</b>	<b>-7.786</b>	<b>-2.5%</b>

<sup>1</sup> Excludes Second Line of Defense funding.

<sup>2</sup> Excludes Second Line of Defense funding. Includes \$1 million for Accelerated Material Consolidation & Conversion (MCC) as part of Accelerated Material Disposition initiative.

<sup>3</sup> Includes \$3 million for RERTR from the Accelerated Material Disposition initiative.

<sup>4</sup> According to FY 2005 DOE Congressional Budget Justification, includes funding for program formerly known as "Russia/NIS Safeguards Sustainability," and for efforts to remove nuclear material from vulnerable sites.

<sup>5</sup> Detailed budget information on this program only became publicly available in the FY 2005 Congressional Budget Justification. It is assumed that the final level was the level requested for FY 2004.

<sup>6</sup> In FY 2005 DOE Congressional Budget Justification, DOE moved funding for this item to the new "Global Nuclear Security" program.

Expanded funding would also be needed to put in place security upgrades able to address more substantial threats;<sup>11</sup> to expand the program to cover additional nuclear warhead facilities; or to more rapidly address the most dangerous radiological materials.

<sup>11</sup> Currently, the MPC&A program is installing upgrades intended to be able to defeat fairly modest threats, such as a single insider attempting to steal material, or a small group of outsiders attacking a facility to steal material, or both working together. If a decision were taken to cooperate with Russia and other countries to secure nuclear facilities against more substantial threats, substantially more investment would be needed to secure each facility. In many cases, for example, the U.S. program has resisted funding some types of upgrades, such as perimeter intrusion, detection, and assessment systems (PIDAS), because they are judged to be too expensive, though this is changing slowly. Personal communications with U.S. laboratory participants, September 2002, and with DOE officials, September 2003 and January 2004.

**Table 4-4**  
**U.S. Funding for Interdicting Nuclear Smuggling**

(US\$ in millions, by fiscal year)	Dep't.	FY 2003 Final Enacted	FY 2004 President's Budget	FY 2004 Final Enacted	FY 2005 President's Budget	Change from FY 2004 Final	% Change from FY 2004 Final
Second Line of Defense	DOE	136.950 <sup>1</sup>	24.000 <sup>2</sup>	52.000 <sup>2</sup>	39.000 <sup>2</sup>	13.000	25.0%
WMD Proliferation Prevention	DOD	39.800	39.400	29.400	40.030	10.630	36.2%
Export Control and Related Border Security Assistance <sup>3</sup>	State	35.766	40.000	35.788	38.000	2.212	6.2%
International Counterproliferation	DOD	8.800	10.100	10.100	10.000 <sup>4</sup>	-0.100 <sup>4</sup>	-1.0% <sup>4</sup>
<b>Total, Interdicting Nuclear Smuggling</b>		<b>221.316</b>	<b>113.500</b>	<b>127.288</b>	<b>127.030</b>	<b>-0.258</b>	<b>-0.2%</b>

<sup>1</sup> Funding listed under the Material Protection, Control, & Accounting budget line item. Excludes \$2.194 million for Nuclear Assessment Program, which was transferred to the Department of Homeland Security.

<sup>2</sup> Funding listed under the Material Protection, Control, & Accounting budget line item.

<sup>3</sup> Funding for this program has been updated from last year's report to include all countries, and not just that directed at countries of the former Soviet Union, in recognition of the global nature of the proliferation problem.

<sup>4</sup> Estimated amount until the Department of Defense makes available more detailed information about its request.

## Interdicting Nuclear Smuggling

As highlighted by Figure 4-1, this goal has truly been the growth activity in the four years of the Bush administration. In FY 2001, the Second Line of Defense program had a budget of \$1.9 million, while the DOD's WMD Proliferation Prevention Initiative (aimed at helping non-Russian FSU border and internal security forces detect, deter, and interdict WMD trafficking) did not even exist.<sup>12</sup> After the FY 2003 peak of over \$220 million, total new funding for all the programs pursuing this goal is slated to fall back to \$127 million in FY 2005, still nearly three times the FY 2001 level.

The new funding has produced a great expansion in the number of countries with which the United States cooperates and in the depth of cooperation within those countries. In FY 2001, the Second Line of Defense program had just begun efforts to install radiation detection equipment at border crossings and ports of entry and exit in Russia and Ukraine, while the State Department's Export Control and Related Border Security (EXBS) Assistance program was active in fewer than 30 countries.<sup>13</sup> For FY 2005, the Second Line of Defense program hopes to have installed radiation detection equipment at nearly 100 sites inside and outside of the former Soviet Union, including six of the world's largest seaports, while maintaining equipment previously provided by the Departments

<sup>12</sup> DOE, *FY 2003 Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, D.C.: DOE, February 2002; available at <http://www.mbe.doe.gov/budget/03budget/content/defnn/nuclnonp.pdf> as of April 29, 2004), p. 124. Also, DTRA, *Fiscal Year (FY) 2003 Budget Estimates: Former Soviet Union Threat Reduction Appropriation (Cooperative Threat Reduction Program)* (DOD: Arlington, Va., February 2002; available at [http://www.dod.mil/comptroller/defbudget/fy2003/budget\\_justification/pdfs/operation/fy03\\_CTR.pdf](http://www.dod.mil/comptroller/defbudget/fy2003/budget_justification/pdfs/operation/fy03_CTR.pdf) as of April 29, 2004).

<sup>13</sup> U.S. Department of State, "Bilateral Economic Assistance - State and Treasury," in *FY 2003 Congressional Budget Justification for Foreign Operations* (Washington, D.C.: State Department, April 15, 2002; available at <http://www.state.gov/documents/organization/9467.pdf> as of April 29, 2004), pp. 105–106.

**Table 4-5**  
**U.S. Funding for Stabilizing Employment for Nuclear Personnel**

(US\$ in millions, by fiscal year)	Dep't.	FY 2003 Final Enacted	FY 2004 President's Budget	FY 2004 Final Enacted	FY 2005 President's Budget	Change from FY 2004 Final	% Change from FY 2004 Final
International Science and Technology Centers/ BW Redirection	State	52.000 <sup>1</sup>	59.000 <sup>1</sup>	50.202 <sup>1</sup>		N/A	N/A
Nonproliferation of WMD Expertise	State				50.500 <sup>2</sup>	0.298	0.6%
Russian Transition Initiatives	DOE		40.000 <sup>3</sup>	39.764 <sup>3</sup>	41.000 <sup>3</sup>	1.236	3.1%
Initiatives for Proliferation Prevention	DOE	22.439	0.000 <sup>3</sup>	0.000 <sup>3</sup>	0.000 <sup>3</sup>	N/A	N/A
Nuclear Cities Initiative	DOE	16.639	0.000 <sup>3</sup>	0.000 <sup>3</sup>	0.000 <sup>3</sup>	N/A	N/A
Civilian Research and Development Foundation	State	14.000 <sup>4</sup>	15.000 <sup>4</sup>	15.000 <sup>4</sup>	15.000 <sup>4</sup>	0.000 <sup>4</sup>	0.0% <sup>4</sup>
<b>Total, Stabilizing Employment for Nuclear Personnel</b>		<b>105.078</b>	<b>114.000</b>	<b>104.966</b>	<b>106.500</b>	<b>-1.534</b>	<b>-1.5%</b>

<sup>1</sup> Budget information does not show enough detail to provide component targeted at nuclear weapons scientists and engineers.

<sup>2</sup> Replaces budget item called "International Science and Technology Centers/BW Redirection." Budget information does not show enough detail to provide component targeted at nuclear weapons scientists and engineers.

<sup>3</sup> DOE and congressional documents combine amounts for the Nuclear Cities Initiative and the Initiatives for Proliferation Prevention into the Russian Transition Initiatives line item. In the past, about 2/5 of funding has gone to NCI and about 3/5 to IPP.

<sup>4</sup> Estimated amount, until further information is made available by the State Department.

of Defense and State in at least 25 countries.<sup>14</sup> Meanwhile, the State Department is looking to cooperate with over 40 countries in FY 2005.<sup>15</sup>

### **Stabilizing Employment for Nuclear Personnel**

There is little doubt that if the United States wishes to have any significant impact on the economic future of the ten entire cities in Russia where most of Russia's nuclear materials and nuclear personnel reside, it will have to allocate more than \$40 million a year to the task (the proposed budget for the "Russia Transition Initiatives," comprising both the Nuclear Cities Initiative and Initiatives for Proliferation Prevention). This

amount is simply not enough to have more than a marginal effect on the outcome of these cities, and their inhabitants, wrenching transition away from nuclear weapons work. Here, too, however, the issue is much more than money—as we discussed in detail in our March 2003 report, fundamental reforms of these efforts and sustained political leadership to push them forward will be needed if the mission of providing a viable alternative is to be accomplished.<sup>16</sup>

Meanwhile, as described in the last chapter, the administration decided to allow the U.S.-Russian agreement governing the Nuclear Cities Initiative to expire in September 2003, because of a dispute over liability

<sup>14</sup> DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., pp. 445–454; also, DTRA, *Cooperative Threat Reduction: Annual Report to Congress, Fiscal Year 2004*, op. cit., pp. 80–81.

<sup>15</sup> U.S. Department of State, "Request by Appropriation Account: Bilateral Economic Assistance - Department of State (part 2)," op. cit., pp. 129–133.

<sup>16</sup> See Bunn, Wier, and Holdren, "Stabilizing Nuclear Employment for Nuclear Personnel," in *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan*, op. cit., pp. 141–146.



**Table 4-6**  
**U.S. Funding for Monitoring Weapons and Warhead Stockpiles and Reductions**

(US\$ in millions, by fiscal year)	Dep't.	FY 2003 Final Enacted	FY 2004 President's Budget	FY 2004 Final Enacted	FY 2005 President's Budget	Change from FY 2004 Final	% Change from FY 2004 Final
HEU Transparency Implementation	DOE	17.118 <sup>1</sup>	18.000	17.894 <sup>1</sup>	20.950	3.056	17.1%
Warhead Dismantlement Transparency	DOE	16.150 <sup>1</sup>	16.141	15.814 <sup>1</sup>	16.431	0.617	3.9%
Trilateral Initiative	DOE	1.500 <sup>2</sup>	1.500 <sup>2</sup>	1.500 <sup>2</sup>	1.500 <sup>2</sup>	0.000	0.0%
<b>Total, Monitoring Stockpiles and Reductions</b>		<b>34.768</b>	<b>35.641</b>	<b>35.208</b>	<b>38.881</b>	<b>3.673</b>	<b>10.4%</b>

<sup>1</sup> Updated to reflect allocation specified in FY 2005 DOE Congressional Budget Justification.

<sup>2</sup> While funding for this activity is embedded in a larger budget line item, in recent years, this project has been funded at approximately \$1.5 million per year. *Source:* William Hoehn, III, Russian American Nuclear Security Advisory Council.

provisions. Projects launched before the agreement expired will continue, however, and both sides have expressed a willingness to revive the initiative with new projects if the liability issue is eventually resolved.

The International Science and Technology Centers, meanwhile, are another area where increased funding could lead directly to increased progress: they have a backlog of projects that would employ former weapons of mass destruction experts, and have been approved as worthy and meeting the Centers' objectives, but remain unfunded due to insufficient budgets.

### **Monitoring Stockpiles and Reductions**

Here, the most critical issues blocking or delaying progress are almost entirely policy issues—in most cases more money for these efforts would not bring much additional progress unless those policy issues were resolved. As we discussed in our March 2003 report, however, success in putting in place a declarations and monitoring regime to build confidence that

agreed reductions are being implemented, that nuclear stockpiles are safe and secure, and that assistance funds are being used appropriately, is likely to require providing substantial incentives for Russian agreement—strategic or financial. For example, funding would be needed were the United States to provide assistance for warhead dismantlement, as proposed in the March 2003 report, in return for agreement on measures to confirm that the dismantlement was taking place, without compromising classified information.<sup>17</sup>

### **Ending Further Production**

As discussed in the previous chapter, the United States is providing funding to build fossil power plants to replace Russia's three remaining plutonium production reactors, so that these can shut down. The Department of Energy expects that two of these reactors will shut down in 2008, and the last one in 2011.<sup>18</sup> For the moment, DOE is flat-lining the budget for this effort at \$50 million per year, which is a substantial factor slowing progress toward shutting down the last

<sup>17</sup> See Bunn, Wier, and Holdren, "Monitoring Stockpiles and Reductions," in *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan*, op. cit. pp. 147–150.

<sup>18</sup> Under current plans, the two plutonium production reactors at Seversk would shut by 2008, and the one at Zheleznogorsk by 2011. DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., pp. 467–476. This represents a delay of one year for Seversk and 3 years for Zheleznogorsk, compared to projections as recently as May 2002. (Personal communication from James Mulkey, program manager, May 2002.)

**Table 4-7**  
**U.S. Funding for Ending Further Production of Weapons-Usable Nuclear Material**

(US\$ in millions, by fiscal year)	Dep't.	FY 2003	FY 2004	FY 2004	FY 2005	Change from	% Change
		Final Enacted	President's Budget	Final Enacted	President's Budget	FY 2004 Final	from FY 2004 Final
Elimination of Weapons Grade Plutonium Production	DOE	49.221 <sup>1</sup>	50.000	65.035 <sup>2</sup>	50.097	-14.933	-23.0%
<b>Total, Ending Further Production</b>		<b>49.221</b>	<b>50.000</b>	<b>65.035</b>	<b>50.097</b>	<b>-14.938</b>	<b>-23.0%</b>

<sup>1</sup> \$0.2 million in FY 2000 funds transferred to DOE from DOD expired, and were reappropriated to DOE in FY 2003.

<sup>2</sup> \$15.3 million in FY 2001 funds transferred to DOE from DOD expired, and were reappropriated to DOE in FY 2004 by National Defense Authorization Act of FY 2004.

reactor. The total cost of the effort had been projected at less than \$500 million, but recent cost estimates for building the fossil replacement plants are substantially higher than previous figures.<sup>19</sup>

### **Reducing Excess Stockpiles**

Here, too, there is a mixed picture: in essence, the current budget provides sufficient funds for current approaches, but not enough to pursue new, faster ways of getting the job done.

As discussed in the previous chapter, the program to reduce Russia's excess plutonium stockpile has been delayed for years by a variety of factors, ranging from disputes over liability provisions to the decision to rely on international financing of the effort rather than having the United States pay for this effort while other countries focused their Global Partnership contributions on other areas. Either a U.S. commitment to pay the full cost, or serious exploration of some of the other approaches that could accelerate the effort (such as a U.S. purchase of Russia's excess plutonium, comparable to the purchase of Russia's excess HEU, with subsequent use as reactor fuel or immobilization) would require greater U.S. funding commitments.<sup>20</sup>

For HEU, as we discussed in our March 2003 report, sufficient funds are in place to carry out the current approaches to disposition of U.S. HEU, and for the purchase of Russian HEU (which is financed primarily through commercial means rather than government expenditure). To its credit, in FY 2004 the administration requested \$30 million for accelerated purchases of excess HEU from Russia—enough for a modest increase in the pace of such purchases, amounting to roughly a 5% addition to the 30 tons per year already being purchased. But, as noted above, Congress, led by the House, summarily rejected the centerpiece of this effort, a \$25 million proposal to purchase roughly 1.5 metric tons of Russian HEU and blend it to commercial grade low enriched uranium (LEU)—the first step in a proposed ten-year program to create a strategic stockpile of LEU from some 15 metric tons of HEU, to fuel U.S. reactors in the event of a supply disruption.<sup>21</sup>

In its initial report on the FY 2004 spending bill, the House Appropriations Committee objected that the proposal carried "a ten-year projected cost estimate of \$710 million to \$1.13 billion in order to eliminate an additional 15 Metric Tons (MT) of excess HEU in Russia. Under the existing 1993 HEU/LEU Purchase

<sup>19</sup> Interviews with DOE officials, March and April, 2003.

<sup>20</sup> For recommendations both on strengthening the current approach and exploring alternative or complementary approaches to disposition of excess weapons plutonium, see See Bunn, Wier, and Holdren, "Monitoring Stockpiles and Reductions," in *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan*, op. cit., pp. 156–161.

<sup>21</sup> DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, D.C.: DOE, February 12, 2003; available at <http://www.mbe.doe.gov/budget/04budget/content/defnn/nn.pdf> as of April 29, 2004), pp. 733–741.

**Table 4-8**  
**U.S. Funding for Reducing Excess Stockpiles of Weapons-Usable Nuclear Material**

(US\$ in millions, by fiscal year)	Dep't.	FY 2003 Final Enacted	FY 2004 President's Budget	FY 2004 Final Enacted	FY 2005 President's Budget	Change from FY 2004 Final	% Change from FY 2004 Final
Russian Plutonium Disposition	DOE	33.781 <sup>1</sup>	47.100	46.975	64.000	17.025	36.2%
HEU Reactor Fuel Purchase	DOE	12.420	1.000	1.000	10.000	9.000	900.0%
HEU/LEU Purchase and Stockpile	DOE	0.894	25.000	0.000	0.000	0.000	N/A
<b>Total, Reducing Excess Stockpiles</b>		<b>47.095</b>	<b>73.100</b>	<b>47.975</b>	<b>74.000</b>	<b>26.025</b>	<b>54.2%</b>

<sup>1</sup> Excludes \$64M in planned expenditures from carryover balances from FY 1999 Emergency Supplemental of \$200M.

Agreement, 30 MT per year are presently being eliminated by downblending to low enriched uranium at no cost to the taxpayer."<sup>22</sup> The committee's analysis was incorrect on several counts. First, the total cost was not likely to be anything remotely resembling their figures: at current prices, the price of the LEU derived from 15 tons of Russian HEU would be in the range of \$300 million, not two to four times that figure. Second, the proposal was intended to achieve a fundamentally different purpose than the commercial purchase now underway—destroying HEU that the market was not yet able to accept, and building up a stockpile of LEU to ensure that fuel would be available for U.S. reactors in the event of a supply disruption. Third, the U.S. government would have recouped its investment if there ever were a supply disruption and the material were sold to commercial reactor operators—so the real cost of the effort would be the interest on the initial investment until the material was sold. Fourth, if funded, this modest initial effort could have provided the basis for negotiation of a much larger and more cost-effective effort in which, rather than the U.S. government buying LEU from Russia outright and paying its full commercial value, the U.S. government might pay Russia a fee for service to blend HEU to LEU, eliminating the proliferation risks posed by the HEU, and

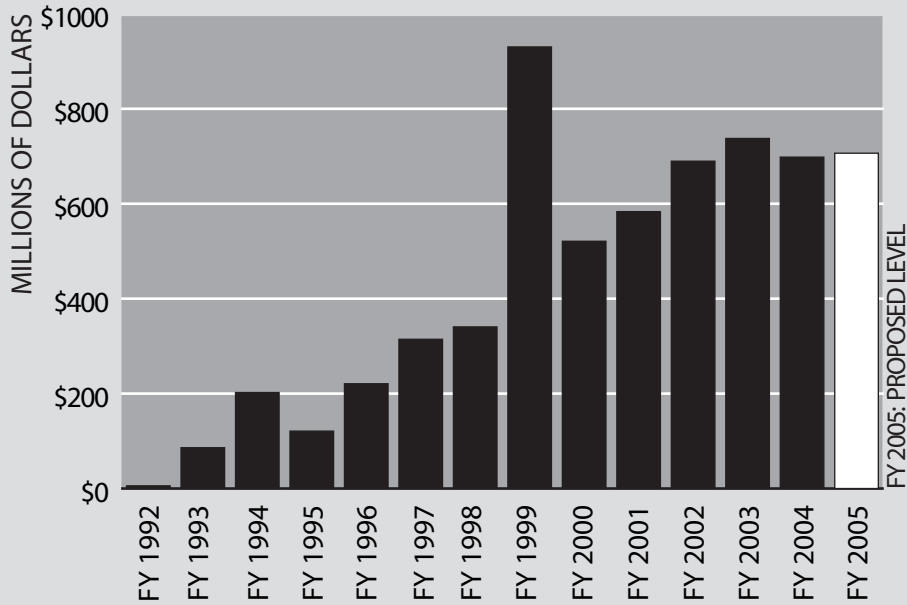
store it in Russia until the market was ready for its commercial sale. The cost of blending is probably a small fraction of the commercial value of the LEU; experts from Russia's Federal Agency for Atomic Energy (FAAE) are now studying this question in detail in a project funded by the Nuclear Threat Initiative. Fifth, it is not correct to say that the ongoing HEU Purchase Agreement has been conducted at no cost to the taxpayer: some \$10–20 million is appropriated every year to monitor the blending (going back to 1994), \$325 million was appropriated in 1999 to stabilize the purchase agreement, and the sale price the government received when it privatized the U.S. Enrichment Corporation in 1998 was hundreds of millions of dollars lower than it would have been had the HEU Purchase Agreement never existed.

If concerns in the United States and Russia could be overcome, a large-scale acceleration of the blend-down rate, as proposed in detail in our report last year, would require significant additional funding. Destroying an additional 300 tons of Russian HEU, for example, might cost \$300–\$600 million, or more if financial incentives beyond paying the blending cost to the Russian government were needed to seal an agreement.<sup>23</sup>

<sup>22</sup> U.S. House of Representatives, *Energy and Water Development Appropriations Bill, FY 2004*, 108<sup>th</sup> Congress, H. Rept. 108-212 (July 15, 2003; available at <http://thomas.loc.gov/cgi-bin/cpquery/z?cp108:hr212:as> as of April 29, 2004).

<sup>23</sup> See Matthew Bunn, "The Cost of Rapid Blend-Down of Russian HEU," July 11, 2001; see also Robert L. Civiak, *Closing the Gaps: Securing High Enriched Uranium in the Former Soviet Union and Eastern Europe* (Washington, D.C.: Federation of American Scientists, May 2002; available at <http://www.fas.org/ssp/docs/020500-heu/full.pdf> as of January 14, 2003).

**Figure 4-2**  
**Historical U.S. Budgets for Controlling Nuclear Warheads, Material, and Expertise**



Note: FY 1999 includes one-time funding of \$325 million added by the FY 1999 Omnibus and Supplemental Appropriations Act to buy natural uranium to solidify the HEU Purchase Agreement, and a one-time appropriation of \$200 million, which is still being drawn upon, to support Russian plutonium disposition.

Source: Authors' calculations, based on data in "Interactive Budget Database," Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials, February 2004 (available at [http://www.nti.org/e\\_research/cnwm/overview/funding.asp](http://www.nti.org/e_research/cnwm/overview/funding.asp) as of May 6, 2004).

## SHIFTS IN FUNDING PRIORITIES OVER THE LAST FOUR YEARS

With its budget proposal for FY 2005, the current administration has now submitted four years' worth of budget requests to Congress, thus creating a useful data set for examining the shifts in funding priorities since the administration took office. Since FY 2001, which was the last budget approved under the watch of the Clinton administration, Congress and the Bush administration have greatly increased both their rhetorical emphasis on, and the budgets for, national defense, homeland security, and the struggle against global terrorism.

As Figure 4-2 shows, the budgets appropriated for securing nuclear warheads, material, and expertise,

since President Bush came to office (FY 2002–2004) have been the highest ever (excluding the exceptional FY 1999, which included one-time appropriations of \$325 million to stabilize the U.S.-Russian HEU Purchase Agreement and \$200 million for the Russian plutonium disposition that continues to be used by DOE to fund current operations).<sup>24</sup>

But these budgets came in the context of the aftermath of the 9/11 attacks. (Indeed, prior to the attacks, and before even carrying out its policy review, the administration had attempted to significantly cut funding for several of these efforts.) Since those attacks, military and homeland security spending have surged, while spending for more cooperative efforts to deal with the nuclear terrorist threat at its source

<sup>24</sup> *Omnibus Appropriations Bill for FY 1999*, Public Law 277, 105<sup>th</sup> Congress (October 21, 1998; available at <http://thomas.loc.gov/cgi-bin/bdquery/z?d105:HR04328:ENR> as of April 29, 2004), Division B, Chapter 2.

have not grown at anything resembling a comparable pace.

For national defense, for international assistance, and especially for homeland security funding, there was a distinct departure from the past in the budget years following September 11, 2001 (which was at the close of FY 2001). After that date, the Bush administration and the Congress have clearly set as their top spending priorities fighting a global war on terrorism, securing the homeland of the United States, fighting wars in Afghanistan and Iraq, and then helping to stabilize those two nations.<sup>25</sup>

For example, for the budgets actually received (for FY 2002–2004) or proposed (for FY 2005), even adjusting for inflation, appropriations for non-Defense Department homeland security activities have been 106% higher for the entire period than they would have been if the final FY 2001 budget for those programs had been kept constant in real terms, growing only with inflation.<sup>26</sup> In other words, appropriations for homeland security have more than doubled compared to their pre-9/11 levels. For international assistance (including funds to help rebuild Iraq and Afghanistan), the total resource level from FY 2002–2005 is almost 70% higher than it would have been if the FY 2001 budget had been kept constant in real terms. For national defense, largely because it started from such a high FY 2001 level (almost \$307 billion dollars for the year), the total allocation for FY 2002 through FY 2005 was 25% higher than it would have been if Congress and the President had simply stuck to the FY 2001 resource level in real terms. And the final defense budget for FY 2005 is certain to rise, as the initial budget proposal of the administration for FY 2005 omitted funding for Iraq and Afghanistan war operations and reconstruction. The administration originally announced its intention to wait until

January 2005 before submitting the supplemental request to Congress, but in early May administration officials requested that Congress provide \$25 billion to bridge an anticipated funding shortfall from the beginning of the fiscal year in October through January.<sup>27</sup> In real terms, U.S. military spending is now well above its average Cold War levels.<sup>28</sup>

The budgets for efforts to control nuclear warheads, material, and expertise, for FY 2002–2005 have been 16% higher in real terms than if these programs had simply been left at the inflation-adjusted FY 2001 level—a significantly smaller increase. And this 16% increase was for a group of programs dwarfed in overall size by the other categories that received such large increases: the total FY 2002–2005 resource level for programs working to control nuclear warheads, materials, and expertise is 32 times smaller than the total resources for international assistance, 40 times smaller than the combined homeland security funding level, and 574 times smaller than the total national defense budget. Just the increase in total resources over the FY 2001 base for international assistance was 14 times larger than the total devoted to securing and reducing the nuclear stockpiles over those four years.

What is more, the main increase came in FY 2002 in the immediate aftermath of the 9/11 attacks. Since that time, budgets for these efforts have remained essentially level, while the budgets for other critical national security endeavors have continued to grow.

<sup>25</sup> U.S. House of Representatives, Committee on Appropriations, “Highlights of the War Supplemental Conference Report,” October 29, 2003 (available at <http://appropriations.house.gov/> as of February 18, 2004).

<sup>26</sup> This and the other figures in the following discussion are from authors’ calculations, based on data in “Interactive Budget Database,” *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, February 2004 (available at [http://www.nti.org/e\\_research/cnwm/overview/funding.asp](http://www.nti.org/e_research/cnwm/overview/funding.asp) as of April 29, 2004), and OMB, *The Budget for Fiscal Year 2005, Historical Tables*, op. cit.

<sup>27</sup> DOD, “Under Secretary of Defense, Dov Zakheim Fiscal 2005 Briefing,” op. cit. Joseph J. Schatz, “Bush Admits Higher War Cost With Request for \$25 Billion,” *CQ Weekly* (May 8, 2004), p. 1084.

<sup>28</sup> OMB, *The Budget for Fiscal Year 2005, Historical Tables*, op. cit., Table 3.1.

## COMPARISON OF BUSH ADMINISTRATION AND CONGRESSIONAL FUNDING PRIORITIES

### FY 2002

In its initial days in office, the administration questioned even the resource level for these efforts that existed at that time, proposing a budget for activities focused on reducing the threat of unsecured nuclear weapons, raw ingredients, and know-how of roughly \$465 million, or some 20 percent below the FY 2001 level.<sup>29</sup> In the aftermath of the 9/11 attacks, Congress provided hundreds of millions of dollars to programs intended to address various aspects of the risk that weapons of mass destruction would fall into terrorist hands, and the administration ultimately acquiesced.<sup>30</sup> It was in fact the Senate that led the charge to both restore funding to its FY 2001 level, and include additional funding in supplemental appropriations to speed efforts to prevent extant nuclear material and expertise from falling into the hands of terrorists.

<sup>29</sup> Authors' calculations, based on data from "Interactive Budget Database," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, op. cit., and described in detail in Matthew Bunn, John P. Holdren, and Anthony Wier, *Securing Nuclear Warheads and Materials: Seven Steps for Immediate Action* (Washington, D.C.: Nuclear Threat Initiative and Project on Managing the Atom, Harvard University, May 2002; available at [http://www.nti.org/e\\_research/securing\\_nuclear\\_weapons\\_and\\_materials\\_May2002.pdf](http://www.nti.org/e_research/securing_nuclear_weapons_and_materials_May2002.pdf) as of April 29, 2004), pp. 15–23. Also, William Hoehn, "Analysis of the Bush Administration's Fiscal Year 2002 Budget Requests for U.S.-Former Soviet Union Nuclear Security: Department of Energy Programs," *Russian American Nuclear Security Advisory Council* (August 10, 2001; available at <http://www.ransac.org> as of April 29, 2004).

<sup>30</sup> See, for example, David Broder, "Good News on Nukes," *Washington Post*, December 23, 2001. For an account of the final spending picture after these amounts were approved, see William Hoehn, "Preliminary Report: Anticipated FY 2003 Budget Request for Department of Energy Cooperative Nuclear Security Programs in Russia," *Russian American Nuclear Security Advisory Council* (January 9, 2002; available at <http://www.ransac.org> as of April 29, 2004). Also, see our discussion in Bunn, Holdren, and Wier, *Seven Steps for Immediate Action*, op. cit., pp. 15–23.

<sup>31</sup> The White House, Office of Press Secretary, "Fact Sheet: Administration Review of Nonproliferation and Threat Reduction Assistance" (Washington, D.C., December 27, 2001; available at <http://www.whitehouse.gov/news/releases/2001/12/20011227.html> as of April 29, 2004).

<sup>32</sup> For a damning post mortem on the overall FY 2003 budget process, see Stan Collender, "Budget Battles: Rock Bottom," *GovExec.com* (November 6, 2002; available at <http://www.govexec.com/dailyfed/1102/110602bb.htm> as of April 29, 2004). The Library of Congress' *Thomas* website presents a useful summary page of appropriations actions for the FY 2003 budget, at Library of Congress, "Status of FY 2003 Appropriations Bills," *Thomas: Legislative Information on the Internet* (available at <http://thomas.loc.gov/home/approp/app03.html> as of April 29, 2004). *Consolidated Appropriations Resolution, 2003*, Public Law 7, 108<sup>th</sup> Congress, 1<sup>st</sup> Session (February 20, 2003; available at <http://thomas.loc.gov/cgi-bin/query/z?c108:H.J.RES.2.ENR>: as of April 29, 2004). Department of Energy programs are dealt with in Division D of the bill; the State Department's nonproliferation programs are dealt with in Division E. Also see U.S. House of Representatives, *Conference Report to Accompany House Joint Resolution 2, Making Further Continuing Appropriations for Fiscal Year 2003, and for Other Purposes*, 108<sup>th</sup> Congress, H. Rept. 108-10 (February 12, 2003; available at <http://thomas.loc.gov/cgi-bin/cpquery/z?cp108:hr10>: as of April 29, 2004).

### FY 2003

The administration did shift away from its initial stance, releasing in December 2001 the results of its review of threat reduction programs, which endorsed most of them and called for expansions of some.<sup>31</sup> The administration's FY 2003 budget proposal would have funded these programs at a level slightly above that of FY 2001—but it still represented an attempt to cut the budgets to a point well below what Congress had called for in FY 2002, after the 9/11 attacks (if supplemental appropriations are included). Later, in mid-2002, the administration committed to continuing to invest \$1 billion a year for all WMD cooperative threat reduction efforts for another decade, as a part of the Global Partnership—and the other members of the Group of Eight (G-8) industrialized democracies agreed in principle to match that annual investment.

For the initial appropriation request for FY 2003, the 107th Congress at first approved the administration's proposal, but then it failed because of partisan budget gridlock to pass into law final versions of the Department of Energy and State budgets until February 2003, after a third of the fiscal year had passed.<sup>32</sup> This

final bill agreed to by Congress only slightly modified the administration's original budget proposal.

Then, in late March 2003 (just over a month after the final FY 2003 appropriation bill was passed), the administration submitted a request for approximately \$75 billion in supplemental appropriations to finance military operations in Iraq, to increase homeland security spending, and to provide international assistance for post-war Iraq and other countries.<sup>33</sup> The administration's initial request did not include any new funding for controlling nuclear warheads and materials, nor did the House of Representatives initial bill.

The Senate, on the other hand, pushed to include funding for various cooperative nonproliferation efforts. After the Senate Appropriations Committee included \$55 million in new funds for securing nuclear materials and weapons and for interdicting nuclear smuggling outside the former Soviet Union, the full Senate, led by Senators Reid (D-NV) and Domenici (R-NM), adopted a package that included \$150 million for nonproliferation activities (an initial \$300 million package submitted by Reid and others failed to win support).<sup>34</sup> Over half of the money (\$84 million) was directed to be spent on developing and deploying nuclear detectors at overseas ports to intercept smuggled nuclear material before it reaches U.S. shores.

The \$79 billion final compromise was signed into law on April 16, 2003. It included \$148 million in supplemental funding for nonproliferation activities, much of which was directed toward cooperative efforts to control nuclear materials and expertise around

the world.<sup>35</sup> Thus, as in FY 2003, the Senate had led the way in adding funding for programs to counter the threat posed by nuclear weaponry, material, and expertise existing around the world falling into terrorists' hands.

#### **FY 2004**

While a marked increase from its previous two budget proposals, the administration's funding request for FY 2004 for efforts to control nuclear warheads and materials and expertise, at a final tally of \$696 million, again represented a decrease (by \$42 million in this case) from the previous year's congressional appropriation, including supplementals.<sup>36</sup> (To be fair, the administration's proposal was higher than the FY 2003 levels that existed at the time it was prepared—it was additional funding included in the spring 2003 wartime supplemental appropriation that took the FY 2003 levels above the FY 2004 request.)

The FY 2004 budget proposal envisioned increases for only a handful of programs working to control nuclear warheads, material, and expertise. For the vast majority of this effort, the budget proposed in FY 2004 was effectively identical to that proposed in FY 2003, without even an increase for inflation.

One area in which the administration did propose to increase in FY 2004 over FY 2003 was in reducing excess stockpiles of nuclear materials. The Department of Energy proposed a \$30 million Accelerated Materials Disposition initiative, in which DOE would use \$25 million to begin purchasing a low-enriched uranium (LEU) reserve blended from Russia's HEU stockpile.

<sup>33</sup>The original submission is available at OMB, "Transmittal Letter from the President to the Congress" (Washington, D.C.: The White House, March 25, 2003; available at [http://www.whitehouse.gov/omb/budget/amendments/supplemental\\_3\\_25\\_03.pdf](http://www.whitehouse.gov/omb/budget/amendments/supplemental_3_25_03.pdf) as of April 29, 2004).

<sup>34</sup>William Hoehn, "Update on Activity in the 108th Congress Affecting U.S.-Former Soviet Union Cooperative Nonproliferation Programs," *Russian American Nuclear Security Advisory Council*, June 27, 2003 (available at <http://www.ransac.org> as of April 29, 2004).

<sup>35</sup> Author's calculations, based on U.S. House of Representatives, *Making Emergency Wartime Supplemental Appropriations for the Fiscal Year 2003, and for Other Purposes*, 108th Congress, 1st Session, 2003, H. Rept. 108-76 (available at <http://thomas.loc.gov/cgi-bin/cpquery/z?cp108:hr076>: as of April 29, 2004).

<sup>36</sup>The totals in this table are different from those in the comparable Table 4.2 in our report *Controlling Nuclear Warheads and Materials: A Report Card and Action Plan* for two main reasons. First, supplemental funding for FY 2003 was added for the Second Line of Defense program in the Interdicting Nuclear Smuggling line after last year's report went to print. Second, we have recalculated funding for programs in the Interdicting Nuclear Smuggling and Stabilizing Employment categories to capture the full amount of funding going to these programs anywhere in the world (not just the parts for the former Soviet Union) and to fully reflect the budget information that is publicly available.

The remaining \$5 million would be for other initiatives to accelerate the reduction in Russia's HEU stockpile or the conversion of HEU-fueled research reactors to LEU, following agreement to explore such options at the May 2002 Bush-Putin summit.<sup>37</sup>

Another effort slated for an increase in the administration's budget request is the program to dispose of Russia's excess weapons plutonium. DOE requested \$47 million in FY 2004, after requesting \$34 million in new funds in FY 2003 (though DOE also anticipated using \$64 million in FY 2003 from previous unobligated balances, which are no longer available this year—so the total amount slated for this purpose in FY 2004 was actually less than half the amount budgeted for FY 2003).

The third major increase was an additional \$8 million, to \$48 million in FY 2004, requested for the Department of Defense's Nuclear Weapons Storage Security program in Russia—which reflected optimism that the disagreements over access that have slowed progress in that program to a crawl in recent years had now been largely overcome.

No other program requested a budget in FY 2004 that differed from its FY 2003 request by more than \$3 million. The degree to which the funds requested for FY 2004 are sufficient to make progress at the maximum practical rate varies for each of the six categories of effort focused on controlling nuclear weapons, materials, and expertise.

The FY 2004 budget was the first time during the Bush administration that the final overall budget level for controlling nuclear warheads, material, and expertise that Congress approved largely matched

the administration's request. The House cut a number of programs in the administration's request, while requiring DOE to use funds appropriated in past years to help fund the activities requested in the FY 2004 budget. It only added money for the Second Line of Defense program to fund the DOE initiative to install radiation detection equipment in shipping "mega-ports" around the world. The Senate approved the administration's request (though following the House in directing past funds be used to pay for some activities), while adding funding for programs aimed at securing nuclear and other WMD materials around the world.<sup>38</sup>

In the final compromise, the two bodies basically split their differences. Congress declined to fund the \$25 million proposal to buy Russian highly enriched uranium (HEU) for use as a "strategic stockpile" of commercial nuclear fuel. Congress also directed DOE to use \$48 million from previously approved budgets to fund activities carried out in FY 2004; this \$48 million can be considered a cut in the current year funding.<sup>39</sup> Additional monies for the Second Line of Defense program, and funding that expired but were awarded again to the Elimination of Weapons Grade Plutonium Production program, partly offset these reductions. For the Department of State, Congress reduced the level of new funding from the administration's request for the combined International Science and Technology Centers and Biological Weapons Scientists Redirection budget line item, and for Export Control and Related Border Security Assistance program.<sup>40</sup>

<sup>37</sup> DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 738.

<sup>38</sup> For more details, see Anthony Wier, "Legislative Update," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, February 2004 (available at [http://www.nti.org/e\\_research/cnwm/overview/legislative.asp](http://www.nti.org/e_research/cnwm/overview/legislative.asp) as of April 29, 2004).

<sup>39</sup> It could be that DOE does not cut the budgets of programs related to cooperative threat reduction activities to meet the congressional directive, but for now our figures assume that all of this money will come out of these activities' budgets. DOE refers to the use of \$48 million in prior year balances in DOE, *FY 2005 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., p. 408. The congressional directive is in U.S. House of Representatives, *Energy and Water Development Appropriations Bill, 2004*, op. cit. The original FY 2004 DOE budget request is in DOE, *FY 2004 Detailed Budget Justifications—Defense Nuclear Nonproliferation*, op. cit., pp. 729–742.

<sup>40</sup> Authors' calculations based on U.S. House of Representatives, *FY 2004 Omnibus Appropriations*, 108th Congress, 1st Session, 2003, H. Rept. 108-401 (available at <http://thomas.loc.gov/cgi-bin/cpquery/z?cp108:hr401> as of May 3, 2004), Division D, Title II.



## **FY 2002–2005**

As noted earlier, total appropriations for cooperative programs to better control nuclear weapons, materials, and expertise during FY 2002–2004, plus the administration's request for appropriations in FY 2005, were 16% higher than if the FY 2001 appropriation had simply been flat-lined, in real terms. Essentially all of this modest increase came at the initiative of Congress, not the administration. If Congress had simply approved the administration's budget proposals for these programs without change from FY 2002 through FY 2004, and then did so again for FY 2005, total funding over the period for programs focused on keeping nuclear weapons, materials, and expertise out of the hands of terrorists would have been only 2% higher than if the final pre-9/11 budget had been kept flat, in real terms. Moreover, it is important to remember that the FY 2001 appropriation was in

fact a cut from what the Clinton administration had requested. Indeed, on average, the administration's requests for cooperative action to control nuclear warheads, materials, and expertise over FY 2002 to 2005 were *less*, in real terms, than the last Clinton administration request, made long before the 9/11 attacks ever occurred.<sup>41</sup>

In short, whether one looks at budgets or at the more critical resource of sustained high-level leadership to overcome the obstacles, it continues to be the case that there is a substantial gap between the scope and urgency of the threat as President Bush himself has described it, and the response of the U.S. government. The United States, as with every other government in the world, is very far today from meeting President Bush's pledge to do "everything in our power" to keep nuclear weapons, materials and expertise out of the world's most dangerous hands.

<sup>41</sup> FY 2001 administration request figures are taken from William Hoehn, "The Clinton Administration's Fiscal Year 2001 Budget Requests For Nuclear Security Cooperation with Russia," *Russian American Nuclear Security Advisory Council*, March 13, 2000 (available at <http://www.ransac.org> as of May 13, 2004). In nominal terms, we calculate the budget request for the comparable programs described in this chapter as totaling \$618 million, compared to the actual appropriation level for FY 2001 of \$583 million.



# 5 RECOMMENDATIONS: A SECURITY FIRST AGENDA

A fast-paced global partnership is urgently needed to secure the world's nuclear stockpiles before terrorists and thieves get to them. This must be a global effort, as the essential ingredients of nuclear weapons exist in more than forty countries, on every inhabited continent. But the United States and Russia bear a special responsibility for leading this effort, as they possess more than 95% of the world's nuclear weapons and more than 85% of the world's weapons-usable nuclear material—and in many cases were the suppliers for weapons-usable nuclear material in other countries around the world.

Today, the most essential ingredient for success in this endeavor is fast, concerted action by the Presidents of the United States and Russia to overcome the many obstacles that have slowed the effort to secure stockpiles in their countries and around the world. Breaking through these obstacles requires presidential action, as many of the obstacles cut across agencies and departments, and cannot be addressed by individual Ministers or Cabinet secretaries acting alone, however energetic or well-intentioned. Success will require sustained, top-priority attention from both Presidents—not just occasional encouraging statements, but in-depth, day-to-day engagement. If even a tenth of the effort and resources the U.S. government devoted to Iraq in the last year were devoted to ensuring that all stockpiles of nuclear weapons and weapons-usable nuclear materials around the world were secure and accounted for, there is good reason to believe that the job could be accomplished quickly.

President Bush and President Putin need to say to their respective governments: "I want every warhead and every kilogram of nuclear material in our country and around the world secured, as fast as it can possibly be done, but certainly in no more than four years.

I am appointing someone with the sole job of leading these efforts, pulling together and implementing a prioritized plan, and finding and fixing every obstacle that is slowing them down. They will be able to walk into my office whenever there is a decision I need to make to move these efforts forward. I will make the tough choices to resolve the access problem, and any other problem slowing these efforts. I am prepared to spend what it takes to ensure that inadequate budgets do not slow this effort down. I will not tolerate any delay, I will hold everyone involved accountable for the progress they make—and I will fire anyone who I find slowing this effort down." Such an instruction, if communicated forcefully and followed through, would radically transform the effort to keep these deadly stockpiles out of terrorist hands. The most important parts of the job would get done—and quickly.

In last year's report, we outlined a comprehensive action plan for securing, monitoring and reducing nuclear stockpiles, blocking nuclear smuggling, and redirecting nuclear complexes and nuclear experts.<sup>1</sup> These recommendations remain valid, as only very modest progress has been made in implementing them in the intervening year. Below, we focus on the most urgent and immediate steps—those focused on securing nuclear stockpiles at their source, and interdicting nuclear smuggling. We offer recommendations for action by the U.S. President, by the Russian President, by the leaders of the G-8 group of industrialized democracies and other key nuclear states, and by the U.S. Congress. Because the actions required to address the threat are often similar, there is some overlap in the recommendations directed to each of these actors.

An accelerated and strengthened effort to keep nuclear weapons and materials from being stolen and

<sup>1</sup> See discussion in 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; available at [http://www.nti.org/e\\_research/cnwm/overview/report.asp](http://www.nti.org/e_research/cnwm/overview/report.asp) as of May 3, 2004), pp. 92–163.

falling into the hands of terrorists would have many ingredients, but there are three elements that are essential: removing the nuclear material entirely from the world's most vulnerable sites; accelerating and strengthening the effort in Russia, where the largest stockpile of potentially vulnerable nuclear warheads and materials still exist; and building a fast-paced global coalition to improve security for nuclear stockpiles around the world. The specific recommendations below are intended to achieve those objectives.

## RECOMMENDED ACTIONS BY THE U.S. PRESIDENT

### *A New Decision Directive*

President Bush should issue a decision directive on nuclear security that would address the following issues:

- **Priority.** Designate securing and accounting for all the world's nuclear stockpiles, and other steps to keep nuclear weapons and materials out of terrorist hands, as a top national security priority of the United States and an integral part of the war on terrorism, to be pursued as quickly and effectively as possible, with every resource needed to get the job done.
- **Targets and timetables.** Set ambitious and measurable targets for the effort, including: (a) achieving high security for every nuclear warhead and every kilogram of weapons-usable nuclear material in the former Soviet Union within four years, and worldwide within six years; (b) removing nuclear material entirely from the world's most vulnerable and difficult-to-defend sites within four years, and removing all highly enriched uranium (HEU) from all civilian sites worldwide within 10 years.
- **A senior leader.** Appoint a senior official with full-time responsibility for leading the entire array of efforts focused on keeping nuclear weapons out of the hands of terrorists—seizing opportunities for rapid action, overcoming obstacles, filling gaps, exploiting synergies, and eliminating overlaps. This might take the form of an additional Deputy National Security Advisor. The directive should make

clear that this official has broad authority to direct departments and agencies to shift approaches as needed, and will have direct access to the President whenever issues require presidential action.

- **A prioritized plan.** Direct the senior official to prepare a prioritized action plan within 90 days, outlining specific goals to be achieved, target dates for achieving them, means by which these goals will be met, initial estimates of resources required and their sources, and measurable milestones for assessing progress.
- **Overcoming obstacles.** Direct the senior official to identify the most important obstacles slowing efforts to improve security and accounting for nuclear stockpiles, and immediate actions needed to overcome them. In particular, direct that negotiators immediately offer a reasonable compromise to resolve the threat reduction liability dispute with Russia, and hold cabinet secretaries accountable if the issue is not resolved within 60 days. Instruct the Secretary of State to issue multi-year, multiple-entry visas for all experts from Russia and other participating states identified as critical to achieving the goals of these efforts—and to seek agreement from these states to provide comparable visas for U.S. participants in these efforts.
- **A global nuclear security partnership.** Launch an effort to forge a fast-paced global partnership to secure and account for all stockpiles of nuclear weapons and weapons-usable material worldwide, to levels sufficient to defeat demonstrated terrorist and criminal threats.
- **A central focus of relations with key states.** Direct all of the relevant parts of the government to make achieving these objectives a central element of U.S. relations with Russia, and with other key states—an item to be addressed at every opportunity, at every level, until the job is done. In particular, direct the Secretaries of State, Energy, and Defense to do everything in their power to overcome the sensitivities and obstacles that restrain cooperation to improve nuclear security with Pakistan, India, China, and every other state where nuclear

weapons or sufficient nuclear material to make a nuclear weapon are located.

- **A threat assessment database.** Direct the Secretary of Energy, working with the intelligence agencies and other departments as necessary, to prepare a comprehensive database within 180 days containing every known facility worldwide where nuclear warheads or weapons-usable nuclear material are located, including estimates, for each site, of: (a) the quantity of warheads or material located there; (b) the form of the nuclear material; (c) the estimated effectiveness of security and accounting arrangements there; and (d) judgments as to the level of terrorist and criminal threat at the site and in the surrounding area (including known terrorist activity, the scale of corruption and theft in the area, pay and morale for site workers, and the like). This database should clearly specify key uncertainties, and what additional information would be needed to reduce them. The database should be updated as often as possible, but no less than quarterly.
- **Fast-paced, yet sustainable, upgrades, sufficient to meet the threat.** Direct the Secretaries of Energy and Defense to ensure that programs to ensure security and accounting for nuclear warheads and weapons-usable materials focus simultaneously on three goals: (a) putting security and accounting upgrades in place as rapidly as possible; (b) upgrading to a level sufficient to defeat demonstrated terrorist and criminal threats; and (c) ensuring that these security and accounting improvements will be maintained over the long haul, including after U.S. assistance phases out. In particular, to achieve these goals, it will be essential to work in genuine partnership with experts from the countries where the sites are located, involving them in all aspects of conception, design, and implementation of these efforts.
- **“Global cleanout.”** Establish a task force that consolidates all the necessary resources, authority, and expertise, with the mission of removing all weapons-usable nuclear material from the world’s most vulnerable sites as rapidly as possible—and with the flexibility to negotiate targeted packages of

incentives as necessary to convince facilities to relinquish this material.

- **Securing the most dangerous warheads.** Launch a new reciprocal initiative with Russia to secure, monitor, and dismantle thousands of the most dangerous warheads in both countries (including many tactical warheads, and all warheads not equipped with modern electronic locks or comparably reliable means to prevent unauthorized use).
- **Forging a global security standard.** Launch a new effort to gain G-8 political commitment, as part of the G-8 Global Partnership, on an effective common standard for nuclear security, and on an offer of assistance to any state willing to commit to meet the standard but unable to afford to do so. Seek global agreement to this common standard, including from key states such as Pakistan, India, and China.
- **A comprehensive effort to combat nuclear smuggling.** Direct that the senior official appointed to lead these efforts work with the relevant departments and agencies to prepare a prioritized plan to maximize the chances of recovering stolen nuclear material and stopping nuclear smuggling, including (a) identifying what institutions in what countries are to be provided with what capabilities by when, and with what resources; (b) specific steps to strengthen law enforcement and intelligence cooperation focused on understanding and stopping nuclear smuggling activities and organizations; (c) additional actions that can be taken to make it more difficult for thieves and buyers to connect without fear of being caught or scammed; and (d) putting in place a plan to ensure that capabilities comparable to those of the U.S. Nuclear Emergency Support Team (NEST) can be made available on short notice wherever they may be needed worldwide.

### ***The Next Summit with President Putin***

Using the excellent rapport he has established with President Putin, President Bush should make breaking through the logjams that are slowing progress in securing nuclear weapons and weapons-usable

## CHALLENGES OF ADAPTING THREAT REDUCTION TO NEW CONTEXTS

Facing terrorists with global reach, nuclear security is only as strong as its weakest link. Hence, forging cooperative partnerships to ensure effective security in every country where such stockpiles exist will be an essential element of any fully effective program to reduce the danger of nuclear theft. But adapting the threat-reduction approaches developed in cooperation with Russia and other former Soviet states to the specific circumstances of each other country where cooperation must go forward is likely to be an enormous challenge. Attempts to simply copy the approach now being used in Russia are almost certain to fail.

Cooperation with states with small nuclear weapons arsenals, such as Pakistan, India, China, and Israel, is likely to be especially difficult.<sup>1</sup> For all of these states, nuclear activities take place under a blanket of almost total secrecy. India and Pakistan rely on the secrecy of the locations of their nuclear arsenals for the survivability of their nuclear deterrents, and Israel does not even acknowledge that it possesses nuclear weapons. In each of these states, far more than in Russia, demands for nuclear transparency, and for access to nuclear sites, are likely to be rebuffed as efforts to collect intelligence on the state's most closely guarded secrets. There is little prospect that U.S. experts will be combing through the security systems at military nuclear sites in these countries for years to come.

Nonetheless, there is much that can be done cooperatively to improve security for these states nuclear stockpiles. For example, modern security and accounting equipment could be provided, for these states to install themselves, with their own funds, without requiring U.S. personnel to visit sensitive sites or even know where they are—the approach initially taken with U.S.-Russian cooperation to upgrade security at nuclear warhead sites. Extensive discussions can occur on the best approaches to assessing the vulnerability of nuclear sites and designing improved security systems, and on the capabilities of different types of commercially available equipment that might be used in such designs. Assistance and licensing arrangements can be provided so that manufacturers in these states can produce fully effective security and accounting equipment of their own—and maintain it once installed. Assistance can also be provided in developing and enforcing effective nuclear security and accounting rules and regulations, designed to ensure that no facility is allowed to possess dangerous nuclear stockpiles if it does not meet high standards of security. Extensive training can be provided for nuclear security and accounting designers, operators, managers, and regulators.

These types of assistance would in no way violate the nuclear weapon states' Nonproliferation Treaty obligations not to assist other states in acquiring nuclear weapons. And, with appropriate care, they could be implemented while remaining fully within the export control rules in place in the United States and in other countries.

In each of these countries, there are genuine sensitivities and concerns that will have to be addressed if cooperation is to succeed. In the case of Pakistan, the fear that such efforts are merely an attempt to lay the groundwork for seizing control of Pakistan's nuclear arsenal will never be far from the surface—yet the fact that U.S. personnel are now deeply involved in the even more sensitive task of securing the life of the Pakistani President himself suggests that the path to cooperation to ensure that nuclear assets are adequately secured against the huge insider and outsider threats that have been demonstrated to exist there may ultimately be open. India's nuclear establishment, on the other hand, still resents the decades of nuclear sanctions imposed after India's 1974 test, and their justifiable pride in the advanced nuclear technology India has developed may stand in the way of any cooperation described as "assistance."

In China, nuclear security cooperation will have to overcome the legacy of the charges of Chinese nuclear espionage—which brought a promising earlier round of U.S.-Chinese lab-to-lab cooperation on nuclear security and accounting to a screeching halt.<sup>2</sup> Israel, whose entire nuclear program remains unacknowledged, may be a particularly difficult case, despite its close security partnership with the United States. But with Israel's long experience of terrorism and

material a key focus of the next U.S.-Russian summit, seeking agreement on the following points:

- **Priority.** A joint statement that ensuring that nuclear weapons and weapons-usable materials are secure and accounted for, so that they cannot fall into terrorist hands, is a top security priority for both countries, and an essential element of providing security for the U.S. and Russian homelands.
- **Timetable.** An accelerated timetable for securing every nuclear warhead and every kilogram of weapons-usable nuclear materials in both countries, setting the goal of completing the job within four years.
- **Sustainable security sufficient to meet the threat.** A direction to both governments to undertake an intensive effort to ensure that the security and accounting measures being put in place are adequate to defeat demonstrated terrorist and criminal threats, and that they will be maintained for the long haul—including, in particular, a commitment that Russia will maintain high security

modern scientific and technological base, it may well be that its nuclear assets are already secured against any plausible attacks.

In each of these cases, the scale of the job is much reduced by the very small size of their nuclear stockpiles—more than a hundred times smaller than Russia's. And it should be remembered that the United States and other donor states have had the experience of trying a variety of different approaches to overcome secrecy barriers and other obstacles in Russia, a country where for decades, the main security threat systems at nuclear sites were designed to address was Western spies.

The best approach to moving cooperation forward is likely to vary from one circumstance to another. Each will have to be approached with extreme care, to maximize the prospects of success. In some cases, a "bottom-up" approach, in which technical experts are given some freedom to discuss nuclear security and accounting issues and develop concepts for cooperation (as in the days of the U.S.-Russian lab-to-lab program) may work best—at least until enough confidence has been built to allow more formal government-to-government approaches to succeed. (In particular, the experience in Russia was that once Russian experts saw the value of such cooperation—and saw the prospect for lucrative contracts if it moved forward—they were able to lobby their own governments for progress in ways that U.S. officials could never have done.) In other cases, it may be that only a "top-down" approach, in which the leader of a country is convinced to overrule the objections of the bureaucracy and the security services, will work.

In some cases, bilateral cooperation that would not be possible with a donor state may be possible when led by the International Atomic Energy Agency (IAEA), which is seen by many as an impartial international service. Sometimes, non-government intermediaries may be able to play a helpful role, raising ideas informally with officials on both sides, exploring sensitivities and routes to overcome them, hosting meetings that neither government has to take responsibility for requesting, and the like. In general, cooperation to improve nuclear security will be more appealing politically and will be more likely to succeed if it is seen to be one part of the participation of these states, with the world's leading powers, in the Global Partnership focused on keeping weapons of mass destruction out of terrorist hands.

The challenges of adapting threat reduction to these different contexts, and the likely need for a range of different approaches, will inevitably require sustained political leadership from the highest levels of government, focused on overcoming the obstacles to progress. The Bush administration should substantially increase the political level and intensity of its efforts to forge sensitive nuclear security partnerships with key countries beyond the former Soviet Union.

<sup>1</sup> For a more detailed discussion of these individual cases, see 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; available at [http://www.nti.org/e\\_research/cnwm/overview/report.asp](http://www.nti.org/e_research/cnwm/overview/report.asp) as of October 20, 2003), pp. 122–128. For discussions of the possibilities for cooperation with India and Pakistan in particular, see Lee Feinstein, James C. Clad, Lewis A. Dunn, and David Albright, *A New Equation: U.S. Policy Toward India and Pakistan After September 11* (Washington, D.C.: Carnegie Endowment for International Peace, May 2002; available at <http://www.ceip.org/files/pdf/wp27.pdf> as of April 21, 2004), especially the chapters by Albright and Dunn; and Rose Gottemoeller and Rebecca Longworth, *Enhancing Nuclear Security in the Counter-Terrorism Struggle: India and Pakistan as a New Region for Cooperation* (Washington, D.C.: Carnegie Endowment for International Peace, August 2002; available at <http://www.ceip.org/files/pdf/wp29.pdf> as of April 21, 2004).

<sup>2</sup> For a discussion of this earlier effort, see Nancy Prindle, "The U.S.-China Lab-to-Lab Technical Exchange Program," *Nonproliferation Review* 5, no. 3 (Spring-Summer 1998; available at <http://cns.miis.edu/pubs/npr/vol05/53/prindle53.pdf> as of January 13, 2003).

standards with its own resources after U.S. assistance phases out.

secure, monitor, and dismantle thousands of warheads on each side, as described briefly above.

- **Consolidation.** A commitment to remove nuclear weapons and weapons-usable nuclear materials entirely from a substantial number of the sites where they now exist in each country, consolidating them at other sites to provide higher security at lower cost.
- **A new initiative on securing dangerous warheads.** An announcement of a new initiative to
- **Global cooperation.** An agreement that Russia and the United States will work together, and with other partners around the world, to forge a fast-paced global partnership to ensure high levels of security and accounting for all nuclear warheads and materials worldwide, and to remove nuclear materials entirely from the world's most vulnerable facilities.

- **Overcoming obstacles.** A mechanism for rapidly finding and fixing obstacles to achieving this goal—such as each side designating a senior official with full-time responsibility to lead this effort, with access to each President as needed.
- **Access.** A commitment that Russia will offer U.S. personnel access to all but a small number of the most sensitive sites, as needed to implement these security upgrades; that the United States will offer Russian personnel access to comparable U.S. sites; and that the two Presidents will instruct their governments to work out, within 90 days, appropriate arrangements for ensuring high standards of security at sites too sensitive for either side to grant access to the other.
- **Liability.** Agreement on an approach to threat reduction liability acceptable to both sides, allowing projects that are currently blocked by the lack of such an accord to move forward.
- **Visas.** Agreement that both countries will give multi-year multiple-entry visas to designated key participants in this nuclear security cooperation.
- **Resources.** Combine U.S. and Russian resources to ensure that every facility where nuclear weapons or weapons-usable nuclear materials exist has the resources needed to put in place and to maintain effective security and accounting measures. Provide resources, in Russian government budgets, to maintain security at these sites after U.S. assistance phases out.
- **Access.** Allow U.S. personnel access as needed to ensure that security and accounting upgrades are carried out quickly and effectively. Work out arrangements that will allow upgrades to be accomplished at those few facilities that are truly too sensitive to allow U.S. access.
- **Procedures, training, and sustainability plans.** Ensure that every facility has effective procedures and adequately trained personnel in place for maintaining high standards of security and accounting for nuclear weapons and weapons-usable nuclear materials. Require that each facility develop a plan for maintaining security and accounting after initial upgrades are completed and U.S. assistance phases out. Require that each facility with such stockpiles establish an effective organization devoted to security and accounting, and put in place procedures to make effective performance in security tasks a key element of raises and promotions.
- **Effective standards and regulation.** Ensure that effective national security and accounting standards are in place that every facility must meet if it is to be allowed to continue to operate with nuclear weapons or weapons-usable nuclear materials, and improve the authority and resources of the regulators charged with making sure facilities meet these standards.
- **Consolidation.** Drastically reduce the number of sites where nuclear weapons and weapons-usable materials are stored and handled, and ensure that incentives and disincentives are provided to convince every facility where such stockpiles are not absolutely necessary to give them up.
- **Global cooperation.** Cooperate with the United States, the G-8, and other countries to ensure that

### ***The Next G-8 Summit***

President Bush should make securing the world's nuclear stockpiles against theft and seizure by criminals and terrorists a central focus of the next summit of the G-8 group of industrialized democracies, planned for Sea Island, Georgia, in June 2004—seeking to gain agreement on the objectives for the G-8 recommended below.

### **RECOMMENDED ACTIONS BY THE RUSSIAN PRESIDENT**

President Putin should make clear that security for every Russian nuclear weapon and every kilogram of Russian weapons-usable nuclear material is a critical priority for Russia's own national security, should appoint a full-time official accountable to him to lead the effort, and should direct his government to take immediate actions to accomplish that objective. These steps should include the following points:



all nuclear weapons and weapons-usable materials worldwide are effectively secured and accounted for as rapidly as possible, and that weapons-usable materials are removed entirely from the world's most vulnerable sites.

## RECOMMENDED ACTIONS BY THE LEADERS OF THE G-8 AND OTHER KEY STATES

The leaders of the G-8 group of industrialized democracies should make fast-paced action to keep nuclear weapons and weapons-usable materials worldwide from being stolen and falling into the hands of terrorists the central focus of their Global Partnership Against the Spread of Weapons and Materials of Mass Destruction. They should put the "global" back in this partnership, by focusing on securing nuclear stockpiles everywhere, not just in the former Soviet Union. Indeed, this G-8 initiative can and should become the core of a fast-paced and truly global partnership to secure the world's nuclear stockpiles and block nuclear smuggling.

The leaders of other key states—including, but not limited to, Pakistan, India, and China—must also recognize that securing these stockpiles is crucial to their own security and to the world, and move quickly to meet the threat. Pledges and words are no longer enough—to win the race to secure these stockpiles before they are stolen, rapid *action* is required.

At the G-8 summit planned for June 2004, the G-8 leaders should take the following actions:

- **Agree on the priority of securing all nuclear stockpiles worldwide.** At the summit, the G-8 leaders should agree that an absolutely critical element of efforts to stem the spread of nuclear weapons, and of the war on terrorism, is to ensure that every nuclear weapon and every kilogram of weapons-usable nuclear material worldwide is secure and accounted for—to a level adequate to defeat demonstrated terrorist and criminal threats.

- **Set a timetable for securing global stockpiles.** The G-8 leaders should pledge to ensure that all stockpiles are effectively secured within their own countries, and to cooperate with other states to ensure that this is the case everywhere, within five years.
- **Set a minimum global security standard.** Facing terrorists who have demonstrated global reach, nuclear security is only as strong as its weakest link. The G-8 leaders should commit themselves to ensuring that every nuclear warhead and every kilogram of plutonium or HEU under their control will be secured and accounted for to a level sufficient to reliably defeat the threats that terrorists and criminals have proven they can mount. In particular, all of these stockpiles should be protected *at least* against theft by one insider, or by a small outside group of well-trained, well-armed attackers, or both together. The statement should note that some participants perceive higher threats and will protect their stockpiles to higher standards.
- **Announce an initiative on removing materials from vulnerable sites.** The G-8 leaders should agree to launch a "Strategic Materials Accelerated Removal and Transport" (SMART) initiative, designed to remove nuclear material entirely from all the world's most vulnerable sites, and from all other sites that do not require such material, as rapidly as possible (certainly within the same five-year time-frame, if not sooner).
- **Agree on expanding the Global Partnership worldwide.** As President Bush proposed in his February 2004 address on nonproliferation, the Global Partnership should become truly global, financing projects not just in the former Soviet Union but wherever there are nuclear stockpiles that need to be secured, removed, monitored, or destroyed.<sup>2</sup> The leaders should agree that funds spent on these purposes anywhere in the world should count toward their Global Partnership contributions—while at the same time agreeing to

<sup>2</sup> President George W. Bush, "Remarks by the President on Weapons of Mass Destruction Proliferation, Fort Lesley J. McNair, National Defense University, Washington, D.C." (Washington, D.C.: The White House, February 11, 2004; available at <http://www.whitehouse.gov/news/releases/2004/02/20040211-4.html> as of April 29, 2004).

expand the goal for total funding beyond \$20 billion, to pay for the expansion in geographic scope. The statement should include a specific reference encouraging participants to contribute to the IAEA Nuclear Security Fund as one means of applying their Global Partnership pledges.

- **Agree on a mechanism for setting priorities, dividing up tasks, and coordinating implementation.** The G-8 as an entity has no permanent secretariat—but some one is needed to manage the myriad tasks involved in the Global Partnership if they are to be accomplished quickly and efficiently. The G-8 leaders should agree that particular countries will take the lead and provide such a secretariat function in each project area. In particular, with respect to security of nuclear material worldwide, they should agree on a process to divide up which donor states will pay for which activities at which sites. Currently, lack of coordination among different donor states working at the same sites is undermining efficiency and may even be leading to reduced security in some cases.

## RECOMMENDED ACTIONS BY THE U.S. CONGRESS

The U.S. Congress should:

- **Make the priority clear.** Designate security and accounting for nuclear weapons and weapons-usable nuclear materials worldwide as a top priority for the homeland security of the United States.
- **Exert effective, performance-based oversight, while allowing flexibility.** Congress should set clear goals, and insist that the Executive Branch prepare coherent plans for achieving them, including measurable milestones. And it should hold the Executive Branch accountable for performance in achieving these goals. As Churchill once said, “It is no use saying, ‘We are doing our best.’ You have got to succeed in doing what is necessary.” At the same time, Congress should give the Executive Branch considerable flexibility in how these goals are achieved, making it possible to seize opportunities and adapt approaches as circumstances change.
- **Remove key constraints on flexible performance.** Congress should eliminate some of the layers of constraints on these programs that have built up over the years. In particular, Congress should give the President the permanent authority to waive certification requirements he has sought; should allow the use of threat reduction funds wherever in the world they may be needed to address threats to U.S. and world security, without hemming that flexibility in with undue constraints; and should eliminate the provisions that limit the use of the Mayak storage facility only to plutonium and HEU that came from weapons and will never be returned to weapons, making it possible to use that facility for secure storage of any nuclear material that poses a proliferation threat.
- **Use in-depth hearings with independent witnesses to keep abreast of progress and problems.** To exercise such flexible, performance-based oversight, Congress will need to delve into the progress and problems of these efforts in detail, learning both the good news and the bad news. For that purpose, in-depth hearings on the threat and what is being and could be done to address it will be essential—possibly complemented with staff investigations. It is crucial that such hearings include testimony from independent witnesses—hearing only from the government officials managing these efforts, Congress will rarely hear the bad news.
- **Mandate key initiatives, and legislate solutions.** Where Congress concludes that the Executive Branch needs help—or direction—to launch new initiatives that would fill key gaps in the threat reduction effort, or to resolve obstacles to progress, Congress should step in and lead, as it has in the past. The establishment of the Nunn-Lugar effort itself was a far-seeing Congressional initiative; Senator Pete Domenici’s (R-NM) insertion of funds to stabilize the HEU Purchase Agreement and give Russia an incentive to complete a plutonium disposition agreement in 1999 was absolutely essential to breaking through logjams in those efforts; and current legislation introduced by Senators Dianne Feinstein (D-CA), Bill Nelson (D-FL), and Jack Reed (D-RI) to establish a task force with broad, flexible

authority to remove nuclear materials from the world's most vulnerable sites as rapidly as possible could substantially accelerate that critical effort.<sup>3</sup>

## **A TIME TO ACT**

In hearings held after a terrorist nuclear attack, to determine who was responsible for allowing such a thing to happen and what should be done to prevent it happening again, what would each of us be able to say we had done to forestall such a horrible catastrophe?

The terrorists have made clear that they want nuclear weapons, and are working to get them. A continuing stream of attacks and intelligence analyses makes clear that al Qaeda is regrouping, recruiting and training new operatives, and still seeking to carry out catastrophic attacks on the United States and other countries. President Bush has eloquently warned that "history will judge harshly those who saw this coming danger but failed to act."<sup>4</sup> The question remains: on the day after a terrorist nuclear attack, what will we wish we had done to prevent it? And why aren't we doing that now?

<sup>3</sup> U.S. Senate, S. 2310, 108th Congress, 2nd Session. Feinstein, Domenici, Rep. Adam Schiff (D-CA) and Rep. Curt Weldon (R-PA) each introduced legislation on this topic in 2003; see Wier, "Legislative Update," *Nuclear Threat Initiative Research Library: Controlling Nuclear Warheads and Materials*, January 2004 (available at [http://www.nti.org/e\\_research/cnwm/overview/legislative.asp](http://www.nti.org/e_research/cnwm/overview/legislative.asp) as of May 3, 2004).

<sup>4</sup> President George W. Bush, "Introduction" in *National Security Strategy of the United States of America* (Washington, D.C.: The White House, September 2002; available at <http://www.whitehouse.gov/nsc/nss.pdf> as of April 29, 2004).



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## ABOUT THE PROJECT ON MANAGING THE ATOM

The Project on Managing the Atom (MTA) at Harvard University brings together an international and interdisciplinary group of scholars and government officials to address key issues affecting the future of nuclear weapons and nuclear energy, particularly where these futures intersect.

Current research priorities include reducing the threats of nuclear and radiological terrorism; securing, monitoring, and reducing nuclear warhead and fissile material stockpiles, and reshaping nuclear complexes; strengthening the global nonproliferation regime; addressing the security risks posed by nuclear programs in Iraq, Iran, North Korea, and South Asia; limiting proliferation risks of the civilian fuel cycle, including management of spent nuclear fuel and radioactive wastes containing weapon-usable materials; the future of nuclear energy; and democratic approaches to nuclear decision-making.

MTA is based in the Belfer Center for Science and International Affairs of Harvard University's John F. Kennedy School of Government, and represents a collaboration of the Center's programs on Science, Technology, and Public Policy, International Security, and Environment and Natural Resources. Much of the project's work is international in nature. MTA hosts research fellows from a variety of countries, and its members engage collaborative projects with colleagues around the world.

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- **John P. Holdren**, Co-Principal Investigator; Director, Science, Technology, and Public Policy Program
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- **Steven E. Miller**, Co-Principal Investigator; Director, International Security Program
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Complementing these core staff members are a broad team of research fellows, ranging from students completing their dissertations to former senior government officials.

MTA provides its findings and recommendations to policy makers and to the news media through publications, briefings, workshops, and other events. MTA's current work is made possible with generous support from the John D. and Catherine T. MacArthur Foundation, the Nuclear Threat Initiative, and the Ploughshares Fund. Our web site, at <http://www.managingtheatom.org>, has the full text of all our publications, summaries of current projects, and biographies of all participating researchers.

